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Education and social mobility

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by

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Abstract

Education policy holds the promise of breaking the strong ties between family background and socio-economic position by providing publicly accessible education for children of all backgrounds. However, the education system may also perpetuate social inequalities if well-off families are able to protect their children from downward mobility by e.g., moving to neighbourhoods with high-quality schools, and by providing networks that offer opportunities to succeed.

A growing number of studies however show that educational interventions can have long-lasting effects on students' outcomes, in particular for disadvantaged students, and that they can be cost-effective. For example, reducing class size, increasing general education spending, tutoring and improved teacher quality are policy levers that are shown to be successful in this regard. Shifting from selective to comprehensive school systems is also a policy that enhances equality of opportunity. While the evidence on credit constraints and their role for access to higher education is evolving but still mostly US focused and largely inconclusive, it is a key domain for shaping social mobility given the life-changing impacts that a university degree can have.

Keywords: Equality of opportunity; social mobility; intergenerational mobility; education policy; economics of education; effect evaluation.
JEL-codes: I3; I24; J24

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1 Introduction

Family background is a strong determinant of an individual's educational achievement and labour market success. Understanding the roots of intergenerational persistence in socio-economic status is a salient topic in several academic disciplines: a large body of research studies the mechanisms that give rise to intergenerational persistence, and the policies that may weaken the link between parents and offspring and increase social mobility.

The (public) education system has often been seen as the "great equalizer" with potential to level the playing field and provide disadvantaged children with the skills needed to succeed. Extending compulsory education and introducing comprehensive school systems are policies that have been successful in this regard, as shown in a number of studies based on reforms in the Nordic countries (Meghir and Palme 2005; Pekkarinen, Uusitalo, and Kerr 2009; Aakvik, Salvanes, and Vaage 2010), as well as in the U.K. and the U.S. (Lleras-Muney 2002; Oreopoulos 2006; 2007).

However, the role of education in equalizing opportunities has also been questioned, on different grounds. Inequalities in early childhood environment give rise to skill gaps already before children start school. If early inputs are crucial for later skill formation, compensatory investment through the formal education system may be both unproductive and inefficient (Cunha and Heckman 2007). Another argument is that education does little to change the associations between class origin and destination, because well-off parents can spend resources to prevent their children from experiencing downward mobility (Bukodi and Goldthorpe 2018).[1] For example, unequal education quality across wealthy and poor neighbourhoods and credit constraints reproduce social inequalities across generations. Inefficiencies in private educational investments in the home environment, usually through underinvestment among poor parents, might however further motivate policy interventions targeted at disadvantaged groups, and even push the policy goal beyond equal access and opportunity into more ambitious compensatory policies.

Today, the equalizing potential of the education system in Western economies does not lie in expanding compulsory education or facilitating access to basic education – most countries offer a variety of educational paths for children and adolescents. Instead, unequal opportunities arise due to differences in the home environment and quality differences in formal education and peer networks. A key question is therefore what type of education policy will be most effective when

[1] Other sociological perspectives, the functionalist approach and conflict theory, stress opposite forces for education in affecting social mobility. The functionalist approach emphasizes that education can increase social mobility, while conflict theory argues that education legitimizes and reproduces inequalities (Collins 1994). Which force is dominating may depend on features of the school system, but also on the surrounding society (e.e. the degree of inequality, meritocracy, segregation etc.)

it comes to improving the performance, attainment, and educational choices of children from disadvantaged backgrounds, and whether such policy is enough to affect the strong associations between family background and social and economic status in adulthood.

The evidence on education policy effects has grown in the last 20 years thanks to increased access to administrative data and methodological progress. Within the field of economics of education, causal effects of educational interventions are estimated using randomized controlled trials as well as quasi-natural experiments, and many studies investigate heterogeneous effects by family background, and adopt cost-benefit analyses. There is growing awareness that there is a menu of policies with different implications for efficiency and equity. The literature also convincingly shows that education is strongly associated with – but also causally related to – a range of other life outcomes, such as earnings, political participation, criminal involvement, and health (Holmlund 2020).

This overview summarizes the recent advancements in the field of economics of education, with a particular focus on the role of family background and on the potential for education policy to play a role in providing equal opportunity to children from different socio-economic backgrounds. The article seeks to understand to what extent policies are effective in closing the gap in educational and long-run labour market outcomes between children from disadvantaged and advantaged backgrounds. A large literature documents that early family environment and pre-school interventions play a crucial role for intergenerational transmission (Currie and Almond 2011; Almond, Currie, and Duque 2017; Blanden, Doepke, and Stuhler 2022; Duncan et al. 2022). But the bulk of society's resources for human capital formation are channelled through the formal education system, starting with primary school. This overview therefore concentrates on policies that affect students starting from primary school and throughout the education system. The aim is to present the main themes within this research field and evidence from studies that – in most cases – estimate credible causal effects. Nevertheless, we can only scrape the surface of this large empirical literature within the scope of this review. Our aim is instead to try to highlight representative selections of recent high-quality research across various topics and provide recommendations for further reading when applicable.

The article is structured as follows. Section 2 begins by presenting some stylized facts on the association between socio-economic background and student school performance. Section 3 gives a theoretical background. Section 4 presents evidence on a variety of topics related to educational policy, and Section 5 offers a concluding discussion.

2 Socio-economic background and student school performance

Socioeconomic background is strongly related to school performance, educational attainment, and labour market outcomes. Such intergenerational associations capture the transmission of skills and other advantages from parents to children, both directly, e.g., through genes and parental investments in their children, and indirectly through the peers, schools, neighbourhoods, and other environments that children are exposed to. The various indicators of a child's background are correlated, and it is therefore challenging to identify the relative importance of different background factors (Björklund and Salvanes 2011). The quasi-experimental and experimental literature has however made progress in separating specific background factors from each other. For example, Holmlund, Lindahl, and Plug (2011) show that the intergenerational association in years of schooling between mothers and their children is 0.28 (in Sweden), but the causal effect of raising mother's schooling on the schooling of her child is only about 0.06–0.11. Chetty, Hendren, and Katz (2016) study a randomized controlled trial that offered families the opportunity to move out of high-poverty neighbourhoods in the US and found that children that moved before age 13 were more likely to attend college and had higher earnings as adults. Studies that focus on pre-birth (genetic and environment during gestation) vs. post-birth factors find that both genes and environment matter, and that their contributions are roughly similar in magnitude (Björklund, Lindahl, and Plug 2006). The literature has thus been able to move beyond correlations and identify that parental background, neighbourhood quality and genes all have independent effects on child outcomes.

Understanding the causal effects of childhood environment and policy interventions is at the core of designing effective policies that can enhance equality of opportunity. But it is also necessary to address that disadvantaged children face different types of hurdles at different stages of the education cycle, and when entering the labour market. Many education interventions are evaluated by studying effects on test scores, but do policies that raise test scores of children from low socioeconomic backgrounds also translate into better labour market opportunities in the long run? Even though there are strong correlations between test scores in school and long-run labour market outcomes, it is not necessarily the case that positive causal effects on test scores spill over into better opportunities at later stages. Social and economic boundaries such as networks and credit constraints might limit the chances of disadvantaged children, even when they perform well in school. In essence, this is the sociological critique that questions the equalizing role of education (Bukodi and Goldthorpe 2018).

Figure 1 illustrates this idea through a country-level plot of a measure of inequality in student test scores against a measure of intergenerational education persistence. Inequality in test scores (x-axis) is measured by the ratio between the mean PISA reading score and the score in the lowest

quartile of PISA:s socioeconomic and cultural index (ESCS).[2] The basic idea with this measure is to capture the performance of children of low socioeconomic status (SES) in different school systems, while at the same time adjusting for the fact that average performance varies across countries. Intergenerational education persistence (y-axis) is measured as the slope coefficient (β) from a linear regression of child's years of schooling on parent's years of schooling, with estimates collected by the World Bank.[3] The higher is the estimate of β, the higher is the association between parental and child schooling. Thus, lower values on the y-axis corresponds to higher intergenerational mobility in education.

First, the figure documents the well-known performance gap of disadvantaged children: in all countries, children from the lowest socioeconomic quartile perform well below the mean. The performance gaps range from 5 to 15 percent. Second, there are large differences across countries in terms of the performance of low-SES children, and also large differences in terms of intergenerational persistence.

These country-level differences in test score inequality are likely to in part be explained by economic, demographic, and cultural factors that are unrelated to education policy, but they may also say something about the extent to which countries are able to create equal educational opportunities. However, as the figure shows, there is no statistically significant correlation between countries' capacity to generate relatively high results for disadvantaged students (a low value on the x-axis) and high intergenerational mobility (a low value on the y-axis). With the caveat that these indicators of educational inequality might be measured with error and difficult to compare across countries, the data rejects that countries that generate more equal outcomes in terms of test scores also generate substantially higher intergenerational mobility in years of schooling.[4] This suggests that to understand the role of education for social mobility, it is necessary to also study long-run outcomes beyond test scores, and the obstacles faced by low SES students when moving into higher education and the labour market.

In the next section, some of these ideas are formalized in a theoretical framework that will guide the discussion of policy effects in Section 4.

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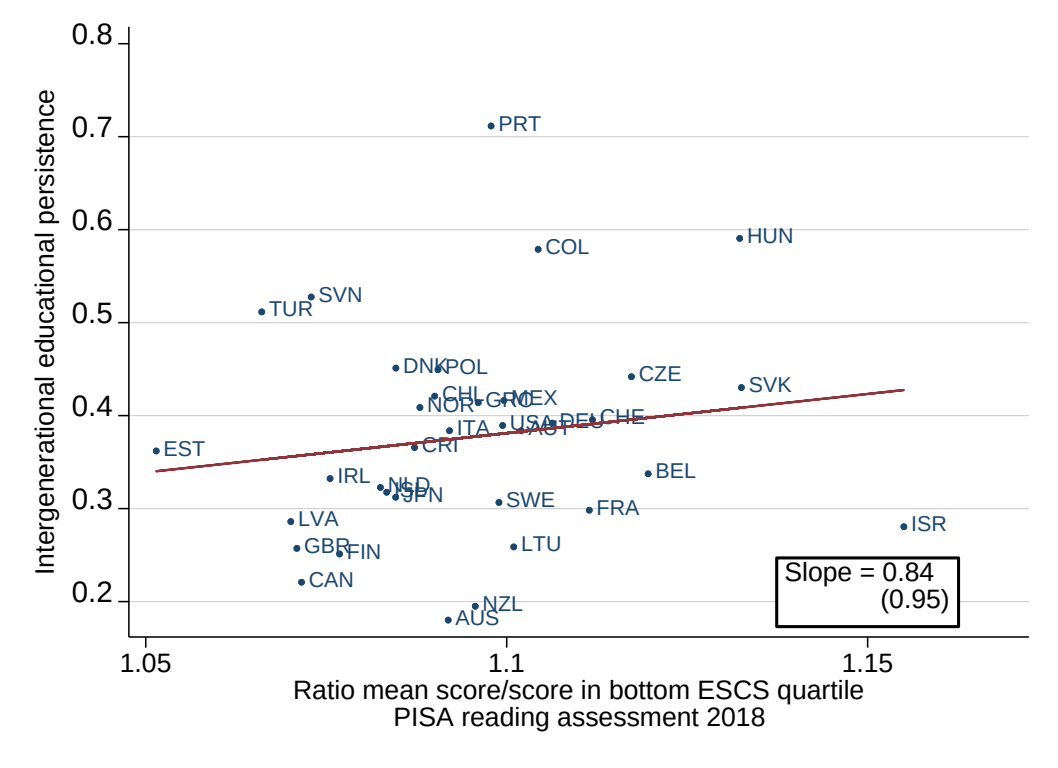
[2] The socioeconomic index (ESCS) used in OECD:s PISA survey (Programme for International Student Assessment) combines information on parents' education and occupation, and students' reports on home possessions that indicate wealth.

[3] Figure 1 presents the β-coefficient (regression of child's years of schooling on parent's years of schooling) for children born in 1970, using the maximum years of schooling of the parents, and including both girls and boys in the offspring generation.

[4] Another caveat is that the regression line in the figure is estimated with considerable uncertainty, with standard errors only allowing us to reject quite strong relationships between schooling persistence and mobility. For example, excluding Israel alone increases the slope coefficient to 1.67 (s.e. 1.07).



Source: OECD, PISA 2018 Database, Table II.B1.2.3 (OECD 2019). World bank (2021). Global Database on Intergenerational Mobility.
Note: Selected OECD countries where both data points are available. The horizontal axis shows the ratio of the mean reading score to the score in the bottom socioeconomic (ESCS) quartile for selected countries in PISA 2018. The vertical axis shows the intergenerational educational persistence, measured by a regression of child's years of schooling on the maximum years of schooling of the parents.

Figure 1 Intergenerational educational persistence and inequality in PISA reading performance.

3 Theoretical background

The theoretical literature on education and social mobility emphasizes family investment channels, the skill production technology, and the role of the local economic and social environment, among other things. This section outlines its most central insights, which structures the discussion of the empirical evidence in the subsequent section.

3.1 Models of family investment and skill formation

The early economics literature on family influence and the determinants of social mobility was pioneered by Becker and Tomes (1979; 1986) and Loury (1981).[5] Using two-period overlapping generations models and a one-parent, one-child family structure, they provide rigorous representations of intergenerational persistence in human capital and income arising from utility-maximizing behaviour of parents. In these models, parents divide income between own

[5] Conlisk (1974) provides a similar type of multigenerational model in a mechanical simultaneous-equations framework.

consumption and educational investments in children according to some altruistic motive, which leads to investment decision rules such as:

$$I = f_1(Y_P),$$

where I is family investment in the skill or human capital of the child, Y_P is parental income, and $f_1(Y_P)$ is non-decreasing in Y_P. The extent to which such investments causally relate to parental resources depends critically on capital-market imperfections, which has been extensively studied in the literature. The most basic credit constraint arises from parents being generally (legally) unable to borrow against children's future income. In multi-period models, parents might also be constrained to borrow against own future income, which can be an important feature in so far as childbirth typically occurs prior to the prime-age earnings years.

Parental investments in children interact with latent (or initial) skill (S_0) to produce adult human capital (S):

$$S = f_2(S_0, I),$$

where S_0 is commonly related to parental skill via genes and early-environmental factors according to a first-order process.[6] The child earns an income as an adult, determined by the return to human capital. The extent of intergenerational persistence in income or human capital/skills is a composite of $f_1(\cdot)$ and $f_2(\cdot)$, as well as the returns to human capital and the heritability of initial endowments.

A couple of basic but important insights arise from these models, given some form of binding credit constraints. First, because parents at lower income levels are more likely to be constrained, one might expect lower intergenerational mobility in the lower part of the income distribution. Thus, some of the empirical research tests for non-linearities in intergenerational transmission, though the support for such non-linearities remains mixed (see surveys by Jäntti and Jenkins 2015; Deutscher and Mazumder 2022). Second, publicly funded education can improve mobility to the extent that it improves access for children from otherwise constrained families (Solon 2004). If public education instead primarily crowds out private investment, its effects on mobility will be smaller. Because publicly funded education nowadays is commonplace at lower and intermediate levels of education, the empirical literature on the role of credit constraints has primarily focused on higher education. While countries with more public funding of education tend to have higher social mobility (e.g. Hanushek and Woessmann 2011), drawing conclusions from international comparisons is problematic given the myriad ways in which countries differ. The evidence on

[6] To keep things concise, a uniform (scalar) concept of skill is assumed throughout the discussion. However, much recent literature recognizes the multi-dimensionality of skill (e.g. cognitive and non-cognitive or personality skills), including the relative importance of different skills for subsequent skill production and long-term outcomes (Heckman and Mosso 2014).

credit constraints is further discussed in Section 4.4; evidence on school funding is reviewed in Section 4.1.

The function $f_2(\cdot)$ is conventionally assumed to be concave in *I*, i.e., parental investments increase child skills but at a diminishing rate. If investments in children have diminishing returns, the skill production of children from low-income families will respond more strongly to changes in investments. The idea of diminishing returns is consistent with recent trends in parental inputs and child achievement, where socioeconomic gaps in parental inputs have grown substantially (Corak 2013) but gaps in school achievement appear more stable (Hanushek et al. 2020). The functional form of $f_2(\cdot)$ is ultimately an empirical question, but diminishing returns is a common explanation to why many interventions within the school domain (e.g., increased funding, improvements in teacher quality, lower class size) have effects that vary heterogeneously depending on parental background. Under diminishing returns, and with low-income families in general investing less in their children, marginal changes in educational inputs should have relatively larger effects (positive or negative) on low-income children. Such heterogeneous effects are the focus of Section 4.

Recent research details the *technology* of skill production, how it interacts with parental, environmental and policy factors, and how skills evolve during childhood. In the tradition of Cunha (2007) and Cunha and Heckman (2007), the skill formation when the child is in grade t can be written:

$$S_t = g_t(S_{t-1}, I_{t-1}, E_{t-1}), \qquad t = 1, \ldots, T. \quad (1)$$

where at $T + 1$ the child enters the adult years, which are ignored here.[7] Child skills depend on own skills in the previous period, as well as parental inputs (I_{t-1}) and non-parental inputs (E_{t-1}) such as public schooling. The function $g_t(\cdot)$ is increasing in each argument and concave in I_{t-1}, and the initial endowments of the child prior to school, e.g., $S_0 = g_0(S_P)$, increases in the skills of the parent.

Equation (1) can illustrate two important ideas from the recent literature: *self-productivity* and *dynamic complementarity* of skill acquisition. Self-productivity arises when skills in one period facilitate the acquisition of additional skills in the next period. Accordingly, skill gaps that arise at an early stage might be difficult to compensate for at later stages. Dynamic complementarity arises when acquired skills make subsequent parental (I_t) and non-parental (E_t) investments more productive.

The joint effect of *self-productivity* and *dynamic complementarity* are often pointed to as an argument for early investments in general, and in disadvantaged children in particular.

[7] The time period under consideration depends on the mechanisms of interest. For example, *t* can in principle be the age of the child and stretch already from birth, and, similarly, *t* can be extended well into adulthood.

Importantly, it can justify policies that redistribute resources toward disadvantaged children in the early years on the grounds of *efficiency* without any appeal to fairness or social justice, although those too might be invoked to strengthen the argument for early-age policies (Heckman and Mosso 2014). However, the technology does not imply that later investments are inefficient, rather the opposite. Given dynamic complementarity, it is essential to invest early to facilitate further skill production, but it is also important to invest later to reap the benefits of the early investment. The extent to which investments at different stages of childhood are complements, and whether early investments are indeed more effective, is a broad empirical question which is further touched upon in Section 4. However, beyond evidence that skills tend to be more malleable early in life (Heckman and Mosso 2014), there exists some explicit support for the ideas of self-productivity and dynamic complementarity (Cunha, Heckman, and Schennach 2010; Lee and Seshadri 2019; Caucutt and Lochner 2020).

3.2 Parents, schools, and the wider society

The recent literature emphasizes several adaptations of the skill production process. One strand of research puts further focus on the role of parents. The skill technology in equation (1) can be extended as:

$$S_t = g_t(S_{t-1}, I_{t-1}, E_{t-1}, S_P), \qquad t = 1, \ldots, T. \quad (2)$$

where parental skills potentially interact with parental and non-parental investments to produce child skills. An example is Becker et al. (2018), who assume complementarity between parental skills and investments, so that the marginal returns of investments by better-educated parents exceed those of less-educated parents. The strength of such complementarity may also vary over childhood. For example, the quality of and/or returns to skill investments may depend more on family background in early childhood, when parents tend to be more directly involved in their children's education and learning process.

Such a feature of the skill technology can explain why better-educated parents invest more in their children, both financially (Corak 2013) and in terms of time spent reading or helping with homework (Doepke and Zilibotti 2019). If skill formation is governed by such technology, the linkages between inequalities in incomes and skills in the parental and child generations are further cemented; the compensating role of public schools or other investments will lead an uphill battle and social mobility will be low.

The literature also recognises the relationship between skill production, the local community, and the wider society. For example, one strand of research emphasises segregation and social interactions in various forms, and their consequences for inequality and social mobility (see Durlauf, Kourtellos, and Tan 2021). The underlying idea is that geographical segregation of rich and poor families produces different social interactions among children, which ultimately worsens

social mobility. For illustration, the skill production in eq. (1) can be extended with a term N_{t-1}, which captures various local or neighbourhood influences, such as direct influences from peers or their parents, or local public policies. As such, N_{t-1} will presumably correlate positively with parental skills or resources.

The social models of intergenerational transmission primarily emphasise geographical segregation by parental income, and two different mechanisms by which segregation affects social mobility. First, given local provision and funding of public education (e.g., via local property taxes in the US), an increase in segregation by income across areas leads to larger disparities in per-pupil spending between children from low- and high-income families. While compelling evidence suggests positive impacts of education expenditures on long-term outcomes (e.g. Jackson and Mackevicius 2021), it is harder to empirically document the aggregate effects of segregation on social mobility. Evidence that house prices react positively to local school quality suggests that parents indeed use residential sorting to improve the child environment, and that the housing market can act as a price mechanism of school quality in public education systems (Black and Machin 2011; Gibbons, Machin, and Silva 2013).

Second, the local community or school exerts a host of additional influences under the umbrella of social interactions, such as peer effects, social learning, role models and norms, and social networks and information. Some of these mechanisms might have direct effects on skill formation in school (e.g., classroom peer effects), according to the baseline skill technology. But research also highlights that some community mechanisms, while irrelevant for contemporaneous skill production, still can have effects on long-run outcomes. For example, the neighbourhood and school might influence aspirations and norms about what constitutes long-term success, it might transmit information about or increase access to jobs and universities through social connections, and so on (Durlauf, Kourtellos, and Tan 2021).

Most of the literature focuses on segregation by income and its interaction with overall inequalities in generating disparities between children. But segregation in other dimensions might also generate disparities, most notably segregation along racial or ethnic lines (Card, Mas, and Rothstein 2008). Such segregation might elevate inequality through social mechanisms (peer effects, information, networks) but also indirectly through economic mechanisms like school funding. For example, a demand for racial segregation can increase costs of living in majority-group neighbourhoods, spurring economic segregation and thus racial disparities in locally funded public goods (e.g., schools). Similarly, if race and income are correlated, a desire to racially segregate can spur economic segregation even if people do not care about economic segregation per se (Boustan 2010). However, the evidence on the consequences of racial segregation for child

school outcomes is mixed. For example, Böhlmark and Willén (2020) find no *causal* effects of neighbourhood immigrant share on child outcomes in Sweden.

There is ample evidence that the time spent by children in higher-quality neighbourhoods improves educational and other outcomes for both the average child (Wodtke, Harding, and Elwert 2011; Chetty and Hendren 2018) and children from disadvantaged backgrounds specifically (Chetty, Hendren, and Katz 2016). There is also compelling though less numerous evidence suggesting that family and social influences work as complements rather than as substitutes: most notably because children from poor families are especially harmed when growing up in poor communities (Wodtke, Elwert, and Harding 2016; Fogli and Guerrieri 2019). However, more evidence is certainly needed on whether and how segregation, neighbourhoods, and social interactions more generally reinforce existing inequalities between families.

The key point in this literature is that family background can map to long-run child outcomes because of the effects of parents' income and education on their choice of neighbourhood and school. Thus, segregation and economic inequality can raise the importance of family background for child school and long-run outcomes, independent of the direct importance of parental investments and inputs.

3.3 Lessons for interpreting empirical evidence

There are a number of complicating factors that are important to keep in mind when studying the empirical literature. This subsection briefly addresses two such factors: skill measurement and general equilibrium effects or other endogenous responses within the process of skill formation.

When interpreting the empirical evidence, it is important to note that the skills produced by equations (1) or (2) only map imperfectly to observable outcomes:

$$Y_{t,k} = h_{t,k}(S_t). \quad (3)$$

Here $Y_{t,k}$ is an outcome k such as a test score, school grades, or long-term outcomes such as educational attainment or earnings, measured in t. While most outcomes considered in the empirical literature undoubtedly reflect underlying skills, i.e., $h_{t,k}(\cdot)$ increases in S_t, the potential variation in the skills-outcome relationship both by outcome and period poses challenges. For example, consider a comparison of the effects of increased public-school funding in first grade vs in high school, and that the effects are evaluated contemporaneously in terms of first-grade diagnostic tests and high-school GPA. If one finds larger effects of high-school funding, this might be due to three different reasons: (1) outcomes better reflect skills at later ages, (2) measured GPA better reflects skills (than diagnostic tests), or (3) increased spending has larger effects on underlying skill formation in high school than in first grade.

The example illustrates that it can be important to consider multiple outcomes, preferably measured at different stages of life. The gold-standard is often to focus on long-term outcomes, such as final educational attainment, employment, or prime-age earnings, both because they are final outcomes of the skill production throughout early life and because they are outcomes that we care about directly. In many cases, however, a more contemporaneous evaluation is the only option, either when long-term outcomes are unavailable or if the evaluated policy happened recently.

Many theoretical papers also consider how changes in the economic environment can feed back into parental choices and influence social mobility. Most obvious are general equilibrium effects of various kinds: for example, changes in the skill distribution affect the returns to skill, which in turn alters the incentives of parents to invest in their kids. An increase in economic inequality can widen the socio-economic gap in parental investments through multiple channels. First, magnified income differences among parents enable rich parents to consume more, which in turn requires a raise in the optimal investment in children (as marginal utilities from consumption and investment equate). Second, while increasing inequality incentivises larger investments in children for all parents, low-income families might face binding credit constraints. Moreover, economic inequality can spur residential segregation, which can magnify inequalities in educational expenditures and school quality as well as other social influences, as outlined above.

If self-productivity and dynamic complementarities are important, then there might also be complex *dynamic* feedbacks within the process of skill formation (e.g. Heckman and Mosso 2014). Policies that improve access to higher education (e.g., lower college costs) might affect the incentives to invest in skills earlier in the education system. Conversely, policies that improve early skill development can affect the demand for higher education, and the efficiency of later policies. In the extreme case, if the school system is very unequal at early stages, such that low-income children all develop poor skills, then their demand for college will be low, financial constraints non-binding, and the motive for any form of public interventions in higher education weak.

A quite different type of feedback mechanism is how different parents respond to various shocks. For example, a negative shock in public inputs (E_{t-1}) in equation (3) might be more efficiently compensated for by better educated and high-income parents. Maybe school quality drops due to unexpected spending cuts or teacher turnover, whereby parents with more resources compensate for such negative shocks by increased time spent with their children doing homework or by buying private tutoring services. For example, Fredriksson, Öckert, and Oosterbeek (2016) find that high-income parents help their children more with homework in response to an

exogenous increase in class size in Sweden, and that learning disparities by parental income grow as a consequence. In that sense, public and private investments in children would be *substitutes* rather than complements.

Broader general equilibrium effects and endogenous parental responses pose challenges when interpreting empirical evidence, both on the underlying drivers of educational inequality and on the effects of various school interventions and reforms. For example, quasi-experimental studies rarely capture spillover effects elsewhere in the system, or dynamic responses over time. Similarly, parental responses might mask the distributional effects of interventions that go in a compensatory direction if high-resource parents respond strongly. While the empirical literature is rich and provides lots of answers to important questions (see next Section), it is crucial to keep in mind both issues related to the measurement of skills and the potential for complex endogenous responses to policies.

4 Education policies and equal opportunities

The theoretical framework above has illustrated the different types of inputs that affect skill production, their interactions, and various feed-back mechanisms that affect the general equilibrium outcome of skill production. Taking the model(s) at face value, enhancing social mobility through education policy entails relaxing credit constraints, providing early educational investments in disadvantaged children, and following up early investments with later ones to harvest the gains of self-productivity and dynamic complementarities in skill production. Taking the theoretical predictions to the data, the empirical literature within economics of education effectively identifies a set of possible policies, inputs, or "investment types" and estimates the returns to such inputs. In a nutshell, the literature estimates causal effects of different types of education policies on proxies for "skills", often using heterogeneity analyses to address the compensatory nature of different types of policies. As described in the theoretical discussion above, larger effects among children from disadvantaged backgrounds are expected if there are decreasing returns to investments in skills. Most effect studies focus on one intervention in isolation, but there are also examples of studies that directly address dynamics and feed-back mechanisms, for example by studying parental responses to public investment shocks, or interactions between early and late interventions. However, the literature has little to say on general equilibrium effects.

This section takes its starting point in this literature and presents evidence on education policies and their potential effects on social mobility through heterogeneous effects. Evidence on effects of education policy is presented thematically, with an aim to cover the most relevant policy areas and with a focus on studies that are representative of the field. The thematic split is in most

cases uncomplicated, but there are examples where policies may fall into more than one category. In chronological order, the subsections deal with the following themes: various aspects of school resources, teacher quality, tracking, and credit constraints.

The overview does not consider system and governance issues, such as school choice, school competition and schools' autonomy. These are all active research areas within the field, but do not necessarily explain why a certain governance type is successful. If a system generates effects on student outcomes, the effects likely arise via a mediating factor that directly impacts the students. The overview of education policies below therefore focuses on policies that directly target students (and that may be part of the mediating factors that make certain systems more successful than others). The conclusion in Section 5 further discusses the limited evidence on pedagogical approaches.

Throughout the overview, results are discussed with a particular attention to i) heterogeneous effects by student background, ii) the type of outcome measured (short-term test scores or long-run labour market outcomes), and iii) cost effectiveness. It should be noted that most studies undertake heterogeneity analyses, some – but far from all – do a cost-benefit analysis, and relatively few studies are able to establish long-term effects on earnings or other labour market outcomes.

4.1 School resources

Understanding the role of school resources for student achievement is a key question within economics of education. Given that increasing school spending is a costly policy, it is particularly important to scrutinise its overall effects, and what types of spending are most effective. The benefits of additional school resources have been questioned (Hanushek 2003), but studies that account for the non-random allocation of resources to schools have shown that resources can make a difference. In the US, school funding used to be strongly linked to local property taxes, which gave rise to inequalities in resources across richer and poorer neighbourhoods. School finance reforms undertaken since the 1970s and 1980s have however led to a more even allocation of school resources across school districts (Jackson 2020). It is also common that school systems allocate some resources based on the socio-economic composition of the schools' students, with the aim to steer more resources to disadvantaged students (OECD 2017). The raw correlations between school resources and student achievement are therefore context-specific and unlikely to be informative about the effects of additional resources. The effects of school resources have therefore been evaluated using experimental or quasi-experimental methods.

4.1.1 Class size reductions

Teachers are the most important school input and many papers in the resource literature study the effects of changes in class size. In a pioneering study, Krueger (1999) estimated the effects of reducing class size in kindergarten through grade 3, exploiting the Tennessee STAR experiment which randomly assigned students and teachers to small or large classes. Reducing class size from 22–25 to 13–17 students increased student achievement in grade 3 by 22 percent of a standard deviation. The effects were larger for minority and low-SES students. Importantly, the positive effects also persist in the long run: Krueger and Whitmore (2001) and Chetty et al. (2011) find that attending a smaller class in the early grades leads to a higher probability of attending college.

Several papers study the effects of class size exploiting discontinuities in class size that occur due to maximum class-size rules. A class-size rule is applied in a school or a school district and stipulates that when student enrolment reaches a break point, a new class must open. For example, if the maximum class size is 30, a school offers one class if enrolment is 30, but must offer two classes when enrolment reaches 31, which thus lowers the class size from 30 to 15–16 students. If variation in enrolment numbers around the break points are as good as random, the effects of class size can be estimated by comparing student outcomes at schools with enrolment just below (large class) and just above (small class) the threshold.

Angrist and Lavy (1999) pioneered this empirical strategy in a study on Israeli primary schools. They found that lowering class sizes had positive effects on student test scores. Fredriksson, Öckert, and Oosterbeek (2013) use a similar design and find positive effects of smaller classes on cognitive test scores among Swedish primary school children, and the effects persist in the long run and show up also on adult labour market outcomes. Fredriksson, Öckert, and Oosterbeek (2016) show that negative effects of larger classes are concentrated among children from low-income backgrounds. They also study parental responses and demonstrate that high-income parents help their children when the class size increases, while there is no such response among low-income parents. This is an important result that demonstrates that children from higher socioeconomic backgrounds may be sheltered from reductions in school quality due to increases in parental involvement.

Connolly and Haeck (2022) study class-size reductions in kindergarten and find positive effects on cognitive and on non-cognitive development for children from disadvantaged neighbourhoods. They also find evidence of non-linearities in the class-size effects; the marginal effect of class-size reductions is decreasing in class size.

However, some studies that exploit class-size rules fail to detect positive effects (Leuven, Oosterbeek, and Rønning 2008; Leuven and Løkken 2018; Angrist et al. 2019). Despite attempts to understand why some studies find positive effects and some not, there is no clear explanation

as to why the results are diverging. The class-size literature to date is therefore not fully conclusive. What is clear is that class-size reductions in some contexts *can* have long-term impacts on college enrolment and earnings, that they have heterogeneous impacts, and that they can be cost-effective (Fredriksson, Öckert, and Oosterbeek 2013). Even so, non-linear effects imply that it is necessary to consider the effectiveness of marginal reductions across many schools compared to large reductions in fewer (disadvantaged) schools.[8]

4.1.2 General school spending

Can more general school resource policies affect student outcomes? School funding mechanisms are often used as a policy tool to improve education quality and to steer resources to disadvantaged students. But the effects of increasing general school spending will depend on the extent to which the school bureaucracy is able to transform resources into education quality by prioritizing the right type of expenditures. Research on the effects of general school spending typically uses reforms or rules within the funding mechanisms that give rise to plausibly exogenous variation in school resources.

The court-ordered school finance reforms (SFR:s) in the US led to new funding models that directed more resources to poor school districts. By exploiting the predicted change in school resources given by school district pre-reform characteristics, it is possible to estimate causal effects of increased resources. The findings from this literature show that increasing school resources in previously low-spending districts has positive effects on long-run education and labour market outcomes, and the positive effects are often larger for disadvantaged students (Jackson, Johnson, and Persico 2016; Jackson 2020). Importantly, the effects are not only present in the studies that focus on the 1970s reforms when spending levels were low, but also for more recent SFR:s that evaluate spending increases at higher levels (Lafortune, Rothstein, and Schanzenbach 2018; Jackson 2020; Rothstein and Schanzenbach 2022). Just as in the class-size literature, the studies of SFR:s have been able to show that higher school resources lead to higher earnings in adulthood and that the effects are larger for students from a disadvantaged background. Lafortune, Rothstein, and Schanzenbach (2018) also show that higher spending is cost-effective. Johnson and Jackson (2019) address interactions between investments in different time periods and find evidence of dynamic complementarities, since the impact of additional

[8] An alternative to lowering class size is to use teacher aides in the classroom. This is an interesting policy with the potential to free up preparation and instruction time for the teacher as well as improving classroom discipline, at a lower cost compared to hiring additional teachers. Krueger (1999) studied random assignment of students to classes with a teacher aide and did not find much evidence to suggest that aides improved test scores. Andersen et al. (2020) study the effectiveness of teacher aides within a randomized controlled trial in Danish schools. Schools were randomized into two types of teacher aide treatments (qualified co-teachers or less qualified aide) and one control group. Both types of treatment are shown to be effective: 10–15 hours of teacher aide per week raise student test scores by 0.09–0.13 of a standard deviation, and the effects are larger for children with low educated parents.

school spending is found to be higher when disadvantaged students had been exposed to Head Start, an early childhood health and education program with widely documented positive achievement effects.[9] They conclude that early investments that are followed up by later ones can help disadvantaged students escape the poverty trap.

Evidence from non-US contexts confirm that spending has positive effects. Gibbons, McNally, and Viarengo (2018) study school funding in the U.K. using a border discontinuity design, exploiting the fact that neighbouring (and comparable) schools that are located in different school districts are under different funding formulae. They find that school resources have a positive effect on test scores at age 11, and that the effects are larger in schools with more disadvantaged students. Machin, McNally, and Meghir (2010) study a policy directing additional resources at disadvantaged urban secondary schools in the U.K. The results point to positive effects on student attendance and mathematics performance. Moreover, the effects are larger in more disadvantaged schools, but at the individual level it is medium- and high-performing students within these schools that gain the most.

Although there is ample evidence that school resources can produce positive results, there also exist studies with credible identification strategies that find no effects of additional spending. For example, Leuven et al. (2007) find that additional resources to disadvantaged schools in the Netherlands did not improve student outcomes. Nevertheless, the vast majority of papers with credible research designs show positive effects, and among those there is evidence for effect heterogeneity, impacts on long-run outcomes (college attendance and labour-market outcomes), and cost-effectiveness.

4.1.3 Tutoring

Tutoring is a remedial policy that has received a lot of attention because of its large effects on test scores. Tutoring is defined as one-to-one or small-group instruction, which can be integrated into the regular school day, or be organized as after-school programmes. Tutors can be professional teachers, but also para-professionals or volunteers. One-to-one instruction can have positive effects on student outcomes through a variety of mechanisms: after-school tutoring effectively extends the school day and increases the total amount of instruction; individual or small-group teaching facilitates customising teaching to the student's level; and tutoring might lead to better study focus and more time spent on the right task. Tutoring can also have positive spillover effects if disturbing students are taught in a separate classroom or behave better as a consequence of the policy (see e.g. Holmlund and Silva 2014 for evidence on spillover effects).

[9] See e.g., Garces, Thomas, and Currie (2002) for a study on the long-term effects of Head Start.

The evaluation literature focuses on tutoring programmes that are targeted at low-achieving students, and the effects are therefore generalisable to that specific group. Remedial programmes are however unlikely to be offered to high-achieving and high-SES students, and the policy is inherently compensatory in its nature. There is extensive evidence on tutoring effects based on RCT:s, and a couple of meta-studies that summarise the literature. Dietrichson et al. (2017) and Nickow, Oreopoulos, and Quan (2020) find strikingly similar results: the combined effect size in their meta-studies is 36–37 percent of a standard deviation. In comparison to many other educational interventions, this is a large effect.[10]

Although tutoring is costly, the large effect sizes imply that tutoring comes out favourably in most cost-benefit analyses (Kraft and Falken 2021). But less is known about the long-run effects on labour market outcomes such as earnings. Guryan et al. (2021) study effects on test scores and high school graduation beyond the treatment year and find positive effects on test scores, and imprecise effects on high school graduation. Compared to other interventions, there is thus less direct evidence on long-term impacts.

4.2 Teacher quality

Within the literature, teacher quality is understood as a measure of teacher effectiveness, i.e., the extent to which teachers are able to raise students' skills. Teacher effectiveness is explored using teacher value-added models (VAM), which effectively retrieve systematic variation in test score gains across classrooms that can be attributed to a specific teacher. The VAM methodology builds on data with repeated test scores, which allow the researcher to control for previous test scores before a teacher is assigned to a class. It is also necessary that teachers teach several classrooms to net out classroom-specific effects. The models also assume that teachers are randomly assigned to classrooms, conditional on covariates.[11]

A teacher's value-added (VA) is often measured by regressing student test scores on prior test scores, other covariates, and teacher-fixed effects. Each teacher's individual coefficient is a measure of his/her relative effectiveness in terms of test score gains, measured in standard deviations in student test scores. Thus, teacher effects constitute a relative measure, where teachers are ranked relative to each other in terms of how much they raise student performance. One of the key contributions of the literature has been to establish the variance of the teacher-effect distribution: a compressed distribution suggests that differences in teacher quality are small

[10] Dietrichson et al. (2017) conduct a meta-study of school policy interventions targeted at low SES children and find that tutoring programmes yield the highest effect size of all intervention types in their study.
[11] VAM models are non-experimental in nature and a large literature explores the robustness of VAM models (see e.g. Jackson, Rockoff, and Staiger 2014 and Koedel, Mihaly, and Rockoff 2015 for overviews). By and large, when non-experimental VAM estimates are used to predict test scores of students who are randomly assigned to teachers in a different year, they seem to perform well. However, there is a lively academic debate on the robustness of VAM models, see e.g. Rothstein (2017).

(or that teachers do not matter for test scores), while a wide distribution is suggestive of larger differences in teacher quality.

Hanushek and Rivkin (2010) conclude that there is substantial variation in teacher quality measured with value-added models. One standard deviation in teacher value-added typically correspond to 0.1–0.2 standard deviations in student achievement (Jackson, Rockoff, and Staiger 2014). There is thus consensus that individual teachers matter for student outcomes, but less is known about which types of teacher characteristics that correlate with teacher value-added. Formal qualifications do not seem to play a role in teacher effectiveness, but experience (at least early in the career) is known to be a predictor of high teacher quality (Hanushek and Rivkin 2010; Leigh 2010).

The VAM literature has generated several key insights. To begin with, being assigned a high value-added teacher has positive effects on long-run outcomes such as college attendance and earnings (Chetty, Friedman, and Rockoff 2014). However, unlike financial resources and smaller classes, teacher quality does not necessarily generate higher gains for disadvantaged students. The effects of teacher quality on short-run test scores are homogenous across students from different socioeconomic backgrounds, while the benefits on long-run outcomes (e.g. college quality) are larger for students from well-off families (Chetty, Friedman, and Rockoff 2014). This result suggests that test score gains and family inputs among high-SES students are complements and help boost their long-run outcomes.

Second, the bulk of the VAM literature has identified teacher quality using teachers' impact on immediate test scores, at the end of the teaching year. A recent working paper by Gilraine and Pope (2021) stresses the difference between a teacher's capacity to raise short-run test scores and improving long-lasting skills (both cognitive and non-cognitive). Long-lasting deeper knowledge and non-cognitive skills are potentially more important for future learning and for educational choices at later stages. Gilraine and Pope (2021) compare traditional short-run teacher VA to long-run VA (based on test scores one year later, i.e., associating performance in year $t + 1$ with the teacher that taught in year t), and to a measure of non-cognitive VA developed using indicators of absences, effort, suspensions, and grade retention. They find that being assigned to a high long-run VA teacher has much larger effects on future outcomes such as high school graduation and SAT performance, compared to short-run VA. They also demonstrate that long-run VA, compared to short-run VA, is more strongly related to non-cognitive VA.

The evidence in Gilraine and Pope (2021) as well as in Jackson (2018) and Liu and Loeb (2019) suggests that teachers' ability to improve non-cognitive skills has larger long-term impacts than traditional VA measures. Their studies include long-term outcomes that capture the lower tail of the performance distribution, such as high school graduation and drop-out, and Liu and

Loeb (2019) show that the effects are larger for low-achieving students. Non-cognitive skills have been shown to be particularly important in the lower tail of the distribution also in other settings: Lindqvist and Vestman (2011) show that men with poor labour market outcomes lack non-cognitive rather than cognitive skills.

There are important insights from the value-added literature when it comes to compensatory education policy. Since teacher quality matters, systematic sorting of high-performing teachers to schools with high-SES students (or low share of minority students) exacerbates inequalities in the school system. Such sorting is not only correlational, but arises as a direct consequence of the student composition in schools: Jackson (2009) shows that the end of busing in a US school district lead to a rise in segregation, and to a decrease in the share of high-quality teachers in schools that experienced an increased concentration of black students.

If there are complementarities between teacher quality and home resources, as suggested by Chetty, Friedman, and Rockoff (2014), systematic sorting of high-quality teachers to high-SES students might be efficient, but will undoubtedly raise inequality. If instead, as suggested by Liu and Loeb (2019), non-cognitive VA has larger impacts on low-achieving students, there is no trade-off between efficiency and equity and directing high non-cognitive VA teachers to disadvantaged students could be a successful policy.

In the US, there is a lot of focus on the use of VAM in teacher personnel policies, with the aim to create incentives for high VA teachers to remain on the job. In other school systems where testing is less frequent, such policies are not possible and they remain highly controversial.[12] Nevertheless, if it were possible to better identify what characterises a good teacher (and which type of teacher is best for different types of students), it would benefit all school systems and allow active recruitment policies to maximise output and equality.

One policy question that is often highlighted in the education debate is whether economic compensation can attract high-quality teachers to disadvantaged schools (OECD 2018). Elacqua et al. (2022) summarise the existing literature and point to evidence that economic incentives can have positive effects on hiring and retention of high-quality teachers. However, scaling up such policies is likely to be costly and must be related to their returns, which appear to be high.[13] But monetary incentives affecting the whole teacher labour market are also likely to have general equilibrium effects that cannot always be factored in.

[12] Such policies have been criticized on the grounds that they lead to "teaching to the test" and that it is unethical to base hiring and firing decisions on value-added which is measured with some degree of error.
[13] Chetty, Friedman, and Rockoff (2014) show high returns to teacher value-added.

4.3 Peer effects and tracking

An important area of research is to what extent the assignment of students with different abilities across schools, and to classes within schools, can improve efficiency and equity in the education system. If it is possible to identify the optimal allocation of students, it is a promising intervention, since re-allocating students comes at a low cost compared to other input-based policies.[14]

Classroom composition can affect outcomes through peer effects, i.e. the externalities by which peers' backgrounds, current behaviour, or outcomes affect an outcome of another student (Sacerdote 2011). The mix of student characteristics, such as ability or motivation, can also affect outcomes through the efficiency of teaching.

Ability tracking, i.e., the idea that students of different ability are taught separately, exists in different forms. In the US and Canada, ability tracking takes place mostly within schools (students follow the same curriculum but are grouped by ability), while in Europe tracking traditionally takes place by dividing students into vocational and academically oriented secondary schools, thus following different curricula (Betts 2011). These are two distinct types of policies with potentially different implications for inequality. The end result of tracking depends on the extent to which i) teaching is more efficient in homogenous groups, ii) the curriculum and/or expectations are adapted to the group and iii) peer effects or other social-interaction effects exist (see Section 3.2). The efficiency of tracking will also depend on the quality of the ability measure that is used to group students. All in all, there is no clear prediction of the consequences of tracking on student achievement and later outcomes (both in terms of levels and distribution). There is however a concern that tracking might be harmful for low-performing (often disadvantaged) students: they might lose out on the positive spillovers from interactions with high-performing peers, sorting into tracks might be influenced by socioeconomic background, and lower tracks might be taught by less qualified teachers.

The effects of peers' backgrounds, behaviours and current outcomes cannot be empirically separated, and the many studies that aim to estimate peer effects capture the combination of all correlated peer-related mechanisms. Sacerdote (2011; 2014) summarises the literature that relies on exogenous variation in peers and concludes that although peer effects exist, they are often context-specific and there is no clear consensus regarding the size and the nature of peer effects. Angrist (2014) furthermore discusses the empirical challenges of estimating peer effects and concludes that the most reliable evidence on peer effects comes from studies that manipulate peer composition such that peer characteristics are independent of individual characteristics.

[14] While the direct monetary costs of such a policy might be small (e.g. busing costs), there can be substantial political costs associated with pushing a system towards such allocation of students. Implementing interventions aiming to increase the school- or classroom-mix of students by SES or ability is thus not without its challenges.

When it comes to tracking, the European experience indicates that early tracking into vocational and academic paths increases inequality in educational and labour market outcomes, and is to the disadvantage of children from lower socioeconomic backgrounds (see Betts 2011 for an overview of the literature). The most credible evidence is based on comprehensive school reforms that allows a quasi-experimental research design. For example, Pekkarinen, Uusitalo, and Kerr (2009) show that the comprehensive school reform in Finland had large positive effects on intergenerational mobility.

The effects of within-school tracking are less well understood, in part because the research has been based on non-experimental research designs (Betts and Shkolnik 2000; Betts 2011). There are however a few studies that use experimental methods in order to manipulate the ability composition in the classroom, and study how different ability types perform under different configurations of peers. These papers speak to both the issue of peer effects and effects of tracking – and are able to estimate the net effect of both. Duflo, Dupas, and Kremer (2011) use a randomized controlled trial in Kenya to study how ability-mixed vs. tracked classes perform. They find that even though low-performing students benefit from high-ability peers, they – as do students of all abilities – perform better in tracked classes, which is explained by the efficiency of teaching homogenous groups. When teachers are faced with a homogenous group, they can target their level of instruction such that a larger proportion of students can benefit from it.

Carrell, Sacerdote, and West (2013) use a population of students in the US Air Forces Academy and design 'optimal' peer groups that maximise low-performing students' exposure to high-ability peers. The results of combining high and low-performing students were however negative: it led to segregation between ability groups within the class, where low performers could not benefit from interactions with their high-performing peers. Finally, Booij, Leuven, and Oosterbeek (2017) randomly allocate undergraduate students at the University of Amsterdam to tutorial groups, using an assignment procedure that created large and exogenous variation in both the mean and standard deviation of pre-determined GPA across tutorial groups. The findings show that student performance increases in mean peer GPA but decreases in the standard deviation of peer GPA. The results predict that low and middle-ability students benefit from tracking: moving from mixed to tracked groups increases their achievement by 19 percent of a standard deviation, which is a large effect. Survey evidence indicates that one possible explanation is that low-GPA students experience more positive interactions and are more involved in their studies in tracked groups compared to mixed groups.

The studies on within-school tracking highlighted above represent very specific contexts and are therefore difficult to generalize to all types of education settings. The conclusions however

point in the same direction: within-school tracking is not necessarily detrimental for the weakest students and may in fact generate positive effects holding other inputs constant.

The lessons from the tracking literature show that two-tier systems with different curricula are likely to increase educational inequality and that comprehensive school systems can create better opportunities and long-run labour market outcomes for children from disadvantaged backgrounds. There are still many countries that adopt early selection into academic and vocational tiers and there is thus room for policy changes that might benefit students from low socioeconomic backgrounds. When it comes to within-school tracking, more evidence is needed but the most recent findings indicate that the concerns that it is harmful for the weakest students is unfounded and that it can even have positive effects. However, the experimental studies on within-school tracking have not been able to study long-run outcomes. But under the assumption that the positive effects translate into long-run economically or socially meaningful outcomes and given its low costs, it is not unlikely to generate positive rates of return.

4.4 Credit constraints, higher education, and networks

The well-established relationship between parental income and child educational achievement and attainment has traditionally been interpreted as evidence of market restrictions including credit constraints. While this is a conceptually attractive explanation, parental income correlates with many aspects of the childhood environment—parental education, skills, altruism, as well as neighbourhood and school factors (see Section 3). The empirical literature on credit constraints often builds on tests of model predictions and estimation of structural models, presumably because actual family-level credit constraints are difficult to observe in data and instead need to be inferred using a structural framework. A small number of quasi-experimental studies exist, often exploiting variation in tuition systems or access to financial aid. The literature is generally dominated by studies from the US setting, and typically studies the role of financial constraints pertaining to higher education.

The early wave of evidence is often sceptical towards the idea that financial constraints play an important role for access to higher education and social mobility (see surveys by Lochner and Monge-Naranjo 2012 and Heckman and Mosso 2014). An important observation was that college enrolment gaps by parental income largely disappear once conditioning on pre-college skills or school achievement of children (e.g., Carneiro and Heckman 2002). The fact that children from high-income families are more likely to enter college is interpreted as a result of their higher skills developed prior to college rather than a parental-income effect. This argument is consistent with evidence by Carneiro, Heckman, and Vytlacil (2011) and Nybom (2017), suggesting that for low skill/ability individuals the returns to college enrolment are small if not zero. However, credit constraints might affect other margins than whether to enrol in college or not. For example, Keane

and Wolpin (2001) estimate a structural model, showing that while credit constraints have little effect on future educational attainment, they affect consumption levels and work while in school, potentially magnifying socioeconomic gaps in school performance. Restuccia and Urrutia (2004) similarly conclude that financial constraints are of little importance for college education, but more consequential at earlier phases of education. Further, it is important to keep in mind that this US evidence is from a context with sizeable tuition fees, but also widespread opportunities for student aid and stipends for gifted low-income children. Without the latter, credit constraints might play a larger role. For example, evidence from Chile and Mexico suggests that credit constraints are more important in high-inequality, middle-income countries where a larger proportion of children is likely to be constrained (Kaufmann 2014; Solis 2017; Cáceres-Delpiano, Giolito, and Castillo 2018).

The early literature also explored the role of credit constraints by testing for non-linearities in intergenerational income persistence. Among families for which credit constraints bite, presumably somewhere in the lower part of the parent income distribution, the rate of income persistence should be higher than elsewhere in the distribution. However, the early empirical support for such concave relationship was inconclusive (Corak and Heisz 1999; Grawe 2004), and more recent evidence remains mixed (see surveys by Jäntti and Jenkins 2015 and Deutscher and Mazumder 2022). Given the recent developments in the literature, including dynamic complementarity (Cunha and Heckman 2007) and potential cross-effects between inputs and parental skills (Becker et al. 2018), it is not even clear what type of non-linearities credit constraints may give rise to. The recognition that credit constraints need not produce concavity and concavity does not imply credit-market failure implies that simple tests of nonlinearity have become less useful for learning about credit constraints.

More recent studies have generally found more support for the importance of credit constraints. This could be due to refined methods, with structural approaches that allow for richer sets of mechanisms, and often including multiple childhood investment stages. It could also be since college tuition and returns to college have risen sharply in the US, and recent studies tend to use more recent data.

Belley and Lochner (2007), Bailey and Dynarski (2011), and Lochner and Monge-Naranjo (2012) show that by the 2000s, family income had become a much stronger determinant of college enrolment in the US, consistent with a greater role of financial constraints driven by the higher tuition costs. Similarly, Blanden, Doepke, and Stuhler (2022) find that college enrolment gaps by parental income far from disappear once conditioning on pre-college skills or school achievement of children. Parental-income gradients in enrolment are found for several high-income countries and are particularly steep in the relatively expensive US system. Again, many different

mechanisms may generate such gaps, but the general patterns are consistent with college costs and credit constraints playing a role.

Most of the recent structural evidence rejects that credit constraints are inconsequential, but from different angles. Abbott et al. (2019) show that an expansion of financial aid increases college enrolment and improves welfare, consistent with binding financial constraints. However, because of substantial heterogeneity in the return to college, ability-tested financial aid is preferred compared to a more general subsidy. Many studies allow for multiple stages of childhood and emphasise the dynamic interaction of educational investments and credit constraints. Prospective college students from low-income families can only be financially constrained if they have developed sufficient skills in childhood such that college is a worthwhile investment. A number of recent studies thus point to credit constraints earlier in childhood as the main obstacle for social mobility (Herrington 2015; Hai and Heckman 2017; Lee and Seshadri 2019). Caucutt and Lochner (2020) find only moderate effects of policies that relax financial constraints at a specific stage of childhood, while eliminating financial constraints throughout early life can have a much larger impact on the educational attainment of low-income children and on social mobility. In related work, Carneiro et al. (2021) use Norwegian data to study the effects of the timing of parental income across childhood. Exploiting transitory variation in parental income around its permanent level, they find that parental income in early *and* late childhood is relatively more important for children's outcomes as adults compared to income in mid-childhood.

Thus, the body of evidence on credit constraints is vast but also quite hard to sort out. One might find it surprising that credit constraints matter at early stages, given that pre-college education tends to be publicly funded. However, parents are (mechanically) younger, earn lower incomes, and have less savings when their children are younger – thus they are more likely to be constrained in various ways. And even under public education, it is possible to privately invest in children within the system, e.g., by moving or commuting to better schools, taking time off from work to help with homework, buying tutoring services, and so on. Together with the notion of self-productivity and dynamic complementarity of skills, one might thus build a social-mobility case for the importance of early-life constraints on low-income families, and policies to circumvent them.

At the same time, the decision to acquire a college education has very large impacts on various long-term outcomes, including for students who are around the margin of attending. Even the relaxation of weak credit constraints pertaining to college enrolment might thus be potentially important for social mobility, at least for relatively gifted low-income children. Moreover, if such later constraints are less binding because low-income students compensate by working in school

(as in Keane and Wolpin 2001), it might harm their study performance and chances to graduate. In a recent study for Sweden, Joensen and Mattana (2021) exploit a student aid reform and find that decreased aid generosity (from grants to loans) increases work while in school and harms human-capital accumulation. On that note, Blandin and Herrington (2021) document that a socio-economic gap in completing college conditional on attending has emerged over the last decades in the US. While this could be tied to financial stress, it might also have totally different sources, including a lack of requisite skills.

However, the role of higher education in the transmission of advantages likely goes beyond just enrolling and completing college. As Becker et al. (2018) note, returns to education could be higher for high-income families if they have or gain access to information and networks that enable them both to make more efficient investments and to provide further advantages on the labour market. Recent work emphasizes *where* children from different backgrounds study, the extent of sorting and segregation across colleges, and their long-run effects. Chetty et al. (2020) show evidence that the degree of parental-income segregation across US colleges is very high, and that colleges with the best earnings outcomes predominantly enrol students from high-income families. Zimmerman (2019) show that Chilean elite colleges magnify socioeconomic gaps in attaining leadership positions and top incomes, and that peer ties between college classmates from similar backgrounds benefit high-income students on the labour market. Michelman, Price, and Zimmerman (2022) highlight the role of exclusive clubs (e.g., “old boys’ clubs”) at US elite colleges in preventing upward mobility into top positions on the labour market. There is also evidence that low-income students more often choose “safer” fields of study with lower financial returns (e.g. Altonji, Blom, and Meghir 2012). However, it is less clear whether this result stems from differences in preferences or skills, or rather that high-income students are less constrained from undertaking risky investments.

5 Discussion

This overview summarises evidence on education policies and their possible impact on social mobility. The article has discussed school resources, teachers, tracking and access to higher education. In all reviewed areas there is some evidence of higher returns to investments for disadvantaged students, which is to be expected if the skill production function is concave in its inputs. Evidence on long-run outcomes suggests that implementing the right policy can have lifelong consequences for disadvantaged children and be cost effective to society. The literature is however not always conclusive. For example, studies on class-size reductions point to diverging conclusions, and only a few studies find that the quality of teachers is more important for

disadvantaged students. There is also a risk that "zero effects" studies are missing due to publication bias, in which case the overall conclusions from the literature might be misleading.

Economics of education has moved a long way to build theory and identify the impacts of resources and schools' organisations but contributes less to the knowledge about pedagogical practices. What happens in the classroom is largely a black box and rarely captured with the kind of data used by education economists. Dietrichson et al.'s (2017) meta-analysis classifies interventions into different categories, and while interventions such as cooperative learning say something about the actual educational practices in a school, most of the other categories remain silent about activities and learning theories adopted in the classroom.

Some partial evidence of successful practices comes from the literature on charter schools in the US, which has found large test score gains in urban charter schools (see Cohodes and Parham 2021 for an overview). Urban charter schools often employ a "No Excuses" approach, which can be summarised as high academic expectations, a strict code of behaviour and an extended school day. It is also common to use tutoring and frequent assessments and feedback routines. Although their success has often been explained by the focus on discipline and high expectations, the literature can rarely separate the various components and identify to what extent they contribute to the effectiveness of charter schools. One attempt to do so shows that each feature of the No Excuses concept contributes to test score gains, even when other practices are held constant (Dobbie and Fryer 2013).

More research is needed on the effectiveness of different pedagogical practices, and their heterogeneous impacts. The use of RCT:s to gauge causal effects of in-classroom practices is a natural way forward, with possible synergies between economics and educational psychology.

Proving that education policy actually affects intergenerational mobility in society is a challenging task. Even in the presence of long-run effects on labour market outcomes, it is not clear how large the effects have to be to alter intergenerational persistence, nor what the general equilibrium outcome will be. Current trends in intergenerational persistence can also reflect past policies: equalising interventions targeting the parent generation can increase intergenerational persistence in the next, if underlying skills and abilities are strongly inheritable across generations in a way that is shielded from feasible policies (Nybom and Stuhler 2022).

An outstanding question is whether early schooling or higher education matter more for social mobility, and thus where the policy focus should be directed. On the one hand, self-productivity and dynamic complementarity of skills would suggest that early interventions are more effective, and that early learning is more impactful on people's lives. On the other hand, the decision to acquire or not acquire a college education has very large impacts on various long-term outcomes, including for students who are around the margin of attending. Therefore, a reform that helps

some potential students (with appropriate skills) into attending college might be quite impactful in terms of social mobility in long-run outcomes like adult income. In comparison, a policy that raises achievement in middle school might have only a marginal impact, if the opportunities for low-SES students at higher levels of education are then curtailed. While theory and evidence continue to provide a strong case for early interventions and childhood skill development, we should thus not disregard the role played by the higher education system in shaping social mobility.

Lastly, studies establishing causal effects of various education policies cannot be interpreted in isolation, and we should put more attention to society-wide factors and the long-term dynamics of policies. And even if specific policies do not alter the established aggregate measures of social mobility, they can still be successful if they raise the living standard of those affected and are cost-effective to society.

References

Aakvik, Arild, Kjell G. Salvanes, and Kjell Vaage. 2010. 'Measuring Heterogeneity in the Returns to Education Using an Education Reform'. *European Economic Review* 54 (4): 483–500. https://doi.org/10.1016/j.euroecorev.2009.09.001.

Abbott, Brant, Giovanni Gallipoli, Costas Meghir, and Giovanni L Violante. 2019. 'Education Policy and Intergenerational Transfers in Equilibrium'. *Journal of Political Economy* 127 (6): 2569–2624.

Almond, Douglas, Janet Currie, and Valentina Duque. 2017. 'Childhood Circumstances and Adult Outcomes: Act II'. Working Paper 23017. National Bureau of Economic Research. https://doi.org/10.3386/w23017.

Altonji, Joseph G, Erica Blom, and Costas Meghir. 2012. 'Heterogeneity in Human Capital Investments: High School Curriculum, College Major, and Careers.' *Annual Review of Economics* 4: 185–223.

Andersen, Simon Calmar, Louise Beuchert, Helena Skyt Nielsen, and Mette Kjærgaard Thomsen. 2020. 'The Effect of Teacher's Aides in the Classroom: Evidence from a Randomized Trial'. *Journal of the European Economic Association* 18 (1): 469–505. https://doi.org/10.1093/jeea/jvy048.

Angrist, Joshua D. 2014. 'The Perils of Peer Effects'. *Labour Economics*, Special Section articles on "What determined the dynamics of labour economics research in the past 25 years? edited by Joop Hartog and and European Association of Labour Economists 25th Annual Conference, Turin, Italy, 19-21 September 2013 Edited by Michele Pellizzari, 30 (October): 98–108. https://doi.org/10.1016/j.labeco.2014.05.008.

Angrist, Joshua D., and Victor Lavy. 1999. 'Using Maimonides' Rule to Estimate the Effect of Class Size on Scholastic Achievement'. *The Quarterly Journal of Economics* 114 (2): 533–75.

Angrist, Joshua D., Victor Lavy, Jetson Leder-Luis, and Adi Shany. 2019. 'Maimonides' Rule Redux'. *American Economic Review: Insights* 1 (3): 309–24. https://doi.org/10.1257/aeri.20180120.

Bailey, Martha J, and Susan M Dynarski. 2011. 'Gains and Gaps: Changing Inequality in US College Entry and Completion'. National Bureau of Economic Research.

Becker, Gary S, Scott Duke Kominers, Kevin M Murphy, and Jörg L Spenkuch. 2018. 'A Theory of Intergenerational Mobility'. *Journal of Political Economy* 126 (S1): S7–25.

Becker, G.S., and N. Tomes. 1979. 'An Equilibrium Theory of the Distribution of Income and Intergenerational Mobility'. *The Journal of Political Economy* 87 (6): 1153–89.

———. 1986. ‘Human Capital and the Rise and Fall of Families’. *Journal of Labor Economics* 4 (3): 1–39.

Belley, Philippe, and Lance Lochner. 2007. ‘The Changing Role of Family Income and Ability in Determining Educational Achievement’. *Journal of Human Capital* 1 (1): 37–89.

Betts, Julian R. 2011. ‘Chapter 7 - The Economics of Tracking in Education’. In *Handbook of the Economics of Education*, edited by Eric A. Hanushek, Stephen Machin, and Ludger Woessmann, 3:341–81. Elsevier. https://doi.org/10.1016/B978-0-444-53429-3.00007-7.

Betts, Julian R, and Jamie L Shkolnik. 2000. ‘Key Difficulties in Identifying the Effects of Ability Grouping on Student Achievement’. *Economics of Education Review* 19 (1): 21–26. https://doi.org/10.1016/S0272-7757(99)00022-9.

Björklund, Anders, Mikael Lindahl, and Erik Plug. 2006. ‘The Origins of Intergenerational Associations: Lessons from Swedish Adoption Data’. *The Quarterly Journal of Economics* 121 (3): 999–1028.

Bjorklund, Anders, and Kjell G. Salvanes. 2011. ‘Education and Family Background: Mechanisms and Policies’. In E. A. Hanushek, S. Machin, & L. Woessmann (Eds.), Handbook of the economics of education. Elsevier.

Black, Sandra E, and Stephen Machin. 2011. ‘Housing Valuations of School Performance’. In E. A. Hanushek, S. Machin, & L. Woessmann (Eds.), Handbook of the economics of education. Elsevier.

Blanden, Jo, Matthias Doepke, and Jan Stuhler. 2022. ‘Educational Inequality*’. Working Paper 29979. Working Paper Series. National Bureau of Economic Research. https://doi.org/10.3386/w29979.

Blandin, Adam, and Christopher Herrington. 2021. ‘Family Heterogeneity, Human Capital Investment, and College Attainment’. *American Economic Journal: Macroeconomics*, 14(4): 438–78.

Böhlmark, Anders, and Alexander Willén. 2020. ‘Tipping and the Effects of Segregation’. *American Economic Journal: Applied Economics* 12 (1): 318–47.

Booij, Adam S., Edwin Leuven, and Hessel Oosterbeek. 2017. ‘Ability Peer Effects in University: Evidence from a Randomized Experiment’. *The Review of Economic Studies* 84 (2): 547–78. https://doi.org/10.1093/restud/rdw045.

Boustan, Leah Platt. 2010. ‘Was Postwar Suburbanization “White Flight”? Evidence from the Black Migration’. *The Quarterly Journal of Economics* 125 (1): 417–43.

Bukodi, Erzsébet, and John H. Goldthorpe. 2018. *Social Mobility and Education in Britain: Research, Politics and Policy*. Cambridge University Press. https://doi.org/10.1017/9781108567404.

Cáceres-Delpiano, Julio, Eugenio Giolito, and Sebastián Castillo. 2018. 'Early Impacts of College Aid'. *Economics of Education Review* 63: 154–66.

Card, David, Alexandre Mas, and Jesse Rothstein. 2008. 'Tipping and the Dynamics of Segregation'. *The Quarterly Journal of Economics* 123 (1): 177–218.

Carneiro, Pedro, Italo López García, Kjell G Salvanes, and Emma Tominey. 2021. 'Intergenerational Mobility and the Timing of Parental Income'. *Journal of Political Economy* 129 (3): 757–88.

Carneiro, Pedro, and James J. Heckman. 2002. 'The Evidence on Credit Constraints in Post–Secondary Schooling'. *Economic Journal* 112 (482): 705–34.

Carneiro, Pedro, James J Heckman, and Edward J Vytlacil. 2011. 'Estimating Marginal Returns to Education'. *American Economic Review* 101 (6): 2754–81.

Carrell, Scott E., Bruce I. Sacerdote, and James E. West. 2013. 'From Natural Variation to Optimal Policy? The Importance of Endogenous Peer Group Formation'. *Econometrica* 81 (3): 855–82. https://doi.org/10.3982/ECTA10168.

Caucutt, Elizabeth M, and Lance Lochner. 2020. 'Early and Late Human Capital Investments, Borrowing Constraints, and the Family'. *Journal of Political Economy* 128 (3): 1065–1147.

Chetty, Raj, John N. Friedman, Nathaniel Hilger, Emmanuel Saez, Diane Whitmore Schanzenbach, and Danny Yagan. 2011. 'How Does Your Kindergarten Classroom Affect Your Earnings? Evidence from Project Star'. *The Quarterly Journal of Economics* 126 (4): 1593–1660. https://doi.org/10.1093/qje/qjr041.

Chetty, Raj, John N. Friedman, and Jonah E. Rockoff. 2014. 'Measuring the Impacts of Teachers II: Teacher Value-Added and Student Outcomes in Adulthood'. *American Economic Review* 104 (9): 2633–79. https://doi.org/10.1257/aer.104.9.2633.

Chetty, Raj, John N Friedman, Emmanuel Saez, Nicholas Turner, and Danny Yagan. 2020. 'Income Segregation and Intergenerational Mobility across Colleges in the United States'. *The Quarterly Journal of Economics* 135 (3): 1567–1633.

Chetty, Raj, and Nathaniel Hendren. 2018. 'The Impacts of Neighborhoods on Intergenerational Mobility I: Childhood Exposure Effects'. *The Quarterly Journal of Economics* 133 (3): 1107–62. https://doi.org/10.1093/qje/qjy007.

Chetty, Raj, Nathaniel Hendren, and Lawrence F. Katz. 2016. 'The Effects of Exposure to Better Neighborhoods on Children: New Evidence from the Moving to Opportunity Experiment'. *American Economic Review* 106 (4): 855–902. https://doi.org/10.1257/aer.20150572.

Cohodes, Sarah R., and Katharine S. Parham. 2021. 'Charter Schools' Effectiveness, Mechanisms, and Competitive Influence'. Oxford Research Encyclopedia of Economics and Finance. 28 June 2021. https://doi.org/10.1093/acrefore/9780190625979.013.648.

Collins, Randall. 1994. *Four Sociological Traditions*. Revised&Enlarged edition. New York: Oxford University Press.

Conlisk, John. 1974. 'Can Equalization of Opportunity Reduce Social Mobility?' *The American Economic Review* 64 (1): 80–90.

Connolly, Marie, and Catherine Haeck. 2022. 'Nonlinear Class Size Effects on Cognitive and Noncognitive Development of Young Children'. *Journal of Labor Economics* 40 (S1): S341–82. https://doi.org/10.1086/718328.

Corak, Miles. 2013. 'Income Inequality, Equality of Opportunity, and Intergenerational Mobility'. *Journal of Economic Perspectives* 27 (3): 79–102. https://doi.org/10.1257/jep.27.3.79.

Corak, Miles, and Andrew Heisz. 1999. 'The Intergenerational Earnings and Income Mobility of Canadian Men: Evidence from Longitudinal Income Tax Data'. *Journal of Human Resources*, 34(3): 504–533

Cunha, Flavio. 2007. 'An Essay on Skill Formation'. PhD Thesis, Ph. D. thesis, University of Chicago.

Cunha, Flavio, and James Heckman. 2007. 'The Technology of Skill Formation'. *American Economic Review* 97 (2): 31–47. https://doi.org/10.1257/aer.97.2.31.

Cunha, Flavio, James J Heckman, and Susanne M Schennach. 2010. 'Estimating the Technology of Cognitive and Noncognitive Skill Formation'. *Econometrica* 78 (3): 883–931.

Currie, Janet, and Douglas Almond. 2011. 'Human Capital Development before Age Five'. In David Card, Orley Ashenfelter (Eds), Handbook of Labor Economics, Volume 4, Part B, pp. 1315-1486 Elsevier.

Deutscher, Nathan, and Bhashkar Mazumder. 2022. 'Measuring Intergenerational Income Mobility: A Synthesis of Approaches'. *Journal of Economic Literature* (forthcoming).

Dietrichson, Jens, Martin Bøg, Trine Filges, and Anne-Marie Klint Jørgensen. 2017. 'Academic Interventions for Elementary and Middle School Students With Low Socioeconomic Status:

A Systematic Review and Meta-Analysis'. *Review of Educational Research* 87 (2): 243–82. https://doi.org/10.3102/0034654316687036.

Dobbie, Will, and Roland G. Fryer. 2013. 'Getting Beneath the Veil of Effective Schools: Evidence From New York City'. *American Economic Journal: Applied Economics* 5 (4): 28–60.

Doepke, Matthias, and Fabrizio Zilibotti. 2019. *Love, Money, and Parenting: How Economics Explains the Way We Raise Our Kids*. Princeton University Press.

Duflo, Esther, Pascaline Dupas, and Michael Kremer. 2011. 'Peer Effects, Teacher Incentives, and the Impact of Tracking: Evidence from a Randomized Evaluation in Kenya'. *American Economic Review* 101 (5): 1739–74. https://doi.org/10.1257/aer.101.5.1739.

Duncan, Greg, Ariel Kalil, Magne Mogstad, and Mari Rege. 2022. 'Investing in Early Childhood Development in Preschool and at Home'. Working Paper 29985. Working Paper Series. National Bureau of Economic Research. https://doi.org/10.3386/w29985.

Durlauf, Steven N, Andros Kourtellos, and Chih Ming Tan. 2021. 'The Great Gatsby Curve'. Working Paper Series 43. Stone Center on Socio-Economic Inequality.

Elacqua, Gregory, Diana Hincapie, Isabel Hincapie, and Veronica Montalva. 2022. 'Can Financial Incentives Help Disadvantaged Schools to Attract and Retain High-Performing Teachers? Evidence from Chile'. *Journal of Policy Analysis and Management* 41 (2): 603–31. https://doi.org/10.1002/pam.22375.

Fogli, Alessandra, and Veronica Guerrieri. 2019. 'The End of the American Dream? Inequality and Segregation in Us Cities'. National Bureau of Economic Research.

Fredriksson, Peter, Björn Öckert, and Hessel Oosterbeek. 2013. 'Long-Term Effects of Class Size'. *The Quarterly Journal of Economics* 128 (1): 249–85. https://doi.org/10.1093/qje/qjs048.

———. 2016. 'Parental Responses to Public Investments in Children: Evidence from a Maximum Class Size Rule'. *Journal of Human Resources* 51 (4): 832–68. https://doi.org/10.3368/jhr.51.4.1114-6779R1.

Garces, Eliana, Duncan Thomas, and Janet Currie. 2002. 'Longer-Term Effects of Head Start'. *American Economic Review* 92 (4): 999–1012. https://doi.org/10.1257/00028280260344560.

Gibbons, Stephen, Stephen Machin, and Olmo Silva. 2013. 'Valuing School Quality Using Boundary Discontinuities'. *Journal of Urban Economics* 75: 15–28.

Gibbons, Stephen, Sandra McNally, and Martina Viarengo. 2018. 'Does Additional Spending Help Urban Schools? An Evaluation Using Boundary Discontinuities'. *Journal of the European Economic Association* 16 (5): 1618–68. https://doi.org/10.1093/jeea/jvx038.

Gilraine, Michael, and Nolan G. Pope. 2021. 'Making Teaching Last: Long-Run Value-Added'. Working Paper. Working Paper Series. National Bureau of Economic Research. https://doi.org/10.3386/w29555.

Grawe, Nathan D. 2004. 'Reconsidering the Use of Nonlinearities in Intergenerational Earnings Mobility as a Test for Credit Constraints'. *Journal of Human Resources* 39 (3). http://ideas.repec.org/a/uwp/jhriss/v39y2004i3p813-827.html.

Guryan, Jonathan, Jens Ludwig, Monica P. Bhatt, Philip J. Cook, Jonathan M.V. Davis, Kenneth Dodge, George Farkas, et al. 2021. 'Not Too Late: Improving Academic Outcomes Among Adolescents'. Working Paper. Working Paper Series. National Bureau of Economic Research. https://doi.org/10.3386/w28531.

Hai, Rong, and James J Heckman. 2017. 'Inequality in Human Capital and Endogenous Credit Constraints'. *Review of Economic Dynamics* 25: 4–36.

Hanushek, Eric A. 2003. 'The Failure of Input-Based Schooling Policies*'. *The Economic Journal* 113 (485): F64–98. https://doi.org/10.1111/1468-0297.00099.

Hanushek, Eric A, Paul E Peterson, Laura M Talpey, and Ludger Woessmann. 2020. 'Long-Run Trends in the US SES-Achievement Gap'. National Bureau of Economic Research.

Hanushek, Eric A., and Steven G. Rivkin. 2010. 'Generalizations about Using Value-Added Measures of Teacher Quality'. *American Economic Review* 100 (2): 267–71. https://doi.org/10.1257/aer.100.2.267.

Hanushek, Eric A, and Ludger Woessmann. 2011. 'The Economics of International Differences in Educational Achievement'. *Handbook of the Economics of Education* 3: 89–200.

Heckman, James J, and Stefano Mosso. 2014. 'The Economics of Human Development and Social Mobility'. *Annual Review of Economics* 6: 689–733.

Herrington, Christopher M. 2015. 'Public Education Financing, Earnings Inequality, and Intergenerational Mobility'. *Review of Economic Dynamics* 18 (4): 822–42.

Holmlund, Helena. 2020. 'A Researcher's Guide to the Swedish Compulsory School Reform'. *Journal of the Finnish Economic Association* 1: 25–50.

Holmlund, Helena, Mikael Lindahl, and Erik Plug. 2011. 'The Causal Effect of Parents' Schooling on Children's Schooling: A Comparison of Estimation Methods'. *Journal of Economic Literature* 49 (3): 615–51. https://doi.org/10.1257/jel.49.3.615.

Holmlund, Helena, and Olmo Silva. 2014. 'Targeting Noncognitive Skills to Improve Cognitive Outcomes: Evidence from a Remedial Education Intervention'. *Journal of Human Capital* 8 (2): 126–60. https://doi.org/10.1086/676460.

Jackson, C. Kirabo. 2018. 'What Do Test Scores Miss? The Importance of Teacher Effects on Non–Test Score Outcomes'. *Journal of Political Economy* 126 (5): 2072–2107. https://doi.org/10.1086/699018.

———. 2020. 'Does School Spending Matter? The New Literature on an Old Question'. In An Equal Start: Policy and Practice to Promote Equality of Opportunity for Children, American Psychological Association.

Jackson, C. Kirabo, Rucker C. Johnson, and Claudia Persico. 2016. 'The Effects of School Spending on Educational and Economic Outcomes: Evidence from School Finance Reforms *'. *The Quarterly Journal of Economics* 131 (1): 157–218. https://doi.org/10.1093/qje/qjv036.

Jackson, C Kirabo, and Claire Mackevicius. 2021. 'The Distribution of School Spending Impacts'. National Bureau of Economic Research.

Jackson, C. Kirabo, Jonah E. Rockoff, and Douglas O. Staiger. 2014. 'Teacher Effects and Teacher-Related Policies'. *Annual Review of Economics* 6 (1): 801–25. https://doi.org/10.1146/annurev-economics-080213-040845.

Jackson, C. Kirabo. 2009. 'Student Demographics, Teacher Sorting, and Teacher Quality: Evidence from the End of School Desegregation'. *Journal of Labor Economics* 27 (2): 213–56. https://doi.org/10.1086/599334.

Jäntti, Markus, and Stephen P. Jenkins. 2015. 'Chapter 10 - Income Mobility'. In *Handbook of Income Distribution*, edited by Anthony B. Atkinson and François Bourguignon, 2:807–935. Handbook of Income Distribution. Elsevier. https://doi.org/10.1016/B978-0-444-59428-0.00011-4.

Joensen, Juanna Schrøter, and Elena Mattana. 2021. 'Student Aid Design, Academic Achievement, and Labor Market Behavior: Grants or Loans?' Unpublished manuscript.

Johnson, Rucker C., and C. Kirabo Jackson. 2019. 'Reducing Inequality through Dynamic Complementarity: Evidence from Head Start and Public School Spending'. *American Economic Journal: Economic Policy* 11 (4): 310–49. https://doi.org/10.1257/pol.20180510.

Kaufmann, Katja Maria. 2014. 'Understanding the Income Gradient in College Attendance in Mexico: The Role of Heterogeneity in Expected Returns'. *Quantitative Economics* 5 (3): 583–630.

Keane, Michael P, and Kenneth I Wolpin. 2001. 'The Effect of Parental Transfers and Borrowing Constraints on Educational Attainment'. *International Economic Review* 42 (4): 1051–1103.

Koedel, Cory, Kata Mihaly, and Jonah E. Rockoff. 2015. 'Value-Added Modeling: A Review'. *Economics of Education Review* 47 (August): 180–95. https://doi.org/10.1016/j.econedurev.2015.01.006.

Kraft, Matthew A., and Grace T. Falken. 2021. 'A Blueprint for Scaling Tutoring and Mentoring Across Public Schools'. *AERA Open* 7 (January): 23328584211042856. https://doi.org/10.1177/23328584211042858.

Krueger, Alan B. 1999. 'Experimental Estimates of Education Production Functions'. *The Quarterly Journal of Economics* 114 (2): 497–532.

Krueger, Alan B., and Diane M. Whitmore. 2001. 'The Effect of Attending a Small Class in the Early Grades on College-Test Taking and Middle School Test Results: Evidence from Project STAR'. *The Economic Journal* 111 (468): 1–28.

Lafortune, Julien, Jesse Rothstein, and Diane Whitmore Schanzenbach. 2018. 'School Finance Reform and the Distribution of Student Achievement'. *American Economic Journal: Applied Economics* 10 (2): 1–26. https://doi.org/10.1257/app.20160567.

Lee, Sang Yoon, and Ananth Seshadri. 2019. 'On the Intergenerational Transmission of Economic Status'. *Journal of Political Economy* 127 (2): 855–921.

Leigh, Andrew. 2010. 'Estimating Teacher Effectiveness from Two-Year Changes in Students' Test Scores'. *Economics of Education Review* 29 (3): 480–88. https://doi.org/10.1016/j.econedurev.2009.10.010.

Leuven, Edwin, Mikael Lindahl, Hessel Oosterbeek, and Dinand Webbink. 2007. 'The Effect of Extra Funding for Disadvantaged Pupils on Achievement'. *The Review of Economics and Statistics* 89 (4): 721–36. https://doi.org/10.1162/rest.89.4.721.

Leuven, Edwin, and Sturla A. Løkken. 2018. 'Long-Term Impacts of Class Size in Compulsory School'. *Journal of Human Resources*, August, 0217-8574R2. https://doi.org/10.3368/jhr.55.2.0217.8574R2.

Leuven, Edwin, Hessel Oosterbeek, and Marte Rønning. 2008. 'Quasi-Experimental Estimates of the Effect of Class Size on Achievement in Norway*'. *The Scandinavian Journal of Economics* 110 (4): 663–93. https://doi.org/10.1111/j.1467-9442.2008.00556.x.

Lindqvist, Erik, and Roine Vestman. 2011. 'The Labor Market Returns to Cognitive and Noncognitive Ability: Evidence from the Swedish Enlistment'. *American Economic Journal: Applied Economics* 3 (1): 101–28. https://doi.org/10.1257/app.3.1.101.

Liu, Jing, and Susanna Loeb. 2019. 'Engaging Teachers: Measuring the Impact of Teachers on Student Attendance in Secondary School'. *Journal of Human Resources*, 56(2): 343–379. https://doi.org/10.3368/jhr.56.2.1216-8430R3.

Lleras-Muney, Adriana. 2002. 'Were Compulsory Attendance and Child Labor Laws Effective? An Analysis from 1915 to 1939'. *The Journal of Law & Economics* 45 (2): 401–35. https://doi.org/10.1086/340393.

Lochner, Lance, and Alexander Monge-Naranjo. 2012. 'Credit Constraints in Education'. *Annual Review of Economics* 4 (1): 225–56. https://doi.org/10.1146/annurev-economics-080511-110920.

Loury, Glenn C. 1981. 'Intergenerational Transfers and the Distribution of Earnings'. *Econometrica* 49 (4): 843–67.

Machin, Stephen, Sandra McNally, and Costas Meghir. 2010. 'Resources and Standards in Urban Schools'. *Journal of Human Capital* 4 (4): 365–93. https://doi.org/10.1086/658634.

Meghir, Costas, and Mårten Palme. 2005. 'Educational Reform, Ability, and Family Background'. *American Economic Review* 95 (1): 414–24. https://doi.org/10.1257/0002828053828671.

Michelman, Valerie, Joseph Price, and Seth D Zimmerman. 2022. 'Old Boys' Clubs and Upward Mobility Among the Educational Elite'. *Quarterly Journal of Economics*. 137(2): 845–909.

Nickow, Andre, Philip Oreopoulos, and Vincent Quan. 2020. 'The Impressive Effects of Tutoring on PreK-12 Learning: A Systematic Review and Meta-Analysis of the Experimental Evidence'. Working Paper. Working Paper Series. National Bureau of Economic Research. https://doi.org/10.3386/w27476.

Nybom, Martin. 2017. 'The Distribution of Lifetime Earnings Returns to College'. *Journal of Labor Economics* 35 (4): 903–52.

Nybom, Martin, and Jan Stuhler. 2022. 'Interpreting Trends in Intergenerational Mobility'. Unpublished manuscript.

OECD. 2017. *The Funding of School Education*. https://doi.org/10.1787/9789264276147-en.

———. 2018. *Effective Teacher Policies*. https://doi.org/10.1787/9789264301603-en.

———. 2019. *PISA 2018 Results (Volume II): Where All Students Can Succeed*. Paris: Organisation for Economic Co-operation and Development. https://www.oecd-ilibrary.org/education/pisa-2018-results-volume-ii_b5fd1b8f-en.

Oreopoulos, Philip. 2006. 'Estimating Average and Local Average Treatment Effects of Education When Compulsory Schooling Laws Really Matter'. *American Economic Review* 96 (1): 152–75. https://doi.org/10.1257/000282806776157641.

———. 2007. 'Do Dropouts Drop out Too Soon? Wealth, Health and Happiness from Compulsory Schooling'. *Journal of Public Economics* 91 (11): 2213–29. https://doi.org/10.1016/j.jpubeco.2007.02.002.

Pekkarinen, Tuomas, Roope Uusitalo, and Sari Kerr. 2009. 'School Tracking and Intergenerational Income Mobility: Evidence from the Finnish Comprehensive School Reform'. *Journal of Public Economics* 93 (7–8): 965–73. https://doi.org/10.1016/j.jpubeco.2009.04.006.

Restuccia, Diego, and Carlos Urrutia. 2004. 'Intergenerational Persistence of Earnings: The Role of Early and College Education'. *The American Economic Review* 94 (5): 1354–78.

Rothstein, Jesse. 2017. 'Measuring the Impacts of Teachers: Comment'. *The American Economic Review* 107 (6): 1656–84.

Rothstein, Jesse, and Diane Whitmore Schanzenbach. 2022. 'Does Money Still Matter? Attainment and Earnings Effects of Post-1990 School Finance Reforms'. *Journal of Labor Economics* 40 (S1): S141–78. https://doi.org/10.1086/717934.

Sacerdote, Bruce. 2011. 'Chapter 4 - Peer Effects in Education: How Might They Work, How Big Are They and How Much Do We Know Thus Far?' In *Handbook of the Economics of Education*, edited by Eric A. Hanushek, Stephen Machin, and Ludger Woessmann, 3:249–77. Elsevier. https://doi.org/10.1016/B978-0-444-53429-3.00004-1.

———. 2014. 'Experimental and Quasi-Experimental Analysis of Peer Effects: Two Steps Forward?' *Annual Review of Economics* 6 (1): 253–72. https://doi.org/10.1146/annurev-economics-071813-104217.

Solis, Alex. 2017. 'Credit Access and College Enrollment'. *Journal of Political Economy* 125 (2): 562–622.

Solon, Gary. 2004. 'A Model of Intergenerational Mobility Variation over Time and Place'. *Generational Income Mobility in North America and Europe*, In M. Corak (Ed.), Generational

Income Mobility in North America and Europe (pp. 38-47). Cambridge: Cambridge University Press.

Wodtke, Geoffrey T, Felix Elwert, and David J Harding. 2016. 'Neighborhood Effect Heterogeneity by Family Income and Developmental Period'. *American Journal of Sociology* 121 (4): 1168–1222.

Wodtke, Geoffrey T, David J Harding, and Felix Elwert. 2011. 'Neighborhood Effects in Temporal Perspective: The Impact of Long-Term Exposure to Concentrated Disadvantage on High School Graduation'. *American Sociological Review* 76 (5): 713–36.

World Bank (2021). Global Database on Intergenerational Mobility. Washington, D.C.: World Bank Group.

Zimmerman, Seth D. 2019. 'Elite Colleges and Upward Mobility to Top Jobs and Top Incomes'. *American Economic Review* 109 (1): 1–47.