

Article

Beyond Material Disadvantage: Living Conditions, Immigrant Optimism, Aspirations and Attainment Among Immigrant and Non-Immigrant Pupils in Scotland

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Abstract

This article examines the living experiences, aspirations and attainment of immigrant and non-immigrant pupils in Scotland. Drawing on immigrant optimism theory, the study uses the Scottish subset of PISA 2022, which includes measures of young people's aspirations and attainment, to explore the relative roles of family socio-economic background, housing circumstances, educational and cultural resources, family and school support, and student dispositions in shaping aspirations and attainment, with particular attention to first- and second-generation immigrant pupils. Based on random-effects regression modelling, the findings suggest that, despite less favourable material and housing circumstances, immigrant pupils in Scotland, especially first-generation pupils, have stronger educational and occupational aspirations than non-immigrant pupils, as well as mathematics performance that matches or surpasses that of non-immigrant pupils with comparable family characteristics. Family educational and cultural resources, student dispositions and particular forms of school support were associated with aspirations and/or attainment. First-generation pupils' mathematics advantage is linked to dispositions such as perseverance and growth mindset, as well as to the higher occupational aspirations of this group. However, immigrant pupils' higher educational and occupational aspirations cannot be explained by family, individual or school characteristics: the regression results show that their aspirations remain higher than those of non-immigrant pupils even after these differences are taken into account. The article therefore contributes to debates on immigrant optimism and segmented assimilation by showing that material disadvantage does not necessarily translate into lower aspirations or attainment. While socio-economic deprivation and constrained living conditions matter for immigrant children's educational outcomes, these effects may be mediated and, in part, offset by educational and cultural resources, family engagement and school support, and learner dispositions. The study therefore highlights the importance of looking beyond material disadvantage alone in order to understand immigrant pupils' aspirations and educational attainment.



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1. Introduction and Study Context

The outcomes of immigrant children are central to debates about integration, equality of opportunity and social mobility. Educational attainment is only one part of this story. Aspirations are also important because they show how young people imagine their futures,

and how family expectations, school support and individual dispositions are translated into future plans.

This article examines whether immigrant pupils in Scotland differ from non-immigrant pupils in their aspirations and attainment and explores whether housing and material conditions, other family resources, pupils' individual dispositions, and the school's creative learning environment and support help to explain these differences, with particular attention paid to the mechanisms that enable immigrant pupils to overcome material disadvantage and maintain their educational attainment and their educational and occupational aspirations. The article builds on immigrant optimism theory and selective and segmented assimilation approaches (Rumbaut 1997; Ogbu 1991). Immigrant optimism theory highlights the high educational expectations often found among immigrant families, even in contexts of economic constraint (Kao and Tienda 1995). Because education is understood by immigrant families as the main route to mobility and success in the host society, there are strong expectations that their children will succeed educationally and subsequently translate this success into higher occupational outcomes later in life.

Segmented and selective assimilation perspectives add that immigrant pupils' outcomes depend not only on family aspirations but also on the resources, institutions and contexts of reception that shape whether these aspirations can be realised. These arguments are consistent with research showing that the children of immigrants often have high levels of attainment, sometimes despite experiencing material deprivation or parental socio-economic disadvantage (White 2002; Siahhaan et al. 2014), and that parental involvement, family cultural and social capital, and motivation can offset some of the disadvantages associated with socio-economic background (Anguiano 2004; Alba and Nee 2003).

Immigrant children are often exposed to unfavourable material and housing conditions. Housing, in particular, can affect children's educational outcomes because it shapes the everyday learning environment, access to a quiet study space, rest, stability, health and well-being. Evidence from England and other countries shows that overcrowded and poor-quality housing are associated with poorer educational outcomes and school attendance (Baranyi et al. 2026; Goux and Maurin 2005; Solari and Mare 2012; von Simson and Umblijs 2021). This is particularly relevant to immigrant and refugee children, who are often over-represented in overcrowded, rented, temporary or insecure accommodation (Crawley 2010). Research also links neighbourhood context and housing security to immigrant children's educational outcomes (Entorf 2015; Hutchinson and Reader 2021). It is therefore important to distinguish material and housing conditions from other forms of family resources, such as educational and cultural resources, rather than treating home advantage as a single undifferentiated construct. This makes it possible to explore whether different types of family resources reinforce or mitigate the negative effects associated with poor housing conditions and other forms of material disadvantage. This is the approach taken in the present study.

International and UK research shows that, despite often experiencing material disadvantage, immigrant pupils, particularly second-generation pupils, frequently perform as well as or better than non-immigrant pupils. Research from the United States shows that, despite substantial variation in immigrant pupils' outcomes by generation, country of origin and length of residence, second-generation pupils often approach or exceed the attainment levels of non-immigrant pupils (Siahhaan et al. 2014; Pereira et al. 2006). In the UK, immigrant children may face socio-economic inequalities, exclusion and othering (Crawley 2010; Welply 2021). Nevertheless, research suggests that the immigrant-native achievement gap in England is less pronounced than is often assumed and that pupils who speak English as an additional language can make faster progress than native English speakers, particularly in mathematics (Jerrim 2018).

This raises an important question: not only whether immigrant pupils are disadvantaged, but which resources and dispositions may help to compensate for disadvantage, enabling them both to perform well educationally and to remain aspirational about their future.

Scotland offers a relatively under-researched case for studying immigrant pupils' attainment and aspirations. While there is evidence from qualitative research (e.g., Moskal 2014, 2016), studies using large secondary datasets are rarer because immigrant-origin pupils in Scotland form a smaller and more unevenly distributed group than in some other parts of the UK. As a result, their experiences might be less visible in policy and research. Given the commitment of Scotland's education system to inclusion, wellbeing and reducing the poverty-related attainment gap (Education Scotland 2022, n.d.; Scottish Government 2025), it is important to examine whether immigrant pupils are equally supported, and whether their attainment and aspirations are shaped by the same factors as those of non-immigrant pupils. Studying immigrant pupils in Scotland therefore provides important research evidence that contributes both to the international literature on the outcomes of immigrant children and to national debates in Scotland about equity, inclusion and educational opportunity.

The article uses data from the Programme for International Student Assessment (PISA) 2022. These data allow pupils' performance in mathematics, science and reading to be examined alongside two measures of aspirations: expected future occupation and expected level of education. They also include measures of demographic characteristics, family socioeconomic status, housing and material conditions, home educational and cultural resources, family support, pupils' dispositions and school support. PISA 2022 was conducted in the aftermath of the COVID-19 disruption to schooling (OECD 2023a, 2023b). This context is particularly relevant for immigrant pupils, as disrupted schooling may have affected them unevenly because of differences in school resources, language barriers, familiarity with the Scottish education system, parental employment constraints and access to educational resources at home.

The findings, based on descriptive analysis and multilevel mixed-effects regression modelling, show that immigrant pupils in Scotland, especially first-generation pupils, combine less favourable material circumstances with stronger educational and occupational aspirations and mathematics performance that matches or exceeds that of their non-immigrant peers. Family resources, student dispositions and school support are associated with aspirations and attainment, while housing and material conditions appear less important than educational resources. The mathematics advantage of first-generation pupils is partly accounted for by perseverance, growth mindset, teacher support and occupational aspirations. By contrast, the higher educational and occupational aspirations of both immigrant generations remain statistically significant after family resources, student dispositions, school environment and attainment are taken into account. This suggests that other factors associated with immigrant optimism, including educational expectations and motivation transmitted through families and wider ethnic networks, may contribute to this aspirational advantage (Kao and Tienda 1995; Rumbaut 1997; Ogbu 1991).

This article therefore contributes to debates on immigrant optimism and segmented assimilation by showing that material disadvantage does not necessarily translate into lower aspirations or lower attainment among immigrant pupils. It also highlights the need for schools to recognise both the strengths and vulnerabilities of immigrant pupils: their high aspirations and positive dispositions, but also the possible constraints linked to material conditions, learning support and school resources.

2. Research Background

This study examines the outcomes of first- and second-generation immigrant children in Scotland. Consistent with previous research, first-generation immigrant pupils are usually defined as those born outside the host country (to at least one foreign-born parent, i.e., children born outside the UK to two UK-born parents are not considered immigrants), while second-generation pupils are those born in the host country to at least one foreign-born parent (Crawley 2010; Siahaan et al. 2014; National Research Council and Institute of Medicine 1998; Pivovarova and Powers 2019; Gambino 2017; Van de Werfhorst and Heath 2019).

Straight-line assimilation theory suggests that immigrant disadvantage should decline over generations as families become more integrated into the host society. First-generation pupils may experience the greatest disadvantage because of language barriers, unfamiliarity with the education system, insecure parental employment and the limited transferability of parental qualifications. Over time, the second and later generations are expected to do better, as families acquire host-country-specific human capital and become more familiar with educational institutions (Gordon 1964; Waldinger and Perlmann 1998; Rong and Brown 2002). Human capital approaches similarly suggest that parental education, occupational status, language skills and employment should affect children's outcomes because they shape the resources, expectations and support available to children (Haveman et al. 1991; Krein and Beller 1988; Ruhm 2004).

However, the evidence does not always fit a simple assimilation model. A substantial body of research shows that immigrant pupils often perform as well as, or better than, non-immigrant pupils, including in cases where their families have a lower socio-economic status (Crosnoe and López Turley 2011; White 2002; Rumbaut 1997; Ogbu 1991; Jerrim 2018; Siahaan et al. 2014). Levels and Dronkers (2008) show that, in the broader European context, first-generation migrant pupils often do not perform significantly differently from native pupils once socio-economic background is controlled, while second-generation pupils sometimes outperform comparable native pupils. This suggests that socio-economic background is important but not sufficient for understanding immigrant pupils' outcomes.

Selective or accommodative assimilation provides one explanation for these patterns. This perspective emphasises how immigrant families' cultural values, strong family cohesion, work ethic, respect for education and strategic adaptation to the host context can mitigate the disadvantages associated with limited economic resources or weaker host-country human capital (Rumbaut 1997; Ogbu 1991). According to this view, immigrant families may maintain educationally protective values and norms that support children's achievement, while also adapting to the opportunities and constraints of the host society.

The immigrant optimism hypothesis is especially important for this article because the analysis focuses on aspirations as well as attainment. The immigrant optimism hypothesis suggests that immigrant parents and children often have high educational and occupational expectations because migration is itself linked to hopes of upward mobility and a better future. Aspirations therefore may also be one of the mechanisms through which family expectations, motivation and educational orientation shape attainment. Second-generation pupils have an advantage over the first generation because they combine their parents' ambition and educational expectations with greater language fluency and cultural familiarity with the host society (Kao and Tienda 1995; Landale et al. 1998). Research on immigrant optimism suggests that immigrant-origin pupils often have high educational expectations, motivations and strong orientations towards future mobility, which may help explain why they sometimes perform as well as or better than non-immigrant pupils despite socio-economic disadvantage (Kao and Tienda 1995; Kao 2004). This is supported by research evidence showing that immigrant pupils have substantially and significantly more positive attitudes to education than native pupils, and that these differences are

not fully explained by socio-economic background or school characteristics (Burgess and Heller-Sahlgren 2018). Aspirations also appear to matter for later outcomes: immigrant youths often have higher academic aspirations, which have been shown to predict later educational success even where socio-economic background is less favourable (Yeung 2022; Plenty and Jonsson 2021). Research using PISA data also highlights the role of resilience, growth mindset and attitudes towards school in shaping immigrant students' achievement (Kaya et al. 2024; Fernández-Reino 2016; Burgess and Heller-Sahlgren 2018). Taken together, this literature suggests that immigrant pupils' educational outcomes are shaped not only by parental socio-economic position but also by aspirations, motivation, attitudes to schooling and other dispositions of learners. Research on the second generation in Spain further demonstrates that immigrant pupils' adaptation cannot be understood as a uniform process of either assimilation or disadvantage. Portes et al. (2016) argue that cultural integration may be decoupled from structural outcomes such as educational attainment and occupational mobility, and that trajectories vary according to parental human capital, family structure, modes of incorporation and access to family and community social capital. Their work also highlights the central role of ambition: educational and occupational aspirations mediate the effects of family, teachers and peers and represent an important prerequisite for subsequent achievement. Consistent with immigrant optimism, high parental and student aspirations may persist even among families with limited material resources, although their translation into attainment depends on the resources and institutional conditions available to young people (Portes et al. 2016).

Alba and Nee's (2003) New Assimilation Theory is also relevant because it shifts attention from immigrant children and their family characteristics alone towards institutions and the ways in which adaptation is a two-way process. Thus, the outcomes of immigrant children are shaped not only by family values and aspirations but also by how institutions and especially schools respond to diversity through inclusive practices, language support, curriculum, guidance and teacher support, thus helping to translate aspirations into attainment, especially for pupils who face material or social disadvantage. Indeed, international evidence shows that education policies and school systems can mitigate or intensify immigrant disadvantage (Volante et al. 2021; Hou and Bonikowska 2017). School resources and environment, teacher support, curriculum breadth and institutional inclusion can help immigrant pupils translate high aspirations into achievement. Conversely, experiences of exclusion, othering or discrimination may weaken belonging and constrain educational trajectories (Welply 2021). Therefore, the role of school support is important not only as a predictor of attainment but also as a potential condition under which aspirations are realised.

PISA 2022 is particularly suitable for examining these issues because it includes both attainment measures and aspirational measures. The mathematics test provides a standardised measure of attainment, while expected future occupation and expected level of education provide measures of aspirations. The dataset also includes parental occupational status and education, home resources, cultural and educational resources, family support, student dispositions and school support.

Segmented assimilation theory draws attention to how family, institutional and social contexts interact in shaping outcomes of immigrant children. It argues that the outcomes of immigrants depend on the context of reception, including local opportunities, discrimination and school context, as well as on family support and resources and the strength of co-ethnic and community networks (Portes and Rumbaut 2001; Bean and Stevens 2004; Hirschman 2001; Glick and White 2003; Landale et al. 1998; Reitz 2002). Some groups may experience upward mobility, supported by strong family expectations and community

resources; others may experience blocked mobility where disadvantage, discrimination and weak institutional support limit opportunities.

Social capital theory provides another important framework for understanding immigrant pupils' success. Coleman (1990) conceptualised social capital as resources embedded in social relationships, including norms, expectations and obligations that support children's development. Portes (2000) distinguishes different meanings and functions of social capital, while Bankston (2004) argues that immigrant social capital should not be seen as a fixed ethnic trait but as an adaptive response to settlement conditions. Zhou and Bankston (1998) show how close-knit immigrant communities can reinforce achievement-oriented norms and support educational success. In this perspective, family and community ties, including the school community, can help immigrant pupils to compensate for material disadvantages and maintain high aspirations and educational engagement even when economic resources are limited.

At the same time, material conditions should not be ignored. Housing and household resources affect children's educational opportunities by shaping the home learning environment. Studies show that overcrowding, lack of space and poor housing conditions can negatively affect attainment, school attendance, health and well-being (Goux and Maurin 2005; Solari and Mare 2012; von Simson and Umblijs 2021; Baranyi et al. 2026), and immigrant families often experience overcrowding and housing deprivation and live in deprived neighbourhoods (Crawley 2010). Neighbourhood and housing contexts can also affect immigrant pupils' educational outcomes by shaping stability, safety, peer networks and access to resources (Entorf 2015; Hutchinson and Reader 2021). Yet the important question here is not whether material conditions matter, but whether associations with housing disadvantage are attenuated after other family resources, student aspirations and dispositions are taken into account.

Building on these perspectives, this article examines whether immigrant pupils in Scotland differ from non-immigrant pupils in their aspirations and attainment, and how demographic characteristics, family SES and resources, student dispositions, and school environment and support help to account for these differences. Drawing on immigrant optimism theory, selective and segmented assimilation, and social capital perspectives, this study addresses the following research questions:

1. How do the educational and occupational aspirations and academic attainment of first- and second-generation immigrant pupils compare with those of non-immigrant pupils in Scotland?
2. To what extent are differences in aspirations and attainment between immigrant and non-immigrant pupils associated with material and housing conditions, relative to family educational and cultural resources, family support, student dispositions and school support?

The central theoretical expectation is that differences in aspirations and attainment between immigrant and non-immigrant pupils will not be explained, or will be explained only to a limited extent, by families' housing and material conditions. Educational and cultural resources, family support, and pupils' own dispositions are instead expected to be more strongly associated with these outcomes.

3. Methodology

3.1. Datasets and the Variables

The Programme for International Student Assessment (PISA) is an international study which began in 2000. It aims to evaluate education systems worldwide by testing the skills and knowledge of 15-year-old students in participating countries/economies. Every three years, a randomly selected group of fifteen-year-olds take tests in key subjects—reading,

mathematics and science. The PISA tests are not linked directly to the school curriculum and are designed to assess how well students, at the end of compulsory education, can apply their knowledge to real-life situations (Schleicher et al. 2009; OECD 2009).

The 2022 PISA study in Scotland surveyed 3257 students in 117 secondary schools in Scotland. In the sample of students who took the PISA tests in Scotland, 70% of the students were 15 years old and 30% were 16 years old.

The PISA 2022 mathematics score was used as one of the dependent variables in this study. PISA plausible values are alternative estimates of students' underlying proficiency generated through item-response modelling, rather than directly observed individual test scores (OECD 2009). For the descriptive analysis, mathematics attainment is presented as the average of the ten plausible values (see Table 1). In the regression analysis, however, all ten plausible values (PV1MATH–PV10MATH) were analysed, with estimates pooled across them (see Methods subsection for details).

Table 1. PISA mathematics attainment (the average of mathematics plausible values, PV1MATH–PV10MATH), (unstandardised values, weighted by W_FSTUWT).

Variable	Mean	Standard Error of Mean	95% Confidence Interval
PISA mathematics test score	470.6	1.6	[467.5; 473.8]
N (total number of cases)			3257

Aspirations are measured using two PISA 2022 variables: expected occupational status (BSMJ) and expected educational level (EXPECEDU) (see Table 2). BSMJ is based on students' open-text reports of the job they expect to have at around age 30, coded to ISCO-08 and converted into ISEI occupational status scores. EXPECEDU is based on students' reported expected highest level of education, and is coded from below ISCED level 2 to ISCED level 8.

Table 2. Measures of aspirations used in the study: Highest expected educational level and expected occupation status (unstandardised values, weighted by W_FSTUWT).

Variable	Mean	Standard Error of Mean	95% Confidence Interval	N
Highest expected educational level	5.59	0.04	[5.51; 5.67]	2557
Expected occupation status	66.98	0.44	[66.11; 67.86]	1953

The independent variables drawn from the PISA study extend beyond conventional SES indicators and allow us to test research questions informed by immigrant optimism, segmented/selective assimilation, and social capital theories. In addition to parental human capital measures captured through parents' highest educational qualifications and occupational status, the independent variables capture family material, educational and cultural resources; individual predispositions, including motivation, growth mindset, resilience and learning attitudes; parental support; and the school environment and relationships with teachers¹ (see Tables 4, 5 and 7).

To examine family resources in a way that aligned with the aims of the study, the analysis did not rely on the overall PISA home possessions or wealth indices. These broad measures combine different aspects of family background and may obscure the distinct ways in which home circumstances shape pupils' attainment and aspirations. Instead, we sought to distinguish between different dimensions of home resources in order to assess whether they were associated with aspirations and attainment in different ways. This distinction is particularly relevant in the study of immigrant pupils, whose families may

differ from the native-born population across specific components of home resources. For example, immigrant families may be more disadvantaged in terms of material resources, while being less disadvantaged, or differently positioned, in relation to educational or cultural resources.

Three separate indices were constructed to distinguish between housing/material conditions, educational resources, and cultural resources. The housing/material conditions index captured whether the pupil had their own room, the number of bathrooms, rooms with toilets, and cars or vans in the household. The educational resources index included learning-related resources such as computers, educational software, science books, technical books, dictionaries, and textbooks or books to help with schoolwork. The cultural resources index captured exposure to cultural items or artefacts, including musical instruments, works of art, classical and contemporary literature, and art books. Each index was standardised before being included in the models. The internal consistency of the indices was acceptable, with Cronbach's alpha values of 0.68 for housing/material conditions, 0.73 for educational resources, and 0.75 for cultural resources (see Table 5).

3.2. Method

The three outcome variables were mathematics attainment, expected educational level and expected occupational status. Mathematics attainment was analysed using all ten PISA plausible values (PV1MATH–PV10MATH). As a sensitivity check, and following an approach used in a number of previous secondary analyses of PISA data (e.g., [Shapira 2012](#); [Dronkers et al. 2012](#); [Karakus et al. 2023](#); [Blanco-Varela et al. 2024](#)), the ten mathematics plausible values were also averaged to construct a single measure, and the same sequence of models was re-estimated. These results are presented in Appendix A.

Mathematics attainment,² expected educational level and expected occupational status were standardised as z-scores relative to the Scotland sample mean and standard deviation before inclusion in the models. All metric explanatory and control variables were standardised unless standardised measures were already provided in the PISA dataset.

The final student weight (W_FSTUWT) was applied as a probability weight to adjust for unequal probabilities of selection and survey non-response. Students were modelled as nested within schools, and robust standard errors were used. The 80 replicate weights were not used for variance estimation. This is broadly consistent with OECD multilevel analyses, in which standard errors are estimated within the multilevel modelling framework rather than through the usual replicate-weight procedure ([OECD 2023a](#), p. 277). OECD multilevel analyses, however, additionally apply weights at both the student and school levels. A separate school-level weight was not applied in the present analysis. The substantive focus of the study is on differences between immigrant and non-migrant students, and immigrant pupils are highly unevenly distributed across Scottish secondary schools. In the Scotland PISA 2022 sample, 50% of first- and second-generation immigrant students were concentrated in 24% of schools and 75% in 48% of schools, while 59% of schools included five or fewer immigrant students. The analysis therefore prioritised representation of the student population through the final student weight while accounting for the clustering of students within schools through the multilevel specification. This decision is also considered in the context of the PISA sampling design, in which the school sample is designed to optimise the resulting representative sample of 15-year-old students rather than to provide an optimal representative sample of schools ([OECD 2023b](#), p. 306). Nevertheless, not applying a separate school-level weight represents a departure from the full OECD multilevel weighting procedure. The models therefore account for unequal student selection probabilities and within-school clustering but do not incorporate all features of PISA's complex sampling design. This is acknowledged as a limitation.

Immigrant status distinguished between first-generation pupils, second-generation pupils and non-migrant pupils, based on pupils' and parents' country of birth. Non-migrant pupils were used as the reference category in the regression models. Consistent with definitions adopted in previous research, first-generation immigrant pupils were defined as those born outside the host country to at least one foreign-born parent. Thus, children born outside the UK to two UK-born parents were not classified as immigrants. Second-generation immigrant pupils were defined as those born in the host country (UK) to at least one foreign-born parent (Crawley 2010; Siahhaan et al. 2014; National Research Council and Institute of Medicine 1998; Pivovarov and Powers 2019; Gambino 2017; Van de Werfhorst and Heath 2019).

The analysis used two-level mixed-effects linear regression models, with students (Level 1) nested within schools (Level 2). These models estimate associations between individual- and school-level predictors and the outcomes while allowing the intercept, or baseline outcome, to vary across schools. This accounts for the non-independence of observations arising from students within the same school sharing common institutional contexts and experiences (Raudenbush and Bryk 2002; Snijders and Bosker 2011). The model can be expressed as

$$y_{ij} = \beta_0 + \beta^\top x_{ij} + u_{0j} + \varepsilon_{ij},$$

where y_{ij} is the outcome for student (i) in school (j); β_0 is the overall intercept; x_{ij} represents student-level explanatory variables; and β are the individual level regression coefficients. The school-specific random intercept, u_{0j} , has variance $\tau_{00} = \text{var}(u_{0j})$, and represents unobserved between-school variation, while $\sigma^2 = \text{var}(\varepsilon_{ij})$ represents residual variation between students within schools. The random intercepts are assumed to have mean zero and variance τ_{00} , while the student-level residuals have mean zero and variance σ^2 .

The intra-class correlation coefficient (ICC),

$$ICC = \tau_{00} / (\tau_{00} + \sigma^2)$$

indicates the proportion of the total unexplained variance in the outcome attributable to differences between schools (Raudenbush and Bryk 2002; Snijders and Bosker 2011).

Models for educational and occupational aspirations were estimated using the Stata (Version 19) mixed command, while the mathematics models incorporating all ten plausible values were estimated using `mi estimate: mixed`.³

Within this multilevel framework, a sequence of models was estimated in which groups of variables were added progressively. This stepwise modelling strategy made it possible to examine how differences between first-generation, second-generation and non-migrant pupils changed after accounting for factors that may shape attainment and aspirations. Model 1 included immigrant status only and was used to estimate gross differences between the three groups. Subsequent models added socio-demographic characteristics, including age, gender and parental educational and occupational status, followed by family housing/material, cultural and educational resources, family support, and student dispositions and orientations, and in the mathematics models, teacher support. School characteristics and school-environment measures were additionally included in the educational aspirations models.

For the educational and occupational aspiration outcomes, mathematics attainment was included in the final model. For mathematics attainment, housing/material resources were introduced separately in Model 3, followed by the remaining family resources in Model 4, while occupational aspirations were added in the final model. This modelling sequence made it possible to assess whether differences by immigrant status were reduced, remained stable or increased after accounting for pupils' socio-demographic characteristics,

family resources, individual dispositions, school context and, where relevant, attainment or occupational aspirations.

PISA 2022 used questionnaire matrix sampling, whereby some questionnaire items were administered only to subsets of pupils. Consequently, not all variables used in the analysis were available for the full Scottish sample. This particularly affected measures relating to aspirations, family support, student dispositions and the school environment. Missingness in the main variables used in the regression analyses, overall and by immigrant status, is reported in Appendix B (Table A2). To ensure that estimates were comparable across the sequential models, the regression analyses were conducted using outcome-specific analytical samples restricted to pupils with non-missing information on all variables included in the respective final models. The final analytical samples comprised 1519 pupils nested within 117 schools for mathematics attainment, 1536 pupils within 117 schools for occupational aspirations, and 1872 pupils within 117 schools for educational aspirations.

4. Results

4.1. Descriptive Overview

Table 3 shows differences in 2022 PISA mathematics test scores among students in Scotland, for both the full Scottish sample and the subsample used in the mathematics attainment models. For both first- and second-generation immigrants, the test scores are higher than for non-migrants, although the wide confidence intervals for the immigrant groups, reflecting their relatively small sample sizes, mean that the differences are not statistically significant.

Table 3. Differences in PISA mathematics test performances (the average of mathematics plausible values, PV1MATH–PV10MATH), by immigrant status (unstandardised values, weighted by W_FSTUWT).

Outcome	Sample	Immigrant Group	Mean	s.e.	CI(95)	N
Mathematics test score (average)	Full Scottish sample N = 3257	First-gen.	475.71	5.81	[464.31, 487.12]	256
		Second-gen.	481.02	4.51	[472.17, 489.87]	472
		Non-migrant	468.15	1.78	[464.65, 471.65]	2529
Mathematics test score (average)	Regression analytical sample (with non-missing values for all variables included in the final regression model) N = 1519	First-gen.	490.87	8.62	[473.96, 507.78]	121
		Second-gen.	494.46	6.65	[481.41, 507.51]	226
		Non-migrant	486.64	2.53	[481.67, 491.61]	1172

Table 4 shows differences in expected highest educational level and expected occupational status at age 30, by immigrant status. Both generations of immigrants have a higher expected occupational status than non-migrant students, and these differences are statistically significant. They also have higher expected levels of education, with statistically significant differences between immigrant and non-migrant students.

Table 4. Highest expected educational level and expected occupational status by immigrant status (unstandardised values, weighted by W_FSTUWT).

Outcome	Sample	Immigrant Group	Mean *	s.e.	CI(95)	N
Expected educational level	Full Scottish sample (with non-missing values for expected level of education) N = 2557	First-gen.	6.53	0.16	[6.22, 6.85]	187
Expected educational level		Second-gen.	6.05	0.11	[5.83, 6.26]	382
Expected educational level		Non-migrant	5.41	0.05	[5.32, 5.50]	1988

Table 4. Cont.

Outcome	Sample	Immigrant Group	Mean *	s.e.	CI(95)	N
Expected educational level	Regression analytical sample (with non-missing values for all variables included in the final regression model) N = 1872	First-gen.	6.81	0.18	[6.44, 7.17]	134
Expected educational level		Second-gen.	6.13	0.13	[5.88, 6.37]	281
Expected educational level		Non-migrant	5.61	0.05	[5.51, 5.72]	1457
Expected occupational status	Full Scottish sample (with non-missing values for expected occupational status) N = 1953	First-gen.	72.18	1.26	[69.72, 74.66]	157
Expected occupational status		Second-gen.	71.04	1.05	[69.99, 73.09]	298
Expected occupational status		Non-migrant	65.63	0.52	[64.60, 66.64]	1498
Expected occupational status	Regression analytical sample (with non-missing values for all variables included in the final regression model) N = 1536	First-gen.	73.34	1.34	[70.71, 75.96]	119
Expected occupational status		Second-gen.	72.12	1.16	[69.85, 74.39]	228
Expected occupational status		Non-migrant	67.23	0.56	[66.13, 68.34]	1189

* Note: Bold figures indicate statistically significant differences between the corresponding estimates for first-generation migrants, second-generation migrants, and non-migrants.

Table 5 presents the variables used to construct the indexes of housing/material conditions and home educational and cultural resources. The table also presents differences in the average values of the variables used to construct these indexes, by immigrant status.

Table 5. Home resources: variables used to construct the home-resource indices. Means and 95% confidence intervals by immigrant status.

	First-Gen. Mean * [95% CI]	Immigrant Status Second-Gen. Mean [95% CI]	Non-Migrant Mean [95% CI]
Housing/Material conditions (Cronbach Alpha = 0.68)			
Own room (ST250Q01JA)	0.80 [0.75, 0.85]	0.90 [0.87, 0.93]	0.94 [0.93, 0.95]
Number of bathrooms (ST251Q03JA)	2.30 [2.20, 2.40]	2.60 [2.59, 2.65]	2.60 [2.59, 2.65]
Number of rooms with toilets (ST251Q04JA)	2.42 [2.31, 2.53]	2.82 [2.73, 2.91]	2.90 [2.84, 2.91]
Number of cars/vans (ST251Q01JA)	2.15 [2.05, 2.25]	2.55 [2.46, 2.63]	2.67 [2.63, 2.70]
Educational resources (Cronbach Alpha = 0.73)			
Computers (ST250Q02JA)	0.94 [0.91, 0.97]	0.94 [0.92, 0.96]	0.94 [0.93, 0.95]
Educational software (ST250Q03JA)	0.88 [0.84, 0.93]	0.91 [0.89, 0.94]	0.90 [0.88, 0.91]
Science books (ST256Q06JA)	2.08 [1.95, 2.21]	2.22 [2.11, 2.32]	2.07 [2.02, 2.12]
Technical book (ST256Q08JA)	1.77 [1.63, 1.93]	1.82 [1.71, 1.92]	1.74 [1.70, 1.79]
Dictionaries (ST256Q09JA)	1.94 [1.86, 2.02]	1.93 [1.86, 1.99]	1.82 [1.79, 1.84]
Textbooks/Books to help with schoolwork (ST256Q10JA)	2.36 [2.24, 2.48]	2.59 [2.50, 2.69]	2.46 [2.45, 2.50]

Table 5. *Cont.*

	First-Gen. Mean * [95% CI]	Immigrant Status Second-Gen. Mean [95% CI]	Non-Migrant Mean [95% CI]
Cultural resources (Cronbach Alpha = 0.75)			
Musical instruments (ST251Q06JA)	2.19 [2.04, 2.33]	2.30 [2.12, 2.41]	2.27 [2.22, 2.32]
Works of art (ST251Q07JA)	2.71 [2.55, 2.88]	2.91 [2.79, 3.03]	2.86 [2.81, 2.92]
Classical literature (ST256Q02JA)	1.67 [1.54, 1.80]	1.77 [1.68, 1.87]	1.76 [1.72, 1.80]
Contemporary literature (ST256Q03JA)	1.95 [1.79, 2.11]	2.15 [2.02, 2.28]	2.04 [1.98, 2.09]
Artbooks (ST256Q07JA)	1.92 [1.78, 2.06]	2.05 [1.94, 2.15]	2.06 [2.01, 2.10]

* Note: Bold figures indicate statistically significant differences between the corresponding estimates across the three columns.

The results presented in Table 5 show that first-generation immigrants have less favourable values than non-migrant students on every indicator used to construct the index of family housing/material conditions. They are less likely to have their own room, and their families have fewer bathrooms, fewer rooms with toilets, and fewer cars or vans than their non-migrant peers. Second-generation immigrants are also statistically significantly less likely to have their own room and have fewer cars in the household than non-migrants. In terms of educational resources, statistically significant differences between immigrant and non-migrant pupils are observed only for the number of dictionaries, with both immigrant generations reporting higher numbers. Second-generation immigrants also have a higher number of textbooks/study books at home than non-migrants. The differences in the values of the variables used to construct the home cultural resources index are not statistically significant between immigrants and non-migrants. However, first-generation immigrants tend to report lower values on these indicators than both non-migrants and second-generation migrants, while the latter have broadly similar values to non-migrants.

Table 6 presents the average standardised values of the three indexes obtained from these variables. The average housing/material conditions index is lower for immigrant pupils, with the difference particularly marked for first-generation immigrants, whose mean score is -0.42 standard deviations compared with 0.06 among non-migrants.

The differences in the average values of the cultural and educational resources indexes are not statistically significant between immigrants and non-migrants. However first-generation migrants score lower on cultural resources than non-migrants, and particularly lower than second-generation migrants. By contrast, both generations of migrants, and especially the second generation, score higher on educational resources than non-migrants.

Finally, Table 7 presents differences in student predispositions, parental support, student–teacher relationships, parental SES and aspirations by immigrant status. Immigrant pupils report more favourable scores than non-migrants on the creative school environment and participation in creative school activities measures. First-generation immigrant students also report better-quality student–teacher relationships than non-migrants. Parents of first-generation immigrants have statistically significantly higher levels of education than non-migrant parents; however, their occupational status is lower. Both generations of immigrants report statistically significantly higher scores on the PISA perseverance index: 0.03 and -0.04 for first- and second-generation immigrants respectively, compared with -0.18 for non-migrants. Similarly, both generations of immigrants have higher scores on

the growth mindset indicator: 0.35 and 0.22 for first- and second-generation immigrants respectively, compared with 0.08 for non-migrants. First-generation immigrants also report higher scores on the curiosity indicator than both second-generation immigrants and non-migrants. Levels of stress resistance are also higher among immigrant pupils: 0.10 and −0.06 for first- and second-generation immigrants respectively, compared with −0.22 for non-migrants.

Table 6. Differences in housing conditions and home resources by immigrant status (standardised values; statistically significant differences with non-migrants in bold).

Variable	Immigrant Status	Mean	Standard Error of Mean	95% CI
Housing conditions	First-gen.	−0.418	0.05	[−0.51, −0.32]
	Second-gen.	−0.035	0.04	[−0.10, 0.03]
	Non-migrant	0.061	0.01	[0.03, 0.09]
Cultural resources	First-gen.	−0.071	0.05	[−0.17, 0.02]
	Second-gen.	0.046	0.04	[−0.03, 0.12]
	Non-migrant	0.008	0.02	[−0.02, 0.04]
Educational Resource	First-gen.	−0.004	0.04	[−0.09, 0.08]
	Second-gen.	0.069	0.04	[−0.00, 0.14]
	Non-migrant	−0.014	0.02	[−0.04, 0.02]

Table 7. Differences in student predispositions, parental support, student–teacher relationship, parental SES and aspirations by immigrant status (statistically significant differences with non-migrants in bold).

	First-Generation Immigrant		Second-Generation Immigrant		Non-Migrant	
	Mean (se)	95% CI	Mean (se)	95% CI	Mean (se)	95% CI
Quality of student–teacher relationships *	0.08 (0.06)	[−0.04; 0.20]	−0.09 (0.04)	[−0.17; −0.02]	−0.03 (0.02)	[−0.06; 0.01]
Perseverance *	0.03 (0.07)	[−0.10; 0.16]	−0.04 (0.05)	[−0.14; 0.05]	−0.18 (0.02)	[−0.22; −0.15]
Curiosity *	0.15 (0.07)	[0.02; 0.28]	0.04 (0.05)	[−0.05; 0.13]	−0.08 (0.02)	[−0.12; −0.04]
Stress resistance *	0.10 (0.06)	[−0.02; 0.22]	−0.06 (0.05)	[−0.16; 0.04]	−0.22 (0.02)	[−0.26; −0.18]
Growth Mindset *	0.35 (0.06)	[0.22; 0.47]	0.22 (0.05)	[0.12; 0.33]	0.08 (0.02)	[0.03; 0.12]
Family support *	0.23 (0.07)	[0.09; 0.37]	0.22 (0.05)	[0.13; 0.32]	0.22 (0.02)	[0.18; 0.26]
Emotional control *	0.23 (0.07)	[0.10; 0.36]	0.00 (0.05)	[−0.10; 0.09]	−0.10 (0.02)	[−0.15; −0.06]
Creative school environment *	0.25 (0.06)	[0.13; 0.36]	0.03 (0.04)	[−0.06; 0.12]	0.08 (0.02)	[0.06; 0.12]
Participation in creative school activities *	−0.03 (0.06)	[−0.16; 0.09]	−0.27 (0.04)	[−0.35; −0.18]	−0.30 (0.02)	[−0.33; −0.26]

Table 7. *Cont.*

	First-Generation Immigrant		Second-Generation Immigrant		Non-Migrant	
	Mean (se)	95% CI	Mean (se)	95% CI	Mean (se)	95% CI
Highest level of education of parents (ISCED) [†]	5.51 (0.2)	[5.16; 5.86]	5.28 (0.11)	[5.08; 5.59]	5.01 (0.04)	[4.92; 5.09]
Highest level of occupation of parents (ISEI)	53.5 (1.69)	[50.1; 56.8]	58.1 (1.1)	[55.9; 60.3]	57.4 (0.47)	[56.5; 58.4]
Gap between expected and parental occupation *	0.48 (0.11)	[0.29; 0.72]	0.14 (0.07)	[−0.00; 0.284]	−0.058 (0.03)	[−0.13; 0.02]
Gap between expected and parental educational level *	0.24 (0.20)	[−0.16; 0.64]	−0.03 (0.13)	[−0.29; 0.23]	−0.28 (0.06)	[−0.39; −0.16]

* Standardised values. [†] The values of variables “highest level of parental education” (HISCED) and “child’s expected level of education (EXPECEDU)” are harmonised to allow a direct comparison.

The differences between aspired occupational status and parental occupational status are larger and more positive for immigrant pupils, indicating that they aspire, on average, to occupations of higher status than those held by their parents. In terms of educational aspirations, first-generation immigrants expect to attain a higher level of education than their parents, while second-generation immigrants expect to attain roughly the same level as their parents. Non-migrants, on average, aim for a level of education lower than that of their parents.

4.2. Mixed-Effect Regression Modelling

4.2.1. Student Aspirations: Expected Highest Level of Educational Attainment

Table 8 presents the results of regression modelling of the highest level of educational qualifications expected by pupils.

In Model 1, where only immigrant status is included, immigrant pupils have substantially higher expected future education than non-immigrant pupils: $b = 0.55$ and $b = 0.21$ for the first and second generations, respectively. The regression coefficients for first- and second-generation immigrants remain positive and statistically significant across all models. In the final model, after controlling for socio-demographic characteristics, family resources, student predispositions, perceived school environment and attainment, the coefficients are $b = 0.44$ and $b = 0.18$ for the first and second generations, respectively. These controls account for 20% of the ‘gross’ aspiration advantage for first-generation immigrants. For second-generation pupils, these variables account for 14% of the gross educational aspiration advantage of second-generation pupils (see Table 8).

Still, these variables matter for expected future educational level. All things being equal, parental education, mathematics attainment, and home educational resources are positively and strongly associated with the expected level of education. Similarly, information seeking about future jobs, perseverance and emotional control are also positively and strongly associated with educational aspirations. Furthermore, a creative school environment and participation in creative activities at school are positively associated with educational aspirations, everything else being equal. Therefore, while these factors do not fully account for the immigrant-status difference, the findings show that educational aspirations are shaped by family background and educational resources, student dispositions, school environment and attainment.

Table 8. Mixed effect regression models. Dependent variable: Expected educational level (EX-PECEDU).

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Immigrant status	+Family SE background	+Family resources	+Student dispositions	+School features	+Attainment
Fixed effects	b/se	b/se	b/se	b/se	b/se	b/se
First-generation immigrant	0.55 *** (0.09)	0.49 *** (0.09)	0.54 *** (0.09)	0.49 *** (0.09)	0.45 *** (0.09)	0.44 *** (0.09)
Second-generation immigrant	0.21 ** (0.07)	0.20 ** (0.06)	0.21 ** (0.06)	0.20 ** (0.06)	0.18 ** (0.06)	0.18 ** (0.07)
Age		0.05 * (0.02)	0.04 * (0.02)	0.04 (0.02)	0.04 * (0.02)	0.03 (0.02)
Female		0.15 *** (0.04)	0.14 *** (0.04)	0.18 *** (0.05)	0.18 *** (0.05)	0.22 *** (0.05)
Parental occupational status		0.07 * (0.03)	0.03 (0.03)	0.02 (0.03)	0.02 (0.03)	0.01 (0.03)
Parental education		0.28 *** (0.03)	0.24 *** (0.03)	0.24 *** (0.03)	0.23 *** (0.03)	0.22 *** (0.03)
Material resources			0.03 (0.03)	0.03 (0.03)	0.03 (0.03)	0.02 (0.03)
Educational resources			0.10 *** (0.03)	0.10 ** (0.03)	0.08 ** (0.03)	0.06 * (0.03)
Cultural resources			0.08 ** (0.02)	0.07 ** (0.02)	0.07 ** (0.02)	0.03 (0.02)
Family support			0.05 * (0.02)	0.04 (0.02)	0.02 (0.02)	0.02 (0.02)
Emotional control				0.08 *** (0.02)	0.04 (0.02)	0.03 (0.02)
Information seeking				0.10 *** (0.03)	0.08 * (0.03)	0.09 ** (0.03)
Growth mindset				0.02 (0.02)	−0.00 (0.02)	−0.02 (0.02)
Perseverance					0.19 *** (0.03)	0.16 *** (0.03)
Creative school environment					0.05 (0.03)	0.06 * (0.03)
Creative activities at school					0.07 * (0.03)	0.07 * (0.03)
PISA mathematics test score						0.16 *** (0.03)
Constant	0.02 (0.03)	−0.08 (0.04)	−0.09 * (0.04)	−0.08 * (0.04)	−0.05 (0.04)	−0.10 * (0.04)
Random part						
Var(con)	0.106 *** (0.02)	0.077 *** (0.01)	0.08 *** (0.01)	0.08 *** (0.01)	0.08 *** (0.01)	0.08 *** (0.01)
Var(residual)	0.872 *** (0.02)	0.790 *** (0.02)	0.769 *** (0.02)	0.756 *** (0.01)	0.722 *** (0.01)	0.701 *** (0.01)
ICC	0.11	0.09	0.09	0.10	0.10	0.10
Observations	1872	1872	1872	1872	1872	1872

Notes: Standard errors are shown in parentheses. The reference category for immigrant status is non-immigrant pupils. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The values are standardised relative to the Scotland sample mean and standard deviation. Models are weighted using the PISA final student weight (W_FSTUWT).

Student Aspirations: Expected Occupation

Table 9 presents the results of regression modelling of the occupation that pupils expect to have when they are 30 years old.

Table 9. Mixed effect regression models. Dependent variable: Expected occupational status (BSMJ).

	Model 1	Model 2	Model 3	Model 4	Model 5
	Immigrant status	+Family SE background	+Family resources	+Student dispositions	+Attainment
Fixed effects	b/se	b/se	b/se	b/se	b/se
First-generation immigrant	0.33 *** (0.08)	0.33 *** (0.08)	0.37 *** (0.08)	0.31 *** (0.08)	0.27 *** (0.08)
Second-generation immigrant	0.20 ** (0.07)	0.22 *** (0.06)	0.24 *** (0.06)	0.23 *** (0.07)	0.22 *** (0.06)
Age		−0.02 (0.03)	−0.01 (0.03)	−0.01 (0.03)	−0.03 (0.02)
Female		0.30 *** (0.06)	0.29 *** (0.06)	0.34 *** (0.06)	0.38 *** (0.06)
Parental occupational status		0.15 *** (0.03)	0.11 *** (0.03)	0.09 *** (0.03)	0.07 * (0.03)
Parental education		0.07 ** (0.03)	0.04 (0.03)	0.03 (0.03)	0.01 (0.03)
Material resources			0.04 (0.03)	0.05 (0.03)	0.03 (0.03)
Educational resources			0.11 *** (0.03)	0.09 ** (0.03)	0.07 ** (0.03)
Cultural resources			0.06 (0.03)	0.05 (0.03)	0.01 (0.03)
Family support			0.05 (0.03)	0.04 (0.03)	0.05 (0.03)
Doing paid work				−0.04 ** (0.01)	−0.02 (0.01)
Perseverance				0.14 *** (0.02)	0.09 ** (0.03)
Emotional control				0.06 (0.03)	0.05 (0.03)
Information seeking				0.03 (0.04)	0.03 (0.04)
Growth mindset				0.02 (0.03)	−0.00 (0.03)
PISA mathematic test score					0.23 *** (0.03)
Constant	0.01 (0.03)	−0.15 ** (0.05)	−0.16 *** (0.05)	−0.13 ** (0.05)	−0.19 *** (0.05)
Random part					
Var(con)	0.109 *** (0.01)	0.085 *** (0.01)	0.082 *** (0.01)	0.087 *** (0.01)	0.087 *** (0.01)
Var(residuals)	0.815 *** (0.04)	0.764 *** (0.04)	0.744 *** (0.04)	0.715 *** (0.04)	0.667 *** (0.03)
ICC	0.12	0.10	0.10	0.11	0.11
Observations	1536	1536	1536	1536	1536

Notes: Standard errors are shown in parentheses. The reference category for immigrant status is non-immigrant pupils. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The values are standardised relative to the Scotland sample mean and standard deviation. Models are weighted using the PISA final student weight (W_FSTUWT).

In the immigrant-status model, both first- and second-generation pupils expect higher-status future occupations than non-immigrant pupils: $b = 0.33$ and $b = 0.20$ for the first and second generations, respectively (Model 1).

This advantage remains statistically significant in all later models. In the final model, after controlling for socio-demographic characteristics, home resources, dispositions and mathematics attainment, the coefficients are still positive and statistically significant: $b = 0.27$ and $b = 0.22$ for the first and second generations, respectively (Model 5).

Therefore, as with expected future education, the higher occupational aspirations of immigrant pupils are not explained away by the variables in the model. The variables in the model account for 18% of the occupational aspiration advantage of first-generation immigrants but do not explain the higher occupational aspirations of second-generation immigrants.

Female students have higher occupational aspirations than their male peers. Parental occupational status, home educational resources, perseverance and mathematics attainment are all consistently strong and statistically significant predictors of occupational aspirations. The impact of parental occupation declines from $b = 0.15$ in Model 2 to $b = 0.07$ in Model 5, indicating that part of the association between parental occupation and aspirations is accounted for by home resources, pupils' predispositions and attainment. Parental education is statistically significant in Model 2 ($b = 0.07$) but becomes non-significant after home resources, particularly home educational resources, are added.

Housing conditions and material resources are not statistically significant in any model. Educational resources regression coefficients are consistently positive and significant, from $b = 0.11$ in Model 3 to $b = 0.07$ in the final model (Table 9). This suggests that a richer educational home environment supports higher occupational aspirations among students from similar socio-economic and demographic backgrounds and with similar predispositions. This is unlike cultural resources, which are not statistically significant in any of the models.

Perseverance is strongly and consistently associated with higher expected occupational status. Working for pay is negatively associated with occupational aspirations. However, the effect of this variable becomes non-significant when mathematics attainment is included in the final model. This may indicate that early paid work is connected to more immediate or less academically oriented pathways, unless attainment is taken into account.

Overall, the finding that adding mathematics attainment to the regression reduces several other effects, such as educational resources, perseverance and working for pay, which suggests that academic performance may partly account for the associations between these resources and dispositions, on the one hand, and occupational aspirations, on the other.

4.2.2. Attainment Measured by Performance on Mathematics Test

Table 10 presents multiple-imputation regression models of standardised PISA mathematics performance based on the ten plausible values (PV1MATH–PV10MATH). Model 1 controls for immigrant status only and therefore estimates the gross differences in mathematics attainment between immigrant and non-immigrant pupils. The regression coefficient for first-generation immigrants is 0.17 standardised units above that for non-migrants, although the difference is not statistically significant. The corresponding second-generation advantage is much smaller, at 0.02 standardised units, and is also not statistically significant. Adding controls for age, gender, parental occupational status and parental education in Model 2 slightly reduces the first-generation coefficient, while leaving the second-generation coefficient unchanged. Age is a positive and statistically significant predictor of mathematics attainment across the models, with older pupils performing better, while female pupils score substantially lower than male pupils.

Table 10. Multiple-imputation regression models of standardised PISA mathematics performance based on the ten plausible values (PV1MATH–PV10MATH).

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Immigrant status	+Family SE background	+Family housing/material possessions	+Family resources	+Student dispositions	+Student occupational aspirations
	b/se	b/se	b/se	b/se	b/se	b/se
Fixed effects						
First-generation immigrant	0.17 (0.11)	0.15 (0.10)	0.20 * (0.10)	0.20 * (0.10)	0.13 (0.10)	0.07 (0.10)
Second-generation immigrant	0.02 (0.08)	0.02 (0.08)	0.03 (0.08)	0.05 (0.07)	0.05 (0.07)	−0.00 (0.07)
Age		0.09 ** (0.03)	0.09 ** (0.03)	0.10 ** (0.03)	0.10 ** (0.03)	0.10 *** (0.03)
Female		−0.24 *** (0.06)	−0.23 *** (0.06)	−0.25 *** (0.06)	−0.19 ** (0.06)	−0.25 *** (0.06)
Parental occupational status		0.17 *** (0.03)	0.15 *** (0.03)	0.09 ** (0.03)	0.09 ** (0.03)	0.07 * (0.03)
Parental education		0.09 ** (0.03)	0.08 ** (0.03)	0.05 (0.03)	0.03 (0.03)	0.03 (0.03)
Material resources			0.08 * (0.03)	0.04 (0.03)	0.04 (0.03)	0.03 (0.03)
Cultural resources				0.18 *** (0.03)	0.17 *** (0.03)	0.16 *** (0.03)
Educational resources				0.12 *** (0.03)	0.08 * (0.03)	0.07 * (0.03)
Family support				−0.02 (0.02)	−0.05 (0.03)	−0.05 * (0.02)
Growth mindset					0.10 *** (0.02)	0.10 *** (0.02)
Perseverance					0.17 *** (0.03)	0.15 *** (0.03)
Teacher support					0.07 ** (0.03)	0.07 * (0.03)
Expected occupational status						0.18 *** (0.03)
Constant	0.13 ** (0.04)	0.24 *** (0.05)	0.23 *** (0.05)	0.23 *** (0.05)	0.19 *** (0.05)	0.22 *** (0.05)
Random part						
Var(_cons)	0.183 *** (0.03)	0.135 *** (0.02)	0.130 *** (0.02)	0.10 *** (0.02)	0.11 *** (0.02)	0.10 *** (0.02)
Var(residual)	0.787 *** (0.03)	0.726 *** (0.03)	0.712 *** (0.03)	0.670 *** (0.03)	0.631 *** (0.03)	0.607 *** (0.02)
ICC	0.19	0.16	0.15	0.13	0.14	0.15
Observations	1519	1519	1519	1519	1519	1519

Notes: Standard errors are shown in parentheses. The reference category for immigrant status is non-immigrant pupils. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The values are standardised relative to the Scotland sample mean and standard deviation. Models are weighted using the PISA final student weight (W_FSTUWT).

Parental occupational status is also a strong and statistically significant predictor across the models. By contrast, parental education is statistically significant when introduced as part of the family socio-demographic profile in Model 2 but becomes non-significant once housing/material conditions and other family resources are taken into account.

As the descriptive statistics show (Table 6), immigrant pupils, and particularly first-generation immigrants, are disadvantaged relative to non-immigrant pupils in terms of housing and material resources. Model 3 therefore adds controls for housing/material conditions. Housing/material resources are positively and statistically significantly associated with mathematics attainment in this model. Importantly, accounting for these differences increases the first-generation coefficient from $b = 0.15$ in Model 2 to $b = 0.20$ in Model 3 and makes it statistically significant. This indicates that, among pupils with comparable socio-demographic characteristics and housing/material resources, first-generation immigrants have significantly higher mathematics attainment than non-immigrant pupils. In other words, their less favourable material circumstances appear to suppress rather than explain their attainment advantage.

Model 4 additionally controls for family educational and cultural resources and family support. The first-generation coefficient remains virtually unchanged at $b = 0.20$ and statistically significant. At the same time, the coefficient for housing/material resources falls from $b = 0.08$ in Model 3 to $b = 0.04$ and becomes statistically non-significant once these other family resources are controlled. Family educational and cultural resources remain positively and statistically significantly associated with mathematics attainment in subsequent models, with cultural resources showing a particularly strong association. Family support, by contrast, has a negative coefficient and becomes statistically significant in the final model. This somewhat unexpected finding was explored further using descriptive statistics and the individual measures used to construct the family-support index, but no clear explanation could be identified. It may reflect reverse causality—for example, pupils experiencing greater difficulty may receive more support from their parents—but this interpretation remains tentative and merits further investigation.

Model 5 adds student dispositions, including perseverance and growth mindset, together with mathematics teacher support. Both perseverance and the growth mindset are positively and statistically significantly associated with mathematics attainment, as is teacher support. These associations remain positive and statistically significant in Model 6. Importantly, introducing student dispositions and teacher support reduces the first-generation coefficient from $b = 0.20$ in Model 4 to $b = 0.13$ in Model 5, and it becomes statistically non-significant. This suggests that differences in student dispositions and teacher support account for a meaningful part of the first-generation mathematics advantage.

Finally, Model 6 adds the expected occupational status, which is positively and strongly associated with mathematics attainment. Pupils who expect to enter higher-status occupations therefore also tend to perform better in mathematics, other characteristics being equal. Adding occupational aspirations further reduces the first-generation coefficient to 0.07 standardised units. Because occupational aspirations are introduced after the other controls, the result indicates a strong association between aspirations and attainment, although the cross-sectional nature of the data does not allow us to determine whether higher occupational aspirations contribute to stronger performance, or stronger performance raises aspirations.

The sensitivity analysis using the averaged mathematics plausible values produced fixed-effect coefficients that were almost identical in direction and magnitude to those obtained from the pooled plausible-value analysis (Appendix A). However, standard errors were somewhat smaller when the averaged measure was used. Consequently, the first-generation coefficients in Models 1 and 2 were statistically significant in the averaged-PV models but not in the pooled analysis. This difference reflects the additional uncertainty incorporated when estimates are pooled across the ten plausible values. Importantly, the substantive pattern remained unchanged: the first-generation mathematics advantage increased after differences in housing/material and other family resources were taken into

account and was subsequently reduced after student dispositions, teacher support and occupational aspirations were introduced.

4.2.3. Variance Analysis

The variance components show that all three outcomes vary both between schools and between pupils within schools, although the degree of school-level clustering is substantially greater for mathematics attainment than for aspirations.

For the expected educational level, the between-school variance declines from 0.106 in Model 1 to 0.080 in the final model, a reduction of approximately 25%. Most of this reduction occurs when family socio-economic background is introduced in Model 2, after which the between-school variance remains broadly stable. The residual pupil-level variance declines more progressively, from 0.872 to 0.701, a reduction of approximately 20%. Relatedly, the ICC falls from 0.11 in Model 1 to 0.09 after family socio-economic characteristics are introduced, and is 0.10 in the final model. This suggests that school-level differences in educational aspirations are relatively modest and that much of the variation remains between pupils within the same school.

A similar pattern is observed for expected occupational status. Between-school variance falls from 0.109 in Model 1 to 0.087 in the final model, a reduction of approximately 20%, with most of the decline again occurring after family socio-economic characteristics are introduced. Residual variance falls from 0.815 to 0.667, a reduction of about 18%, and declines more consistently as additional pupil-level characteristics are added. The ICC changes only modestly, from 0.12 in Model 1 to 0.11 in the final model. Thus, as with educational aspirations, most of the remaining unexplained variation in occupational aspirations is located between pupils within schools rather than between schools.

Mathematics attainment shows a stronger school-level pattern. In Model 1, the between-school variance is 0.183 and the ICC is 0.19, indicating that approximately one-fifth of the unexplained variation in mathematics attainment is associated with differences between schools. Between-school variance falls to 0.135 after family socio-economic characteristics are introduced and to 0.100 after housing/material and other family resources are taken into account. It remains at approximately this level in the subsequent models and is 0.100 in the final model, representing an overall reduction of approximately 45% relative to Model 1. This pattern is consistent with a substantial part of the initial between-school variation in mathematics attainment being associated with differences in the socio-economic and home-resource composition of pupils across schools.

Residual pupil-level variance in mathematics also declines across the models, from 0.787 in Model 1 to 0.607 in the final model, a reduction of approximately 23%. The ICC falls from 0.19 to 0.13 by Model 4, before increasing slightly to 0.15 in the final model. This small increase does not indicate an increase in the absolute amount of between-school variation; rather, it reflects the simultaneous reduction in residual pupil-level variance as further predictors are introduced. Overall, mathematics attainment is more strongly differentiated between schools than either educational or occupational aspirations, although a substantial proportion of both between-school and within-school variation is accounted for as family resources, student dispositions, teacher support and occupational aspirations are introduced.

5. Discussion and Conclusions

This article examined the relationship between living experiences, aspirations and attainment among immigrant and non-immigrant pupils in Scotland using PISA 2022 data. The analysis focused on three related outcomes: expected future level of education, expected future occupation, and mathematics test performance. The study was informed

by immigrant optimism theory and selective and segmented assimilation, and asked how the educational and occupational aspirations and academic attainment of first- and second-generation immigrant pupils compare with those of non-immigrant pupils in Scotland, and to what extent differences in aspirations and attainment between immigrant and non-immigrant pupils are associated with material and housing conditions, relative to family educational and cultural resources, family support, student dispositions and school support.

The mixed-effect regression models show that aspirations are influenced by family background and resources. Expected future education is strongly associated with parental education, mathematics attainment, home educational resources, family support, information seeking, emotional control and perceived creative school environment. Expected future occupation is more strongly associated with parental occupational status, home educational resources, perseverance and mathematics attainment. Interestingly, neither aspirational outcome is statistically significantly associated with family housing conditions or material circumstances. Educational aspirations are consistently associated with home educational resources, while the association with cultural resources is attenuated once mathematics attainment is included. Occupational aspirations are strongly associated with educational resources only, once controls for student predispositions and attainment are added.

Therefore, family background and resources, as well as student dispositions, matter; however, they do not fully account fully for higher aspirations of immigrant pupils. Both first- and second-generation immigrant pupils report higher expected future education and a higher expected occupational status than non-immigrant pupils. These differences remain significant after controlling for demographic characteristics, parental education and occupational status, material, cultural and educational resources, family support, student dispositions, perceived school environment and mathematics attainment. For both outcomes, the first-generation advantage is reduced only slightly across the models, while the second-generation advantage remains almost unchanged for educational expectations and increases for occupational aspirations after all control variables are added. This suggests that immigrant pupils' higher aspirations are less readily explained by the conventional predictors included in the model. Rather, they appear to reflect a broader orientation towards education and future mobility that is not fully captured by the measured variables in the model, and which is consistent with the immigrant optimism hypothesis. For non-immigrant pupils, expected future education is associated with a broader set of family, home, school and attainment-related resources. Among immigrant pupils, parental education remains important, and mathematics attainment is important particularly for first-generation pupils, but many other measured resources are weaker or non-significant in the full interaction models.

Existing research suggests that children of immigrants frequently hold occupational aspirations that are high relative to their parental background, implying aspirations for substantial intergenerational upward mobility. Earlier US evidence from the Children of Immigrants Longitudinal Study points to high levels of occupational ambition among children of immigrants despite relatively modest parental socio-economic origins (National Research Council and Institute of Medicine 1998). Using data from Germany and Sweden, Plenty and Jonsson (2021) found that immigrant-background students had higher occupational aspirations even after accounting for parental occupational status and other socio-economic characteristics. Portes et al. (2013) found that the educational and occupational ambitions of children of immigrants in Spain were strongly shaped by parental ambition. Their findings also suggest that these ambitions cannot be understood solely in terms of parental socio-economic status, but also reflect strong family expectations for upward educational and occupational mobility. Longitudinal evidence presented

by Möser (2022) further showed that children of immigrants maintained comparatively high occupational aspirations even when their educational outcomes and labour-market opportunities were less favourable, suggesting a persistent orientation towards higher occupational aspirations among immigrant-origin young people. Their higher aspirations may reflect broader migration-related expectations, family narratives of mobility, and beliefs about education as a route to security and advancement, which are not fully captured by standard measures of socio-economic status, resources or support. This fits well with the expectations of the immigrant optimism hypothesis (Kao and Tienda 1995; Landale et al. 1998).

This provides an important contrast with the pattern observed among non-immigrant pupils in the present study, whose expected occupational status was, on average, lower than that of their parents. While the aspirations of immigrant-origin pupils may partly reflect expectations of upward mobility across generations, the lower relative aspirations of non-immigrant pupils point to a different relationship between family occupational position and anticipated future trajectories.

The results for mathematics attainment differ from those for student aspirations. The mixed-effects regression models show that first-generation immigrant pupils perform better in mathematics than non-immigrant pupils after accounting for the socio-demographic characteristics of their families and family resources. Controlling for housing/material circumstances increases the positive first-generation coefficient and makes it statistically significant. This suggests that the mathematics advantage of first-generation immigrants is not explained by more favourable material or family-resource circumstances; rather, their less favourable material conditions appear to suppress this advantage. First-generation immigrant pupils therefore perform significantly better in mathematics than non-immigrant pupils with otherwise comparable family socio-demographic characteristics, housing/material circumstances and other family resources.

However, the first-generation advantage becomes non-significant after student dispositions and teacher support are introduced and is reduced further after accounting for occupational aspirations. Second-generation pupils perform at least as well as non-migrant pupils, both before and after controls are introduced for family background and resources, student dispositions, teacher support and expected occupational status.

These patterns are also consistent with immigrant optimism and selective and segmented assimilation perspectives, demonstrating the importance of students' personal characteristics, social ties, a supportive institutional environment, and students' dispositions and aspirations. Growth mindset, perseverance, mathematics teacher support and expected occupational status are all positively associated with mathematics performance and help explain the mathematics attainment advantage of first-generation immigrants. This is in line with existing research (Kaya et al. 2024; Fernández-Reino 2016; Burgess and Heller-Sahlgren 2018; Rumbaut 1997; Ogbu 1991). These findings indicate that aspirations and dispositions, a positive home learning environment, and a supportive school environment seem to be part of the mechanism through which immigrant pupils maintain strong attainment despite less favourable housing and material conditions.

The findings also contribute to debates on the link between material disadvantage and children's outcomes. The descriptive analysis shows that both generations of immigrant children experience poorer housing and material conditions, while at the same time often showing stronger aspirations and comparable or higher attainment than their non-migrant peers. The results also show that the first-generation coefficient increases once family SES and home resources are controlled, suggesting that their less favourable circumstances suppress part of the observed mathematics advantage. Therefore, the results support the argument that material disadvantage matters but does not determine outcomes in a

straightforward way, especially for immigrant students, for whom a less advantageous family background and home resources do not explain their aspirational advantage compared with non-migrant students.

Across all three outcomes, housing/material resources are no longer statistically significant once other family resources, particularly educational and cultural resources, are taken into account. For educational aspirations, both educational and cultural resources are positively associated with the outcome, although cultural resources become non-significant once mathematics attainment is controlled for in the final model. For occupational aspirations, neither housing/material nor cultural resources are statistically significantly associated with the outcome, whereas educational resources are positively and statistically significantly associated with occupational aspirations across all models in which they are included. For mathematics attainment, housing/material resources are positively and statistically significantly associated with attainment when first introduced, but this association becomes non-significant once educational and cultural resources are controlled. Both educational and cultural resources remain positively and statistically significantly associated with mathematics attainment in subsequent models, with cultural resources showing the stronger association.

The post-COVID context of PISA 2022 makes these findings particularly relevant. The 2022 data capture pupils after a period of school closures, remote learning and disruption to normal school and home support. This matters because disrupted schooling may have affected pupils unevenly, especially those whose parents were less able to support learning directly or whose schools had fewer resources. The findings suggest that family resources, teacher support, student dispositions and aspirations remain important in this context.

Overall, the results show that immigrant pupils in Scotland, especially first-generation pupils, while facing less favourable material circumstances, also show strong educational and occupational aspirations and strong mathematics performance, which matches or surpasses the performance of non-migrant students. These results are consistent with immigrant optimism and selective/segmented assimilation perspectives, which emphasise the role of family expectations, social capital, educational values and context of reception. The Scottish case therefore shows that material disadvantage does not necessarily translate into lower aspirations or lower attainment among immigrant children. However, the findings suggest that immigrant optimism should not be understood as a simple or automatic advantage. The translation of aspirations into outcomes depends on resources, dispositions and school support. Parental education, parental occupational status, home educational resources, perseverance, growth mindset, teacher support and mathematics attainment all matter. This means that immigrant pupils' high aspirations should be supported by schools and policy, rather than assumed to be sufficient on their own. High aspirations may create potential for educational mobility, but this potential still requires institutional support, inclusive schooling and access to learning resources.

The implications for Scottish education policy are important. Scotland's commitments to inclusion, wellbeing and reducing the poverty-related attainment gap ([Education Scotland n.d.](#)) provide a relevant framework for supporting immigrant pupils. However, because immigrant pupils form a smaller and unevenly distributed group in Scotland, their experiences may be less visible in policy and research than those of white Scottish pupils from disadvantaged socio-economic backgrounds. The findings suggest that schools need to recognise both the strengths and vulnerabilities of immigrant pupils: their high aspirations, positive dispositions and strong performance, but also the constraints linked to material conditions, home learning resources and school support. Supporting immigrant pupils therefore requires attention not only to their educational outcomes but also to the conditions that enable learning and aspirations to be realised.

The findings are also relevant beyond immigrant pupils. Home educational and cultural resources, perseverance, a growth mindset and teacher support are all positively associated with mathematics attainment and are important for all learners. The findings on aspirations are equally important. Immigrant pupils not only perform stronger on some outcomes but also aspire to higher-status occupations than those of their parents, whereas non-migrant pupils' occupational aspirations are, on average, lower than their parents' occupational status. This points to the need to support all pupils, and especially disadvantaged pupils from non-migrant backgrounds, not only with information about future jobs but also with clearer pathways for educational progression and social mobility, while signalling that education remains a key route through which future opportunities can be expanded.

The study has several limitations. The most important is the small sample of first- and second-generation immigrant pupils, which prevents further differentiation by country of origin, migration history or length of residence in Scotland, even where such information is available in the dataset. The data are also cross-sectional, meaning that they identify associations between family background, resources, support, aspirations and attainment, but cannot establish causal direction. It is therefore not possible to determine whether aspirations lead to higher attainment, whether higher attainment raises aspirations, or whether both are shaped by other family and school processes. In addition, some mechanisms central to immigrant optimism, including parental sacrifice, migration histories, ethnic community networks and experiences of ethnic or racial discrimination, are not directly measured in PISA. The models apply the final student weight and account for clustering within schools but do not incorporate the full PISA complex-sampling procedure, including replicate weights and separate school-level weighting.

Despite these limitations, this study makes an important contribution. It shows that immigrant pupils in Scotland have higher educational and occupational aspirations than non-immigrant pupils, and that these differences are not explained away by measured family, home, school, disposition or attainment variables. It also shows that first-generation pupils' mathematics advantage is partly linked to dispositions, teacher support and aspirations. The findings therefore extend research on immigrant optimism by showing that aspirations are a particularly important dimension of immigrant pupils' educational experience. They also contribute to Scottish debates on equity and inclusion by showing that immigrant pupils' outcomes should be understood not only in terms of disadvantage but also in terms of aspiration, resilience and the resources that help pupils, regardless of background, translate future orientations into educational success.

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Appendix A. Sensitivity Analysis

Table A1. Mixed effect regression models. Dependent variable: Standardised PISA mathematics test score (mean of PV1MATH–PV10MATH).

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Immigrant status	+Family SE background	+Family housing/material possessions	+Family resources	+Student dispositions	+Student occupational aspirations
Fixed effects	b/se	b/se	b/se	b/se	b/se	b/se
First-generation immigrant	0.18 * (0.08)	0.16 * (0.08)	0.21 ** (0.08)	0.21 ** (0.08)	0.14 (0.08)	0.08 (0.08)
Second-generation immigrant	0.02 (0.07)	0.02 (0.07)	0.03 (0.07)	0.05 (0.07)	0.05 (0.07)	−0.00 (0.06)
Age		0.10 *** (0.03)	0.10 *** (0.03)	0.10 *** (0.03)	0.11 *** (0.03)	0.11 *** (0.03)
Female		−0.25 *** (0.05)	−0.25 *** (0.05)	−0.26 *** (0.05)	−0.20 *** (0.05)	−0.26 *** (0.05)
Parental occupational status		0.18 *** (0.03)	0.16 *** (0.03)	0.10 *** (0.03)	0.10 *** (0.03)	0.08 ** (0.03)
Parental education		0.10 *** (0.02)	0.09 *** (0.03)	0.05 * (0.02)	0.04 (0.02)	0.03 (0.02)
Material resources			0.08 *** (0.02)	0.05 * (0.02)	0.04 (0.02)	0.04 (0.02)
Cultural resources				0.19 *** (0.03)	0.18 *** (0.03)	0.17 *** (0.03)
Educational resources				0.12 *** (0.03)	0.09 ** (0.03)	0.07 * (0.03)
Family support				−0.02 (0.02)	−0.05 * (0.02)	−0.06 * (0.02)
Growth mindset					0.11 *** (0.02)	0.10 *** (0.02)
Perseverance					0.18 *** (0.03)	0.15 *** (0.03)
Teacher support					0.08 *** (0.02)	0.07 ** (0.02)
Expected occupational status						0.19 *** (0.02)
Constant	0.13 ** (0.04)	0.25 *** (0.05)	0.25 *** (0.05)	0.24 *** (0.04)	0.20 *** (0.04)	0.23 *** (0.04)
Random part						
Var(con)	0.190 ** (0.02)	0.138 *** (0.02)	0.133 *** (0.02)	0.097 *** (0.01)	0.106 *** (0.01)	0.103 *** (0.01)
Var(residual)	0.764 *** (0.03)	0.697 *** (0.03)	0.693 *** (0.03)	0.647 *** (0.03)	0.592 *** (0.02)	0.567 *** (0.02)
ICC	0.20	0.17	0.16	0.13	0.15	0.15
Observations	1519	1519	1519	1519	1519	1519

Notes: Standard errors are shown in parentheses. The reference category for immigrant status is non-immigrant pupils. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The values are standardised relative to the Scotland sample mean and standard deviation. Models are weighted using the PISA final student weight (W_FSTUWT).

Appendix B. Missingness in Variables Used in the Regression Analyses

Table A2. Missing observations for variables included in the multilevel regression models, overall and by immigrant status, total number of cases (N) and percentages (%).

Variable	Missing All N	Missing All %	Missing 1st Gen N	Missing 1st Gen %	Missing 2nd Gen N	Missing 2nd Gen %	Missing Non-Migrants N	Missing Non-Migrants %
Creative activities at school (CREATACT)	652	20	63	25	77	16	512	20
Emotional control (EMOCOAGR)	326	10	30	12	38	8	258	10
Expected occupation status (BSMJ)	1304	40	99	39	174	37	1031	41
Female	0	0	0	0	0	0	0	0
Growth mindset (GROSAGR)	332	10	29	11	39	8	264	10
Highest expected educational level (EXPECEDU)	700	21	69	27	90	19	541	21
Highest level of education of parents (HISCED)	373	11	31	12	46	10	296	12
Highest parental occupational status (HISEI)	507	16	39	15	57	12	411	16
Information seeking (INFOSEEK)	677	21	61	24	72	15	544	22
Mathematics teacher support (TEACHSUP)	456	14	32	13	55	12	369	15
Participation in creative activities (CREATAS)	652	20	63	25	77	16	521	20
Perseverance (PERSEVAGR)	265	8	21	8	27	6	217	9
Working for pay before or after school (WORKPAY)	195	6	12	5	15	3	168	7
Age	0	0	0	0	0	0	0	0
Cultural resources (cultural_index)	115	4	3	1	4	1	108	4
Educational resources (educational_index)	119	4	1	0	3	1	115	5
Family support (FAMSUP)	466	14	44	17	51	11	371	15
Housing/Material resources (material_index)	95	3	1	0	1	0	93	4
Mathematics attainment (mean of PV1MATH–PV10MATH)	0	0	0	0	0	0	0	0

Notes

- ¹ <https://www.oecd.org/en/data/datasets/pisa-2022-database.html>, accessed on 13 May 2026.
- ² For mathematics attainment, the ten plausible values were standardised within the multiple-imputation framework using Stata mi passive: `egen z_math_pv = std(math_pv)` command, so that each plausible value was standardised separately.
- ³ In Stata, the plausible values were imported as multiply imputed versions of the attainment outcome using `mi import wide`. The sequence of multilevel models was then estimated using `mi estimate: mixed`, with coefficients and standard errors pooled across the ten plausible values using multiple-imputation combination rules.

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