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Education externalities
What they are and what we know

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Daniel Münich,
George Psacharopoulos
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Education externalities – What they are and what we know

Daniel Münich and George Psacharopoulos

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Executive summary

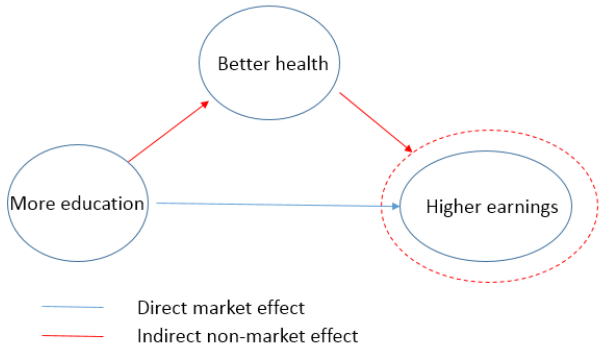
By now it is well known that education is associated with many beneficial effects in society. In the economics of education literature, these effects are typically measured by observing in the labour market the increased earnings or productivity of more educated workers relative to less educated ones.

Table 1: Basic taxonomy of educational benefits

Benefit type	Private	Social
Market	• Improved employability • Higher earnings • Less unemployment • Greater mobility	• Higher net tax revenue • Less reliance on government financial support
Non-market	• Greater consumer efficiency • Better personal and family health • Better health and skills of children	• Reduced crime • Less spread of infectious diseases • Better social cohesion • Increased voter participation

However, there is class of non-market or external benefits of education that have long been recognized but extremely difficult to measure. For example, to the extent that more education is associated with better health, healthier workers must enjoy higher earnings than measured solely on market wages (Figure 1). Another example is the extent to which more educated people are less prone to commit crime, hence saving society policing costs. Such savings are an additional benefit of education.

Figure 1: An example of direct market and indirect non-market effect of more education



The report reviews the empirical studies on attempting to measure the non-market and external effects of education, coming to the conclusion that such effects are significant. For example, taking only the non-market health benefits of education, the rate of return on education investment could be as high as double the one estimated based on market wages alone (Martínez et al., 2016).

The significance of conducting all-inclusive cost-benefit analysis of education, is that policy decisions could be reversed, e.g., subsidize a given level or type of education the social benefits of which exceed the cost of provision.

Résumé

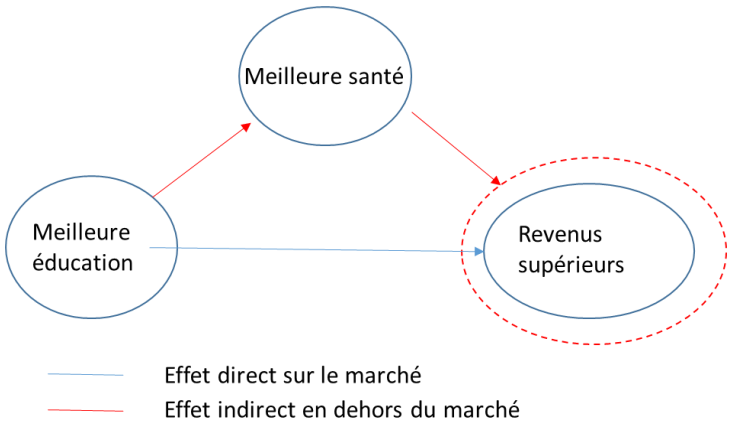
On sait aujourd'hui que l'éducation est associée à de nombreux effets bénéfiques dans la société. Dans la documentation sur l'économie de l'éducation, ces effets sont généralement mesurés en observant sur le marché du travail l'augmentation des salaires ou de la productivité des travailleurs les plus instruits par rapport aux travailleurs les moins instruits.

Tableau 1: Taxonomie de base des avantages sur le plan de l'éducation

Type d'avantage	Privé	Social
Marché	• Amélioration de l'employabilité • Revenus supérieurs • Baisse du chômage • Mobilité accrue	• Augmentation des recettes fiscales nettes • Moins de recours à l'aide financière du gouvernement
En dehors du marché	• Plus grande efficacité pour les consommateurs • Meilleure santé personnelle et familiale • Meilleure santé et habilité pour les enfants	• Réduction de la criminalité • Moins de propagation de maladies infectieuses • Meilleure cohésion sociale • Participation accrue des électeurs

Il existe cependant des catégories d'avantages en dehors du marché ou externes sur le plan de l'éducation qui sont reconnues depuis longtemps, mais qui restent extrêmement difficiles à mesurer. Par exemple, dans la mesure où une meilleure santé est associée à davantage d'éducation, les travailleurs en meilleure santé doivent jouir de revenus supérieurs à ceux mesurés uniquement en fonction des salaires perçus sur le marché (illustration 1). Un autre exemple concerne les personnes plus instruites qui sont moins enclines à commettre des crimes, ce qui permet de réduire les coûts des services de police. De telles économies constituent un avantage supplémentaire de l'éducation.

Illustration 1: un exemple de l'effet direct sur le marché et de l'effet indirect en dehors du marché d'une meilleure éducation



Le rapport passe en revue les études empiriques sur les tentatives visant à mesurer les effets en dehors du marché et externes de l'éducation, en arrivant à la conclusion que ces effets sont significatifs. Par exemple, si l'on ne prend en compte que les avantages pour la santé de l'éducation en dehors du marché, le taux de rendement de l'investissement dans l'éducation pourrait atteindre le double de celui estimé en fonction des salaires perçus sur le marché (Martínez et al., 2016).

La conduite d'une analyse coûts-avantages globale de l'éducation peut permettre que les décisions politiques soient alors modifiées, par exemple, en faveur d'une subvention d'un niveau ou un type d'éducation donné dont les avantages sociaux dépassent le coût de l'enseignement.

Kurzversion

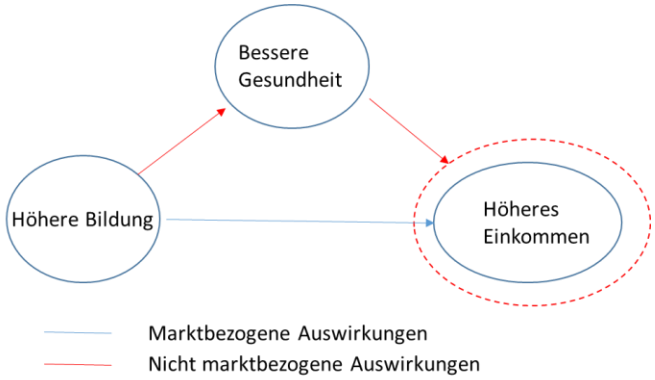
Inzwischen ist allgemein bekannt, dass Bildung viele positive Auswirkungen auf die Gesellschaft hat. In der Literatur über Bildungsökonomie werden diese Auswirkungen üblicherweise durch die Beobachtung des Arbeitsmarktes und der höheren Löhne und Produktivität von gebildeteren Arbeitskräften im Vergleich zu weniger gut ausgebildeten Arbeitskräften gemessen.

Tabelle 1: Grundlegende Taxonomie der Bildungsnutzen

Art des Nutzens	Privat	Sozial
Marktbezogen	• Verbesserte Beschäftigungsfähigkeit • Höheres Einkommen • Weniger Arbeitslosigkeit • Größere Mobilität	• Höhere Steuereinnahmen • Geringerer Bedarf an staatlichen finanziellen Beihilfen
Nicht marktbezogen	• Höhere Kompetenz der Verbraucher • Bessere persönliche und familiäre Gesundheit • Bessere Gesundheit der Kinder; kompetentere Kinder	• Weniger Kriminalität • Geringere Verbreitung von Infektionskrankheiten • Stärkerer sozialer Zusammenhalt • Höhere Wahlbeteiligung

Es gibt allerdings eine Reihe von nichtmarktbezogenen oder externen Vorteilen von Bildung, die schon lange anerkannt, aber nur sehr schwer messbar sind. Da mehr Bildung beispielsweise mit besserer Gesundheit assoziiert ist, erzielen gesündere Arbeitskräfte ein höheres Einkommen, das nicht ausschließlich anhand ihrer Marktlöhne gemessen werden kann (Abb. 1). Ein weiteres Beispiel ist die Tatsache, dass Personen mit höherer Bildung seltener Straftaten begehen, so dass die Gesellschaft Polizeikosten einsparen kann. Diese Einsparungen sind ein zusätzlicher Bildungsnutzen.

Abbildung 1: Beispiel für marktbezogene und nicht marktbezogene Auswirkungen von mehr Bildung



Der Bericht analysiert empirische Studien, in deren Rahmen versucht wurde, die nicht marktbezogenen und externen Auswirkungen von Bildung zu messen, und kommt zu dem Ergebnis, dass diese Auswirkungen erheblich sind. Wenn man z. B. nur die nicht marktbezogenen gesundheitlichen Vorteile der Bildung berücksichtigt, könnte die Investitionsrentabilität doppelt so hoch liegen, wie bei ausschließlich auf Marktlöhnen basierenden Schätzungen (Martínez et al., 2016).

Umfassende Kosten-Nutzen-Analysen im Bereich der Bildung sind wichtig, weil sie Einfluss auf politische Entscheidungen haben können, z. B. durch die Subventionierung einer bestimmten Bildungsebene oder Bildungsform, deren soziale Vorteile die Kosten für die Bereitstellung der Bildung übertreffen.

I. Introduction

For thousands of years people have recognized that education has many benefits beyond those that can be monetized. For example, in 300BC Aristotle wrote: "If a man neglects education, he walks lame to the end of his life". In the wake of the human capital school idea in the late 1950s, empirical research focused mainly on the personal and private monetary rewards associated with education, as inputs to cost-benefit analyses of investment in different levels of education. During the decades that followed, researchers gradually began to pay attention, too, to education's non-pecuniary (non-financial) benefits, and to benefits enjoyed by others than the person educated. Three early landmarks in the literature are worth noting:

- Weisbrod (1962) defined the "option value" of education, in the sense that beyond monetary rewards, additional education gives the opportunity to advance to further education and benefits. Monetizing that additional value of education resulted in doubling the computed rate of return to college education in the United States.
- Michael (1972) theorized that a higher level of education makes the consumer more efficient in making purchases. He estimated the value of the consumption benefits of education to be over 50% of monetary returns.
- Schultz (1975) stipulated that education helps the individual to "deal with disequilibria", i.e., to respond in a more efficient way to changing circumstances.

A textbook style example of an externality is a factory dumping waste into a river and thus imposing a negative externality on factories and individuals who use the water downstream from it. Similarly, building a golf course on a wasteland in front of a row of houses generates a positive externality that increases the value of the houses.

The essence of externalities in education is that their existence does not play a part in private individuals' incentives when deciding about their own education. This happens when individuals are not fully aware of all the future benefits at the moment education decisions are made. This report reviews both externalities benefiting the educated individual themselves and externalities benefiting others. For the sake of clarity, we call the impact of an individual's education on the benefits of others a *spillover*.

In principle, externalities can be positive or negative (e.g., environmental pollution), but when it comes to education, we think mostly of positive externalities. Educational externalities can be quite diverse. Great attention has been paid to their effects in the process of employing technologies, innovations and growth. As surveyed in detail by Davies (2003), there are plenty of static effects on others' earnings, and non-market effects via e.g., health, fertility, longevity, crime, civic participation, political stability, level of democracy, take-up of transfer payments, and higher taxes paid by the more educated. And to make things even more complex, non-market externalities may feed back into earnings, growth etc.[1]

Why the issue is important

Documenting the benefits of education beyond those recognised by the educated individuals themselves or readily observed in educated individuals' labour market performance is important because evidence of such benefits can alter education policy priorities and approaches. In particular, taking externalities into consideration raises the traditional estimate of the social rate of return to education. Since different levels of education may be associated with externalities of

[1] See more in McMahon (1999, 2001).

different types and intensities, taking them into account could substantially alter priorities for public investment in education.

Externalities in education particularly affect policy approaches concerned with efficiency and equity: a reliance on what is called “narrow social benefits”, which are based solely on monetary or market benefits, can lead to underinvestment in education, while adding non-monetary benefits to traditional income measures can alter the way in which well-being is distributed between different population groups.

II. Educational externalities

An externality in economics refers to a side-effect of an action, beyond what the actor is aware of (i.e., an effect that is not part of the actor’s rational decisions). The side-effect in question could be a cost to or a benefit imposed on the actor themselves or another person(s). An example of the former case is that an individual may not be capable of recognizing all the benefits that their current education will generate in their future life. Examples of the latter are that a more educated residential neighbour decreases the incidence of local crime, benefitting all other neighbours; and that the higher hygiene standards adopted by a more educated individual may reduce the spread of disease to others, reducing public spending on treatment and thus reducing the tax burden imposed on all members of the society. The channels such as these, through which better education may affect others, are many and may take both monetary and non-monetary forms.

At the suggestive level, Table 2 shows the average values of non-pecuniary indicators in OECD countries by level of education. Overall, education associates positively (but without any proven causal effect) with a wide range of indicators.

Table 2: Indicators of non-pecuniary benefits by level of education, OECD country averages (as % of adults with particular educational attainment)

Indicator	Educational level		
	Below upper secondary	Upper secondary	Tertiary
In good health	65	79	88
Obese	25	19	13
Smoker	36	30	18
Volunteer	12	18	22
Trusts others	13	18	29
Has say in Government	23	30	43
Participates in elections	74	79	87
Satisfied with life	58	67	76

Source: Based on OECD, *Education at a Glance*, various years

A good example of a possible monetary spillover of education is that of technological progress. If an inventor’s education leads him to come up with an innovation from which other people benefit (over and above what is reflected in the inventor’s income), this is a monetary spillover of education. We all currently benefit from the invention of smartphones; if the benefits we have from smartphones are not 100% internalized (taken into account) in their inventors’ incomes, then this is a spillover.

Terminology and taxonomy

To understand the role of externalities one has first to be aware of the nature of various types of costs and benefits: their form, who pays for the costs and who obtains the benefits. The benefits of education can be classified into a four-cell matrix, as shown in Table 3.[2] The benefits that are easiest to document are those in the northwest quadrant, namely private benefits that manifest themselves in the labour market and can be measured in monetary terms. Those that are hardest to document are those in the southeast quadrant, namely social benefits that cannot be directly observed or measured in monetary terms.

Table 3: A classification of education benefits

Benefit type	Private	Societal (social)
Market	• Improved employability • Higher earnings • Less unemployment • Increased labour market flexibility • Greater mobility	• Higher productivity of others • Higher net tax revenue (saving taxpayers' money) • Less reliance on government financial support (saving taxpayers' money)
Non-market	• Greater consumer efficiency • Better personal and family health • Better health and skills of children	• Reduced crime (affecting others) • Less spread of infectious diseases (to others) • Lower fertility rates • Better social cohesion • Increased voter participation

Several terms are used in the literature to refer to the broad set of non-monetary benefits of education; these include non-monetary, non-pecuniary, non-market, non-production, or, from a different perspective private, social (societal), wide-social, internal and external benefits. While the former set of terms refers to the benefits' form, the latter set refers to those they affect.

These terms can be confusing since, for example, many of the benefits in question are generated in household production (Becker, 1981), and many can be monetized – i.e., exchanged for money or expressed in terms of monetary equivalents. The term non-monetary (costs and benefits) is used in this report to distinguish these benefits from financial benefits, irrespective of who is affected.

A major distinction as far as costs are concerned is who bears the costs of education. Primarily, this is the educated or trained individual (and their family members), or an agency (which may be a firm or government). An important component in the personal costs affecting individuals' decisions regarding investment in education is indirect, in the form of the opportunity costs of time: since education is a time consuming activity, individuals who pursue education give up potential earnings or personal utility from other activities such as leisure. Although opportunity costs are not directly observable, they may constitute a substantial share of the overall costs.

[2] For details see McMahon (1997).

Therefore, opportunity costs should not be neglected in any cost-benefit analysis to determine policy.

The terms *spillover* and *externality* are frequently used to describe the same concept. For the sake of clarity, the term spillover is used in this report to represent only a subset of the externalities resulting from education or training, in particular those which affect individuals *other* than the educated person themselves. In other words, spillovers are effects that accrue externally to somebody other than the person whose action caused them.

When education leads to good citizenship and this leads to a better democracy from which the whole society profits, this is an example of a non-monetary spillover of education. Similarly, if the crime-reducing effect of education reduces the need for public spending on crime prevention and incarceration, this is a further way in which others profit from the education of an individual.

A strong case for policy intervention

As we explained above, externalities are effects that are not internalised into individuals' rational decisions when maximizing their own objectives. As a result, externalities are not readily reflected in market prices, which otherwise serve as an important signal guiding private investment decisions, which in turn constitute the economic grounds for efficiency and justify reliance on free market solutions. Because they don't take the externalities into account, educational decisions made by individuals – pupils and their parents, students, trainees, training providers – can lead to inefficient economic and social outcomes: when that happens, it is called a *market failure*. In other words, if the observed costs and benefits of an action taken by an individual, firm or other entity do not include its external effects, any policy conclusion based on those incomplete observed costs and benefits could be found to be incorrect if the action's external costs and benefits were taken into account.

The existence of externalities and market failures related to them provides strong economic grounds for the involvement of state / government / public bodies in education and schooling, and calls for policy interventions. Those interventions can take a variety of forms, such as imposing costs on those who generate negative externalities and providing subsidies to those who generate positive externalities, setting mandatory minimum school attainment levels, or simply providing more complete and more reliable information to individuals making decisions about their (or their family's) education.

While the theoretical concept of externalities is straightforward and the presence of externalities and associated market failures makes a strong case for public interventions in education, identifying the externalities themselves is quite difficult and it is frequently impossible to measure them. Some have referred to this as the holy grail in economics.

First, existing empirical evidence of the scale and scope of externalities is diverse. The evidence is case and situation-specific and one study's findings cannot and should not be readily generalised for similar situations in different environments and times. Second, while there have been many empirical investigations, a great deal of them do not go beyond mere association. Empirical studies that investigate a causal relationship using rigorous methodologies and good quality data are scarce.[3] For this reason, we do not strictly limit our reference to experience from the Member States but refer also to key studies from other regions. Third, even though we only refer to findings based on rigorous methods and good quality data, these too may be subject to dispute.

[3] For more on the evaluation of causal effects, see EENEE Analytical Report No. 5.

III. Measuring educational externalities

Educational externalities have been identified and estimated at (a) micro and (b) macro level in the literature:

(a) Micro level analyses typically use household or labour market surveys containing data on individuals' and their family members' educational attainment and achievements, health, incomes, earnings, employment and other characteristics. Some also use data on school pupils and students. Laboratory-style controlled experiments are quite rare. A typical externality studied is whether individuals are healthier after completing more education, and that differential health status has a value in terms of, say, increased quality of life and longevity, and reduced medical expenses for the individual themselves and/or the government. This personal utility and higher tax revenue both add to the core internalised market benefits of education (higher earnings and employment) such that an all-inclusive cost-benefit analysis of higher education would then typically find a higher social rate of return on the investment. In the following section on empirical evidence, this report primarily maps the economic literature in this area.

(b) Macro-level analyses use aggregated indicators calculated for broader demographic groups, which frequently represent larger regions or whole countries. Two general methodological approaches are employed. The first uses an aggregate production function based on the new growth theory that originated in a model by Nobel Laureate Lucas (1988), in which the traditional production function devised to explain differences in national income or its growth rate, involving labour and capital as inputs, is augmented by adding the country's education stock as an additional independent variable capturing external effects. The theoretical rationale for this treatment is that education boosts the productivity of traditional inputs such as land, labour and physical capital. In other words, education has a neighbouring effect, in the sense that one person's education boosts the productivity of other less educated people. The theory predicts that the higher a country's average level of education, the higher its level of output or its growth, over and above what the education of each single individual in that country would predict.[4]

In the second method, Mincer's (1974) earnings function[5] is fitted to aggregated data using national income as the dependent variable and the average level of education and physical capital in a given country. In this specification, the theory predicts that the resulting rate of return on the investment must include externalities.

IV. Evidence

When considering empirical findings, careful distinction should be made between *spurious correlations* (associations) between education and outcomes and *causal* relationships. This is because simple correlations are commonly driven by a myriad of hidden factors (other than education) that affect both education and the outcomes in question. For example, if we observe

[4] In the old economic growth theory, there are two distinct empirical sub-formulations known as "Schultz-type" and "Denison-type" growth accounting. In Schultz's (1961b) formulation human capital is added into the production function as an independent variable, along with physical capital and the number of people employed. In Denison's (1967) formulation, instead of adding human capital in monetary terms, the total labour force is split up by level of education. Schultz and Denison (1967) found that a substantial proportion of unexplained growth was due to education (Table 11).

[5] Mincer's function relates individual earnings, such as hourly wage rate, to years of education and years of labour market experience. The equation is commonly augmented for numerous other personal characteristics, such as gender.

that better educated people are healthier, this might be due to the fact that they received better treatment at a young age from their caring parents both in terms of health (and life-style) and in terms of educational support. The causality may also work in the opposite direction (reverse causality): healthier people may earn more because their (long term) good health has enabled them to complete more education and be more productive. There are many such channels through which external factors may contribute to an apparent correlation between education and other personal outcomes. Great effort of scientific research in social sciences, and behavioural sciences in particular, is devoted to disentangle such causal links from observed data.

The scientific empirical evidence we refer to in this report is based, as far as possible, on studies that have tried to control for the many factors other than education that might causally affect outcomes including externalities. Because identifying the causal impacts of education is usually methodologically a very difficult exercise, we content ourselves with outlining the general features of the methods used to do so, and do not pay much attention to the details of the complex methodologies used in each individual study; this leaves us the space to focus primarily on their key findings.

Typically, methodological identification of causal effects is based on the use of an *instrumental variable*, which is a variable capturing specific phenomena that affect how individuals attain education but do not directly affect the outcome studied via any other channel. Researchers are provided with these instrumental treatments by occasional policy interventions, which are like quasi experiments, when one group of the population receives a different level of education than another due to factors not directly associated with the outcomes. The scientific studies we refer to mostly employ policies that increase the mandatory years of schooling. This enables researchers to compare the pupils who were affected with those not affected by the change. The setback is that these policies commonly affect lower levels of education and so the resulting empirical findings do not necessary hold for hypothetical policy changes at advanced levels of education or for training at higher ages. Furthermore, using variation in school entry age or the duration of mandatory schooling is problematic because these changes may affect benefits via other channels than education. For example, starting school at a later age may affect the timing of an individual's first pregnancy.

Controlled experiments, when scientists fully control the treatment (education provision) and follow its long-term financial and non-financial impacts on the treated (educated) individuals and their peers are still rather rare and so there is little empirical evidence available from these.

Health; Life expectancy, Mortality

Large health gaps that coincide with educational attainment have been observed, and are growing. At the same time, educational attainment is commonly found to be more correlated with health indices than income or occupation sorting. As concerns life expectancy, OECD (2015b) reports its correlations with numerous socio-economic characteristics including educational attainments (Table 4). In particular, in the 15 countries analysed by OECD, at age 30 people with the highest level of education can expect to live on average six years longer than people with the lowest level of education (53 years versus 47 years). Quite high discrepancies persist in Eastern European countries, supposedly as a result of these countries' political histories in the second half of the 20th century.

Table 4: Associations between life expectancy and education (gap in life expectancy at age 30 by sex and educational level, 2012 (or latest year)

	Male	Female
Czech Rep.	17.8	5.2
Estonia	15.0	8.1
Hungary	12.1	5.5
Poland	11.6	5.0
Slovenia	9.1	4.4
OECD (15)	**7.7**	**4.2**
Slovak Rep.	6.9	3.5
Israel	5.8	4.7
Finland	5.5	3.5
Denmark	5.4	3.8
Mexico	5.2	4.6
Norway	5.1	3.9
Netherlands (2011)	4.5	4.2
Portugal	4.3	1.8
Sweden	3.7	3.0
Italy	3.6	1.8
OECD (15)	**7.7**	**4.2**

Note: The numbers show the gap in the expected years of life remaining at age 30 between adults with the highest level ("tertiary education") and the lowest level ("below upper secondary education") of education.

Source: Health at a glance 2015c, OECD

In a recent report, OECD (2017, pp.134) also highlights significant associations between educational attainment and self-reported depression.[6] In all the countries studied, the incidence of depression is higher – on average, about twice as high (12% compared with 6%) – among adults who did not achieve upper secondary education than among those with tertiary education. In other words, a decrease in self-reported depression is associated with each additional level of education. Although the OECD report concludes that *"…attaining upper secondary or post-secondary non-tertiary education provides significant tools to assure better emotional well-being"* we note that the reported associations between education and self-reported depression are not necessarily of fully causal origin. Similar caution is advisable in relation to the following conclusion from the OECD (2015c) report, "…*that most mental illness sets in early on, often before the age of 14. This suggests that education systems have an important role to play in identifying individuals who are susceptible to developing a mental illness and giving them appropriate support. This would help to avoid consequences, such as leaving school early, which could have negative repercussions later in life.* Below, we move beyond spurious associations such as these and provide examples of scientific studies that have exerted serious methodological efforts to try to identify truly causal links between education and health.

The typical externality effects of education arise due to individuals not being able to incorporate all the costs and especially benefits of education – for themselves, their children, their peers, and society as a whole – into their educational decisions. Where health is concerned, we can examine these effects by considering three key questions: a) through which potential channels and processes can education have a causal impact on health?; b) does education causally improve health and mortality (life expectancy)?; c) what are the implications of this for education and health policy?.

[6] Based on the European Health Interview Survey.

Lochner (2011) classifies three key ways in which we can expect education to affect individual health. First, education results in higher earnings, which makes costly health care and insurance purchases more affordable. Higher income, due to higher education, also fosters greater demand for health by increasing consumption opportunities. More educated individuals can afford to choose (and bear the costs of) healthier or safer occupations, places of residence, and so on. Second, more educated individuals use available health inputs more efficiently, increasing the marginal productivity of those health inputs and resulting in better health. This is sometimes referred to as "productive efficiency" and can be achieved because better educated individuals are able to acquire or process health information more easily, and have a better understanding of more complex instructions provided by their doctors. Acquiring this better knowledge about their health options and inputs should generally improve their health. Better educated individuals are also more prone to protect the value of their human capital by maintaining a better life style, for example smoking less, eating a more healthy diet, and pursuing regular physical and mental exercise. Third, a higher level of education may also enhance an individual's ability to look for more complicated treatments and to take advantage of a more productive or cheaper combination of health inputs. This is often referred to as the "allocative efficiency" of health inputs, which refers to the fact that more educated individuals, for many reasons, make different health-related choices, choosing more suitable treatments and achieving better health outcomes. More educated individuals are also more likely to purchase better health insurance, take greater safety precautions, and spend more on non-standard health treatments. Needless to say, in some situations more educated individuals may also overestimate the value of certain health behaviours or treatments and this may lead to excess spending on health-related inputs and activities.

The channels through which better education can translate to better health, then, are many. A comprehensive overview of the links between education and health and mortality can be found in OECD (2006). For example, higher education may improve health by improving the individual's socio-economic situation and thus, in turn, diminishing long-term stress. As reviewed in greater detail by Lochner (2011), the actual effect of an individual's education on their health will depend on several mediating factors, which typically include (i) income and economic resources, (ii) personality, self-esteem, and sense of control, (iii) social integration, (iv) health-specific knowledge, (v) cognitive ability/skill, and (vi) preferences for risk and time discounting.

Table 5 lists the numerous channels by which education can affect health, together with related types of costs and benefits. It should be noted that while the private costs vary in nature, the benefits are largely private.

Table 5: Channels through which education may improve health

Channel	Private costs	Benefits
Reduces stress	None	Private
Better decision-making ability / use of inputs	None	Private
Better at gathering/interpreting information	None	Private
Health insurance	Financial	Private
Healthier Lifestyle		
Safety precautions (e.g. seatbelts, smoke alarms)	Utility, financial	Private
Diet	Utility, financial	Private
Exercise	Utility, financial	Private
Nonsmoking, alcohol moderation, avoiding drugs	Utility, saves money	Private
Healthier/safer employment	Lower wages	Private
Healthier neighborhoods	Housing prices	Private
Healthier peers and friends	None	Public

Source: Based on Lochner (2011), Table 2.8

These links are not easily discernible by individuals. Therefore, it is difficult for individuals to take their effects into account when deciding about the costly acquisition of additional education. This is especially true of the more delayed effects, which may be seen only after decades. Yet when the future private benefits of education are not fully taken into account, individuals will likely underinvest in their education.

As concerns spillovers, the impact of an individual's education on the health of others, such as their classmates, co-workers, friends, family, and anyone else the educated person interacts with, may take various forms and can include behaviours that reduce the spread of infectious diseases, better disseminate health-related information, promote the adoption of health friendly life styles, or protect the health of new-borns and infants. Examples of spillover externalities from recent empirical evidence are provided in the section on intergenerational transmission.

Evidence from causal studies

In Europe, in an effort to capture education's impact on health empirically, methodologically rigorous studies have commonly made use of changes in compulsory schooling laws, with the caveats we described in the previous section. In this way, Silles (2009) used the General Household Survey for England, Scotland, and Wales to estimate the effect of education on self-reported health. Her estimates indicate that an additional year of secondary school increases self-reported good health by about 10%. Using similar methodology, Clark and Royer (2010) employed data from the Health Survey of England (1991–2004) and found that education had small and statistically insignificant effects on self-reported health, long-term illness, and physical activity. On the other hand, using data from (Western) Germany , Kemptner, Jürges, and Reinhold (2010) utilized statutory increases in minimum schooling levels and found that education significantly reduced self-reported long-term illness among men, but not among women.

Conti, Heckman, and Urzua (2010a, 2010b), studied the relationship between education and health using the rather novel methodology of a multifactor model of schooling, earnings, and health outcomes and data from the British Cohort Study (following all children born in the United Kingdom during 1 week in 1970 periodically up to the age of 30). Their model accounted for education, post-school earnings, and health behaviours and outcomes depending on family background characteristics, observable health endowments at the age of 10, latent factors of cognitive and noncognitive abilities (i.e. socio-emotional skills), and unobserved health endowment. The study focused on the impacts of completing mandatory schooling (up to age 16) on smoking, obesity, and self-reported health. Their estimates found that the causal effect of educational attainment explains 60–70% of the raw differences in the incidence of smoking, 35–55% of the raw differences in self-reported health, and a third of the differences in obesity for men. The study also highlights that the effects of education are greater for individuals with relatively higher cognitive skills. It also found that cognitive skills are not a very important determinant of smoking decisions or obesity, and that they have a modest effect on self-reported health for women but little effect for men. Finally, they estimated that the impact of noncognitive skills is more important for smoking, obesity, and self-reported health. They conclude that noncognitive skills are about as important as early health endowments in explaining these outcomes at age 30. However, some additional and richer empirical literature in this area comes from the US: a detailed meta-study of the existing empirical research by Lochner (2011) concludes that *"…education appears to have a weaker effect on mortality, self-reported health, and physical activity in Europe than in the United States."* He further adds that *"It is tempting to*

speculate that the effects of education depend on access to health care, general social welfare and unemployment policies, and the level of overall inequality."

Empirical studies focusing on particular health indicators rather than overall self-reported heath status are much less common, mainly due to the limited availability of data describing detailed personal, family and peer neighbourhood characteristics (including education) and health. In this respect, the study by Powdthavee (2010) – who used the Health Survey of England (1991–2007) and changes in compulsory schooling in the United Kingdom to estimate that an additional year of schooling reduces hypertension for both men and women – is rather exceptional.

Numerous studies have estimated the effects of education on smoking[7], obesity[8], and other important causes of chronic health problems. Their dominant finding is that education significantly reduces smoking but has negligible effects on obesity.

As concerns mortality, one of the earliest sophisticated empirical investigations to provide estimates of education's long-term causal impacts on mortality was that by Lleras-Muney (2005, 2006), using US census data from 1960, 1970, and 1980. Later, in Europe, Clark and Royer (2010) investigated data from the United Kingdom and Albouy and Lequien (2009) investigated the French evidence. Both of these European studies made use of national increases in compulsory schooling ages to identify the causal impact of schooling on mortality. However, none of these studies found statistically significant effects.

Lindeboom, Llena-Nozal, and van der Klaauw (2009) used the United Kingdom's 1947 increase in the minimum school leaving age (from 14 to 15) to estimate the causal effects of maternal and paternal education on child health outcomes. Using National Child Development Study data on all births during the first week of March 1958, they found that parental education had small and statistically insignificant effects on birth outcomes (low birthweight, illness at birth) and child health outcomes (chronic conditions, overweight) at ages 7–16.

The limited number of rigorous studies and the very different environmental conditions they are based on do not enable us to draw any general conclusions about the causal impacts of parental education on child health. Indeed, even if we consider that a causal relationship has been reliably identified, it is not clear enough through which channel (type of interaction) this works. Yet another challenge is to disentangle which parent's education contributes most to the child's health. Furthermore, since policy instruments commonly affect both parents (assuming they are of similar ages), estimated impact of education of one parent only may overstate the actual impact of education.

The overall finding from the literature is that more education leads to modest improvements in health and small reductions in mortality. Nevertheless, is should be noted that the majority of the existing studies utilize changes in the duration of compulsory schooling or constraints imposed on early student drop-out. This limits the relevance of this empirical evidence to the lower schooling levels; evidence relevant to higher levels of education, where the further expansion of access to education is still a policy issue, is quite rare.

Another strand of economic literature tackles the role education can play in motivating individuals to gather, process and utilize health-related information. The seminal work by Grossman (1972) hypothesized that educated individuals produce health more efficiently, thus providing one explanation for the observed gaps in health by education level. A more recent study by Lange (2011), using data from an annual household survey of the civilian, non-institutionalized

[7] See Clark and Royer (2010) for England and Kemptner, Jürges & Reinhold (2010) for Germany.

[8] Brunello, Fabbri, and Fort (2009) for European countries, Clark and Royer (2010) for England and Kemptner, Jürges & Reinhold (2010) for Germany.

population of the United States (NHIS) provides evidence on the allocative efficiency hypothesis using data on how the more educated and the less educated respond (i) in their beliefs about their subjective cancer risk and (ii) in the preventative behaviours they adopt as their actual cancer risk varies. In particular, he concludes that educated individuals respond more to objective risk in screening decisions and in their subjective beliefs about risk, and are less hostile to science-based medicine.

Consistent with the above finding, Aizer and Stroud (2010) used an historical dataset including information on pregnant women's smoking habits in 1959-1966, and found that following the public release and wide media exposure, more educated mothers immediately reduced their smoking as measured by both self-reports and serum cotinine levels, while less educated mothers did not, and that the relative health of their newborns likewise increased. They found strong peer effects in the response to the information: after the 1964 report, educated women surrounded by other educated women were more likely to reduce smoking relative to those surrounded by less educated women. Over time, the education gradient in both smoking and newborn health continued to increase, peaking in the 1980s and then falling, eventually returning to initial levels. They concluded that with the provision of information: "…in an era of great advancements in medical knowledge, health disparities may actually increase, at least initially."

Growing evidence suggests that education affects the allocation of health inputs and behaviours. It is still not clear whether allocations are more efficient for more educated individuals or merely different due to their different demand for health. Lochner (2011) summarizes the voluminous findings of these decomposition studies as follows: "[They] offer a few lessons but are not without caveats. Taken at face value, these studies suggest that income and ability combined are important for explaining differences in health behaviors or outcomes by education, while differences in preferences, specific health knowledge, and psycho-social factors are relatively unimportant. … it appears that education has important effects on health behaviors, health outcomes, and mortality via its combined effects on income and ability (both cognitive and noncognitive)."

Empirical evidence on how education spills over from one individual's health to another individual's health is documented primarily in terms of peer effects among school-age adolescents. In particular, studies have focused on the effects mediated via smoking, alcohol, and addiction to other drugs, which have an adverse impact on individual health. Many of the existing studies struggle to distinguish the effect of education from correlations with other neighbourhood characteristics such as the unobserved effects of family composition, which may have a direct impact on individuals' risky behaviour. While there are many studies in this area, and most of them find that peer effects have a causal impact on health-related behaviours, the magnitude of the estimates varies a lot. As a typical example, Fletcher (2010) compared the decisions taken by students in different grades within the same high school, who spent time with different sets of classmates. His preferred estimates suggest that increasing the proportion of classmates who smoke by 10% will increase the likelihood that an individual smokes by approximately 3 percentage points. Another study by Pertold (2014) estimates peer effects in youth smoking due to educational sorting from lower to upper secondary schools in the Czech Republic. His results suggest that male youth smoking is significantly affected by classmates, while female smoking is not. Another important study by Webbink et al. (2010) analyzed education's causal effect on the probability of being overweight, using longitudinal data on self-reported and clinical measures of body size for identical twins in Australia. They confirm a negative association between education and the probability of being overweight among men but not among women.

The important role played by school peers in the transmission of educational spillovers is further supported by a study by Lundborg (2006), who used Swedish cross-sectional survey data on

young individuals aged 12-18 and a careful identification strategy to estimate school class-based peer effects in binge drinking, smoking, and illicit-drug use. He found significant and positive peer effects for all three activities. Gaviria et al. (2001) used a sample of tenth-graders to test for peer-group influences on the propensity to engage in five activities: using drugs, drinking alcohol, smoking cigarettes, going to church, and dropping out of high school. They find strong evidence of peer-group effects at the school level for all five activities and confirm the findings from previous research concerning interaction effects at the neighbourhood level.

The table 6 below, taken from Lochner (2011), compiles the causal effects of education on a series of health indicators, controlling for other factors.

Table 6: Causal effect of years of schooling on health outcomes (% points)

Country	Indicator	Effect
United States	10-yr. mortality rate	-6.3
United States	In poor or fair health	-8.0
United States	Disability	-2.5
United States	Smoking	-22.9
England and Wales	Hypertension	-7.0
England and Wales	In poor health	-3.7
England and Wales	Long term illness	-3.9
England and Wales	Overweight	-4.4
England and Wales	Smoking	-3.5
France	Mortality	-6.3
Germany	Long term illness	-3.9
European women	Overweight	-4.4

Source: Based on Lochner (2011), Tables 2.4 to 2.7.

Note: A percentage point in the table means a change relative to the mean value of the indicator

Crime and Safety

As far as associations that are relatively easy to monitor are concerned, OECD (2017) documents that in general, higher educational attainment in a country is discernibly associated with lower rates of self-reported victimisation, which proxies for the incidence of violent crime. Even so, it should be noted that this association is not so strong when we limit the analysis to the EU Member States, which in general have higher GDP and fewer people educated only to primary level. We proceed, below, to move beyond simple associations and provide examples of recent studies that have employed more rigorous methodologies to disentangle education's causal impacts in the area of crime and safety.

Education's contemporaneous impact on crime functions primarily via incapacitation – i.e., leaving individuals less free time and reducing boredom that could lead to potential criminal activities – and by facilitating desirable social interactions among young people that can change their preferences. The longer-term impacts of education, as Lochner (2011) put it, work via: (i) raising potential future earnings, which in turn raises the future opportunity costs of crime; (ii) affecting the individual's financial or “psychic” rewards from crime; (iii) altering the individual's preferences

for risk taking and patience; and (iv) co-determining the individual's future social networks and peers. Since education increases productive skills and therefore potential earnings, individuals with more education face higher opportunity costs (i.e., private losses in terms of their forgone productivity) if arrested. On the other hand, individuals with more education are more likely to be involved in more sophisticated types of crime. Education also makes individuals more patient and able to plan long-term.[9] This tends to discourage them from participating in crime, since being more forward-looking means that they place greater weight on their possible future punishment and other adverse consequences of when making decisions about committing crime. Education may also increase individuals' risk aversion and thus discourage involvement in risky crime activities. Lastly, individuals with more education are inclined to interact more intensively with other educated individuals to their own benefit, and this interaction would be precluded by involvement in criminal activities.

Examples of causal empirical evidence

Identifying the causal impacts of education and school attendance on crime is methodologically quite complicated and most studies fail to identify truly causal effects. A typical methodological problem is that unobserved individual characteristics, such as patience or risk aversion, simultaneously affect school attendance, educational achievements, and decisions leading to criminal behaviour; this means that individuals who attend school more and complete higher levels of education are likely to commit less crime. Another common problem is that governments tend to choose between funding police services and funding schooling reflecting incidence of crime, which introduces another non-causal spurious positive correlation between education and crime reduction. To overcome these problems, many reliable studies have been based on institutional or other policy changes in compulsory schooling or variation in local access to education, i.e., changes which are unlikely to be directly associated with crime (via other channels than education).

Machin, Marie, and Vujic (2011) exploited a 1972–1973 a raise to the minimum school leaving age in England and Wales to estimate the effects of schooling on criminal convictions for property and violent crimes over the period 1972–1996. By a method that disentangled the causal impacts, they estimated that a 1-year increase in men's average schooling levels reduces conviction rates for property crime by 20–30% and violent crime by roughly a third to a half. Another study by Sabates and Feinstein (2008) examined the effects of an explicit education subsidy on youth burglary rates in England utilizing data from the Educational Maintenance Allowances (EMA) pilot project, which provided subsidies and bonuses for coursework completion to low-income 16–18-year-olds, and the Reducing Burglary Initiative (RBI). They used a differences-in-differences strategy to identify the effects of each of these pilot programmes on burglary as well as the combined effect of the two projects together. Their findings suggest that the combination of both projects significantly reduced burglary rates by 1.3 per 1000 youth (about 5.5%). They also show that the estimated effects on burglary rates for 19–21-year-olds who were not offered the education subsidy were much lower and statistically insignificant.

Buonanno and Leonida (2006) estimated the effects of educational attainment on crime rates in Italy using regional panel data from 1980 to 1995. Their estimates suggest that a 10 percentage point increase in high school graduation rates would reduce property crime rates by 4% and total crime rates by about 3%. The effects on property crime are statistically significant, while the effects on total crime are not. However, they found no evidence to suggest that university graduation reduces crime. Most recently, Landerso et al. (2017) used register-based data and

[9] Becker and Mulligan (1997).

discontinuity in the school starting age for children born around New Year to investigate the effects of school starting age on crime of Danish children. They found that a higher school starting age lowers boys' propensity to commit crime at young ages and the number of crimes they commit.

On top of these few important studies from the Member States, there is much richer evidence from the US. There, Anderson (2009) examined the effects of increasing state compulsory minimum high school dropout rate on crime among affected youth. He found that total arrest rates reduce by 8% when the minimum school leaving age is raised from 16 to 17 years. Similarly, a compulsory school leaving age significantly reduces arrests at ages 16–18 by 9.7–11.5%. Overall, the estimates generally suggest that forcing young people to spend an extra year or two in high school significantly reduces their arrest rates over that period. Examining the effects of single day changes in school-wide attendance on juvenile crime and arrest rates in 29 large American cities from 1995 to 1999, Jacob and Lefgren (2003) found that an additional day of school reduced serious juvenile property crime by about 14% that day, while it increased serious juvenile violent crime by 28%. Similarly, Luallen (2006) used variation due to teacher strikes from the state of Washington between 1980 and 2001 to estimate that an extra day of school reduces arrests for property crimes by about 29% while increasing arrests for violent crimes by about 32% in urban areas. A metastudy by Lochner (2011) refers to a sharp drop in the probability of imprisonment of Afroamericans who have completed secondary education vs. high-school dropouts. A one year increase in years of schooling in a US state reduces arrests by 11%. A 10 percentage points increase in upper-secondary school graduation rates reduces arrest rates by 7%.

Particular research attention has been devoted to the link between school quality and crime. Unfortunately, we are not aware of any studies from the Member States that provide direct estimates of these effects. The existing studies, all of which are based on US data, find that better school quality has a notably larger impact on crime reduction than on student achievement.[10]

Early childhood (preschool) interventions may also affect future juvenile and adult crime by fostering socio-emotional (noncognitive) skills such as learning abilities, socialization or aptitudes for crime, risk aversion, patience, or self-control. Substantial obstacles, due to the long-term observations required, data and methodology setbacks, limit credible empirical research in this area and reliable studies are thus rare. One of the few that do exist is a follow-up of the High/Scope Perry preschool programme in the US that followed children to adult life and found that by age 40 the fraction arrested was reduced substantially.

In his rich review, Lochner (2011) concludes that school attendance and education affect crime in very complex ways. The existing empirical evidence from studies exploring education's impact on crime is largely consistent with a human capital-based theory of crime, suggesting that increased schooling reduces most types of adult crime.[11] The overall consensus of the empirical literature is that education can reduce property and violent crime, including violent offences and murders. However, differences in particular local situations, environments and institutions preclude strong generalisations. Donohue and Siegelman (1998) conclude that the overall efficiency of early childhood programmes as a crime-fighting strategy likely depends heavily on the ability to target children at risk at very young ages. However, overall it is difficult to draw strong conclusions about the roles of educational interventions at pre-school ages.

Based on the existing empirical literature, education policies can reduce property crime and violent crime, including violent offences and murders. The empirical evidence suggests that the most sizeable reductions in crime result from the final years of upper-secondary school. Therefore, policies to reduce the rate of early school drop-out should be promising crime reduction

[10] Cullen, Jacob, and Levitt (2006) and Deming (2009a).

[11] Lochner (2004) and Lochner and Moretti (2004).

tools. Lochner (2011) concludes that "*training programs targeted at low-skill adolescents and young adults have modest (at best) effects on earnings and crime. On the other hand, encouraging youth to finish high school (e.g., through compulsory schooling laws) appears to substantially increase earnings and reduce crime. Preventing early school dropout is likely to be more successful than trying to compensate for dropout a few years later."* Because crime rates are much lower among upper-secondary programs, policies fostering tertiary level attendance or graduation probably do not reduce crime so much.

Some researchers, such as Heckman and Rubinstein (2001), also stress the role of noncognitive (psycho-social) skills as an important determinant of many life outcomes, especially for individuals at the bottom of the education distribution. This implies that even if educational programmes only improve social development and noncognitive skills, they may serve as a crime reducing policy tool. Evidence from some school choice lotteries supports this, indicating that better quality peers and socializing can discourage youth from crime without necessarily raising student achievement or educational attainment. *Altogether, the evidence suggests that efforts to socialize young people can provide them with valuable non-cognitive skills and be effective in discouraging them from crime.*

Equal opportunities

The concept of *equal opportunity* is complex and frequently contested. Its meaning has been debated with varied emphasis in many fields other than economics, including political philosophy, sociology, and law. The notions of equal opportunity and equity in relation to education and schooling policies is reviewed in greater detail by Woessmann and Schuetz (2006) who stipulate that this concept calls for equal access to education and training programmes independent of students' circumstances, as well as for the equal treatment of all students independent of their circumstances. They stress that this concept *"…does not necessarily call for a strict equality of educational outcomes in the sense of a perfect sameness or egalitarianism, because people are allowed to choose to differ according to their self-determined effort."*[12]

Since this report is not concerned with the identification or measurement of the scale and scope of unequal opportunities, we do not adopt any particular definition of equal opportunities. In surveying the scientific evidence of causal impacts, we consider primarily interventions that aim to improve the conditions, performance and outcomes of individuals who are, for some reason, disadvantaged by their own productive or other characteristics or by their surrounding environment.

A substantial proportion of situations involving unequal opportunities are associated with non-random sorting to schools and thereafter *peer effects*. The empirical literature is very rich on both these issues, and we thus focus primarily here on more recent studies and aim to document the richness of channels through which externalities operate and the diversity of the existing findings, rather than providing a comprehensive overview.

As concerns spillovers via peers, Fruehwirth (2014) recently challenged the assumption widely used by many studies that peer spillovers can be measured through observables. He noted that in the education context, many peer spillovers centre around unobservables, such as ability, effort or motivation. He shows that when peer effects arise from unobservables, the typical empirical specifications used in previous studies will not measure these effects accurately. He concludes that this may help to explain differences in the magnitude and even signs of the peer effect estimates found in those existing studies. Further, he shows that under reasonable assumptions,

[12] See also Schuetz (2008), European Commission (2006).

such estimates cannot be applied to determine the effects of regrouping students, which has been a motivation central to the academic literature.

It should be noted that the concept of equal opportunities cannot be understood in its full complexity if studied in isolation from the other phenomena which we discuss below in the subsections on intergenerational transmission and transmission of citizenship values.

Examples of causal empirical evidence

Neidell and Waldfogel (2010) examined peer effects in early education by estimating value-added models with school fixed effects that control for individual, family, peer, and teacher characteristics to account for the endogeneity of peer group formation. They found that preschool attendance had statistically significant and robust effects on maths and reading outcomes, but statistically insignificant effects on various behavioural and social outcomes. They conclude that ignoring spillover effects would result in significantly understating the social returns to preschool.

Holmlund and Silva (2014) studied an educational intervention in the UK that targeted underachieving pupils' socio-emotional (noncognitive) skills with the aim of improving attendance and cognitive outcomes. They evaluated the policy's effect on test scores in national exams at age 16 and found some evidence of improved cognitive outcomes. They also found beneficial effects on school presence and positive spillover effects on nontreated students' test scores.

Beuermann et al. (2015) analysed the results of a rare randomized controlled trial experiment in Peru, in which laptops were provided to children attending primary schools for home use. Although the intervention had a notable impact on the childrens' computer proficiency, it also reduced their academic effort as reported by teachers. There were no impacts on their general academic achievement or cognitive skills and little evidence of any peer spillovers within schools.

Hill (2014) investigated the extent to which course repeaters in upper secondary mathematics courses exerted negative externalities on their course-mates. He found that increasing the share of repeaters in a given course resulted in a moderate and statistically significant increase in the probability of course failure for the first-time course-takers. His results also suggest that this negative effect only appears when the share of repeaters reaches a threshold of five to ten percent of the total number of course-takers, and that course repetition spillovers may be distinct from low-ability peer effects.

The effects of school closing policies on student achievement in Michigan (US) were examined by Brummet (2014). His results indicate that, on average, school closures did no persistent harm to the displaced students' achievement and indeed that students displaced from relatively low-performing schools experienced achievement gains. The displacement of students and teachers created modest negative spillover effects on the receiving schools. He concluded that closing low-performing schools may generate some achievement gains for the displaced students, but impose some negative spillover effects on a large number of students in the receiving schools.

A further example of a study exploring spillovers through peer effects among pupils is that by Tonello (2016). Using administrative data from a census of Italian junior high schools he analysed whether the share of non-native students in a school determines externalities that affect the natives' educational outcomes. His results suggest that the non-native student share has a weak negative impact on the test scores of their native peers. More specifically, increasing the non-native school share by 1 percentage point leads to a decrease of 0.043 % in native peers' mean language test scores, while no such effect is detected for maths. The effects are highly nonlinear and marginally increase as the non-native student share increases.

Clifton-Sprigg (2015) examined the peer effect of children whose parents work abroad on their classmates' school performance. Based on data for lower secondary pupils in Poland, he found that the presence of classmates with parents abroad benefits other pupils. In particular, this impact is driven by girls and pupils whose parents graduated from high school. He concludes that this positive effect is likely due to student-level interactions or to teachers' increased commitment to classes with students from migrant families.

A recent study by Patacchini et al. (2017) investigates whether, how, and why individual education attainment depends on schoolmates' educational attainment. Using longitudinal data on students and their friends in a nationally representative set of US schools, they consider the influences of different types of peers on educational outcomes. They find that there are strong and persistent peer effects in education, but that peers tend to be influential in the long run only when their friendships last more than a year. This evidence is consistent with a network model in which the convergence of preferences and emergence of social norms among peers require long-term interaction.

Empirical studies exploring the spillovers created by inclusion policies for students with special needs on their non-disabled classmates are scarce. Fletcher (2010) analysed this at elementary school level. His cross-sectional results suggest that having a classmate with an emotional problem decreases pupils' reading and maths scores at the end of kindergarten and in the first grade by over 10 percent of a standard deviation, which is one-third to one-half of the minority test score gap. Controlling for non-random sorting of students to schools and to classrooms, the identified impact shrinks to approximately 5 percent of a standard deviation in maths and reading scores.

In order to better document the numerous channels through which education involves intergroup externalities we also feature below several recent studies exploring less investigated phenomena.

Carrell and Hoekstra (2010) explored rarely studied peer based externalities due to troubled children. In particular, they estimated the negative spillovers caused by children from troubled families, using data in which children's school records are matched to cases of domestic violence. They found that children from troubled families significantly decrease their peers' reading and maths test scores and increase misbehaviour in the classroom.

Although investigations into peer effects between teachers are quite rare, one of the few such studies recently is one by Jackson and Bruegmann (2009), which uses longitudinal elementary school teacher and student data to document that students have larger test score gains in maths and reading when their teachers experience improvements in the observable characteristics of their teacher colleagues. These spillovers are strongest for less experienced teachers and persist over time; historical peer quality explains away about 20 percent of the effect, which suggests peer learning is at play.

Koedel (2009) examined spillovers between subjects in teaching. In particular, he explored whether educational production in secondary school involves joint production among teachers of different subjects. He estimated the value-added to reading test scores by teachers of four different subjects: English, maths, science, and social studies. While the initial results indicated that reading output was jointly produced by maths and English teachers, falsification tests confirmed the English-teacher effects but cast some doubt about whether the maths-teacher effects were free from sorting bias.

Borghans and Diris (2014) paid attention to how schools allocate instruction time, to what extent the effectiveness of that allocation depends on the immediate effect of instruction in one subject on achievement in that subject, on how skills further develop over time, and on possible spillover effects on achievement in other subjects. Exploiting a policy intervention in Dutch primary

education, they found that the effects of language instruction on language skills faded away quickly, while the effects of (early) language instruction on several other skills are long-lasting. Their results illustrate that spillover effects can arise in the context of skill acquisition.

Intergenerational effects; reproduction patterns; family formation

The intergenerational transmission of educational attainment from parents to their children and vice versa is a widespread and common (externality) phenomenon. Parents' higher levels of education translate into benefits for their children via a plethora of channels. More educated parents have broader economic options and attribute greater value to their children's education, and thus tend to look for better schooling options for them. More educated parents also better inform their children and form their educational aspirations, in turn fostering their upward educational and social mobility. Furthermore, educated parents provide their children on average with more effective social and educational interactions, better transmit citizenship values to them and better cultivate the psycho-social skills and behaviours that lead to the children's better present and future health.[13]

When studying transmission from parents, the phenomenon of assortative mating (or educational attainment homogamy) should be taken into account. In particular, when considering marriage, individuals are more likely to meet with others with a similar level of education and to prefer spouses with similar educational backgrounds. In addition, controlling for income, the divorce rate is 2.5% among those with higher education, compared to 15% among those who have not completed secondary education (Oreopoulos and Salvanes, 2011). This assortative mating means that the actual transmission from parents' education to their children may be stronger than the estimates suggests, if those estimates do not take assortative mating into account.[14]

Table 7 provides a very simple initial insight into how closely parents' educational attainment coincides with their children's educational attainment. It is by no means exhaustive: these are merely a few examples, and the full range of channels through which intergenerational transmission takes place is far richer and more complex.

Table 7. Parental and child education, EU average (% of all children)

Parents' educational level	Children's educational level			
	Low	Medium	High	Total
Low	34	48	18	100
Medium	8	59	33	100
High	3	33	63	100

Source: Eurostat (2013).

Studies based on the OECD PISA survey of 15-year-old students reveal that in effectively all countries, children from higher socioeconomic and parental educational backgrounds have an advantage of 39 to 95 test score points relative to students from less privileged backgrounds. Recent evidence based on data from the adult population survey PIAAC suggests that across OECD countries, better educated parents account for an 18 test score point difference (Blanden and McNally, 2015). As the level of parental education rises, upward social mobility is dominant. Based on the PIAAC survey data, 39% of adults have attained a level of education higher than

[13] More educated parents have healthier children: Currie and Stabile (2003), Lubotsky and Paxson (2002).

[14] Becker (1973) and Mare (1991).

their parents, while 12% have attained a lower level. Moreover, a 20-34 year-old with tertiary educated parents is 4.5 times more likely to participate in tertiary education than a young adult whose parents did not have a tertiary qualification (OECD, 2017).

While these findings are interesting per se, it should be noted that these effects are mere associations and in many cases do not correspond to impacts directly caused by education.

Examples of causal empirical evidence

Kuziemko (2014) investigates the transmissive externalities of education from children to their parents. In particular, she models how children's acquisition of a particular form of human capital incentivizes adults in their household to either learn from them (if the children can teach the skill to the adults, reducing the adults' cost of learning) or lean on them (if the children's human capital substitutes that of the adults in household production, reducing the adults' benefit from learning). She finds that English instruction improves immigrant children's English proficiency but discourages the adults living with them from acquiring the language. Whether family members "learn" or "lean" affects the externalities associated with education.

Increased schooling within a country is usually negatively correlated with fertility, resulting in fewer children. The reason for this can be traced to a trade-off between the number of children and parental investment per child.[15] At the same time, studies such as Kalil et al. (2010), based on welfare reforms in 1990s, have found that more educated mothers spend more time with their children than less educated mothers. Since parental values are transmitted to children, the probability of a child being born when the mother is a teenager diminishes sharply with additional schooling of mother (Oreopoulos and Salvanes, 2011).

The possible existence of intergenerational externalities at preschool level was investigated theoretically by Casarico et al. (2015). They characterized optimal tax policy and quality of day care services in a model of overlapping generations in which the childcare arrangements chosen by parents of different skill types affect the probability that their children become high-skilled adults in a type-specific way. They determined the optimal quality of day care services by equating the total private marginal benefits of a quality increase to its marginal costs, adjusted for the intergenerational externality in human capital accumulation, and the self-selection constraint. However, this is primarily a theoretical insight on possible causal links, which is still to be investigated empirically.

A phenomenon that mixes externality and spillover (in the senses we established at the beginning of this report) is the role parental education plays in child health. One of the first attempts to identify this causal relationship was by Currie and Moretti (2003), based on US data exploiting variation in the opening of colleges between 1940 and 1996. Relative to a high school graduate, their estimates suggest, one additional year of tertiary education (at college) reduces the probability of having a low-birthweight child by about 20% and a pre-term birth by about 15%. A year at college reduces the incidence of smoking during future pregnancy by about one third, and results in a 3% increase in the incidence of prenatal care. Therefore, the spillover from parental education to birth outcomes seems to work primarily via reducing smoking.

A study by Memptner and Marcus (2013) investigates the effects of maternal education on child health and health behaviour using a rich German panel data set containing information about three generations. Using information on the number of siblings and grandparental characteristics, they find that maternal education has substantial effects on the health behaviour of adolescent daughters, but not on adolescent sons nor on the health status of newborn children. They note

[15] Becker and Lewis (1973), Becker and Tomes (1976)

the mother's health behaviour, assortative mating, household income, and child's schooling track as possible channels of the estimated effects. A mother's education seems to affect her daughter's smoking behaviour through the higher likelihood of the daughter pursuing a higher secondary schooling track.

Recent study by Qureshi (2017) documents sibling spillover effects on child test score achievement using administrative school records. Teacher's experience affects the achievement of a child's younger siblings, but not of the older one, suggesting existence of more important direct sibling effects rather than parental behaviour responses. Their findings suggest underestimation of the importance of education inputs by ignoring the spillover effects on siblings.

Externalities in the provision of education may play an important role via intergenerational conflicts. As noted by Epple et al. (2012), these conflicts arise because older households without children have weaker incentives to support the provision of high quality educational services than younger households with school-age children. Using a model of overlapping generations they show that observed inequality in educational policies across communities is determined by the communities' different stratification by age, and that a political process dominated by older voters correlates with lower quality educational services. The residential mobility of older households creates a positive fiscal externality since it creates a larger tax base per student. Epple et al. (2012) show that this positive tax externality can dominate the negative effects that arise because older households tend to vote for lower educational expenditures.

At the macro-level, educational externalities may play a role in intergenerational transmissions via pay-as-you-go pensions systems. Complex financial channels are theoretically described, for example, in a new study by Andersen et al. (2017), which points out that a kind of negative externality appears when the increased level of education among younger generations reduces fertility, which has an adverse impact on the elderly via the pay-as-you-go pension system. Le Garrec et al. (2013) explore the impact of delaying the legal age of retirement in industrialized economies where population ageing is forecasted to increase the social security burden. They study the macroeconomic and distributional consequences of a global gain in life expectancy, with or without postponing the legal age of retirement and with or without a 'long career' exception. By considering a framework where individuals decide to acquire skills depending on economic incentives and differential mortality, they focus particularly on the spillover effects possibly generated by education.

Social cohesion, democratic citizenship, electoral participation, and values

Existing empirical evidence from the broad area of the social sciences supports the wisdom that education enhances social cohesion in the sense of people trusting each other more. Since social cohesion enables more effective social and economic interactions, it also fosters better economic performance in local and even larger communities. As elaborated and explained by Lochner (2014), the idea that education encourages and strengthens democracy goes back to Lipset (1959) who referred to Aristotle when emphasizing the role of education in informing citizens and increasing their capacity to make "good" electoral decisions while resisting demagoguery. Education may also affect both the benefits and costs of voting and other forms of political engagement. For example, education may instil civic and democratic values, either through the explicit design of education systems (especially in democratic countries) or indirectly by improving analytical skills and an awareness of history and of the diversity of opinions available. Education may also indirectly affect political participation by altering social networks and peers. By raising wage rates, education may affect the time costs associated with active political participation and voting. Schooling also changes people's preferences, e.g., by focusing students' attention on the more distant future and reducing myopia (Becker and Mulligan, 1997).

Oreopoulos and Salvanes (2011) document strong associations between educational attainment and numerous non-market phenomena, such as voting turnout, life-satisfaction, incidence of divorce, after controlling for income and other characteristics. For example, controlling for income, in the US only 30% of those with less than secondary education believe that people can be trusted, vs. 58% of those with higher education. Individuals with more schooling are more likely to report having voted. Milligan, Moretti, and Oreopoulos (2004) report that while only 52% of US high school dropouts report voting, this percentage increases to 67% for high school graduates, 74% for individuals with some college education and 84% for college graduates.

Examples of causal empirical evidence

While the research has primarily focused on the causal link between education and democracy as a channel fostering economic growth, Persson (2015) pointed out that most studies of political behaviour find that individuals with higher levels of education participate in political activities to a greater extent. This informs the conventional wisdom that education increases civic skills and political knowledge, in turn fostering participation. However, a number of recent studies have started to investigate whether education directly causes political participation or merely works as a proxy for other factors, such as pre-adult socialization or social network centrality.

The empirical economic literature in this area can be divided into two broad strands: macroeconomic studies relying on highly aggregated data and microeconomic studies employing data at the level of individuals, families and households.

There have been numerous macroeconomic empirical studies and a comprehensive review would require another report on the scale of this one. We therefore offer only a summary of the key notions. Macroeconomic studies rely on state or country level time-series aggregates of economic performance and various ad-hoc drafted indicators of democracy and education. Identification of the causal links is extraordinarily cumbersome due to the complex interlinkages between most observed and many unobserved factors, and the presented findings are therefore always subject to more or less severe criticism. Not surprisingly, the findings of the various studies have differed a lot and depend substantially on the data used, assumptions made, and methodology employed.

Since Barro (1999), economists have sought to identify empirically the causal links between national educational attainment and countries' economic performance and democratic values, such as electoral rights and civil liberties. Bourguignon and Verdier (2000) build an influential theoretical model, which shows that a more equal initial distribution of education can lead to faster democratization and greater economic growth. Glaeser, Ponzetto, and Shleifer (2007) stress the social nature of political action and education's role in facilitating social interaction. In their model, education endogenously affects political participation, assuming more educated individuals are better at persuading others to become politically active. Another important finding is by Castelló-Climent (2008) who report that an increase in the education attained by the majority of the population is what matters for the implementation and sustainability of democracy, rather than the average years of schooling which may be driven by educational attainment of groups at both end of the educational attainment. Spilimbergo (2009) analyses a panel of 183 countries during the period 1960-2005 and finds that foreign-educated individuals promote democracy in their home country, but only if the foreign education is acquired in a democratic country. His findings give support to the view that education is an appropriate means of providing foreign aid to countries with a deficit of democracy.

In the microeconomic strand, only a small number of studies have exploited individual-level data – from the US, United Kingdom, and Germany – to estimate the effects of an individual's education on their likelihood of participating in the political process in one way or another.

Recent studies by Dee (2004), Milligan, Moretti, and Oreopoulos (2004), and Siedler (2010) use individual-level data and advanced methods to estimate the causal effects of educational attainment and graduation on civic engagement outcomes such as voter registration, voting, and support for free speech. In addition to a line of studies using US data, Milligan, Moretti, and Oreopoulos (2004) analyze political behaviour in the United Kingdom during the 1980s and 1990s and Siedler (2010) studies political outcomes in (formerly Western) Germany combining data from the German Social Survey and the ForsaBus survey on political attitudes between the late 1980s and 2006.

Most of the US micro-level studies' findings (Lochner, 2011) are in line with intuitive expectations: education has a positive impact on political interest, efforts to acquire information about politics and elections, political views about civil rights and freedoms, and general political and social involvement. The effects are either notably smaller or not identified in the case of Germany and the UK. Interestingly, the impact on voter registration and voter turnout in the United Kingdom and Germany is notably weaker compared to the US. However, the authors suggest that this discrepancy is the result of differences in the administrative way in which voters are registered in the UK and Germany compared to US practices. There is modest evidence from the UK that additional secondary schooling increases individuals' efforts to discuss politics with others and to persuade others to share their views. However, the evidence from Germany is generally inconsistent with the view that education encourages democratic ideals.

Cahlíková (2015) uses participation in the Erasmus study abroad program to identify the effect of international experience. In particular, she finds that students, who have returned from the Erasmus study abroad programme exhibit less trust towards people from southern Europe than those from northern Europe.

Pelkonen (2012) estimates the impact of increasing the duration of compulsory schooling in Norway from seven to nine years on voter turnout. He measures the impact both at the individual level and at the municipality level, and finds that additional education has no effect on voter turnout. He also estimates the impact of education on various measures of civic outcomes, but the only positive impact identified is on the likelihood of signing petitions.

Dinesen et al. (2016) explore the much-discussed effects of education on political participation by utilizing data from monozygotic (MZ) twin pairs from the United States, Denmark, and Sweden. They show that while the relationship between education and political participation is highly confounded by genes and/or familial environment in all three countries, years of education in the US and high school completion in Denmark do have a clear positive impact. No effect is found in Sweden.

Persson (2014) challenges the widespread wisdom that education has a direct causal effect on political participation. He uses data from a British cohort study that follows everyone born during 1 week in the UK in 1970 and provides a rich set of variables measuring factors such as cognitive ability and family socioeconomic status through childhood and adolescence. The results show that education has no significant effect on political participation and imply that a great deal of the observed correlation between education and political participation may be due to spurious factors and not causal processes.

Using data on attitudes and knowledge among about 30,000 students from Greece, Norway, Slovenia, and Sweden, Persson (2016) employs a between-grades regression discontinuity design to estimate education's causal effect on political knowledge, intentions to participate in politics, and democratic values, utilizing exogenous variation related to school entry age. His results show that an additional year of schooling has no detectable effect on political knowledge, democratic values or political participation.

Persson and Oscarsson (2010) analyse the outcomes of an extensive reform of the Swedish educational system in the mid-1990s, which aimed to create a 'school for everyone', fostering social equality. In particular, the reform implemented longer educational programmes for all students, with an extended curriculum of social science courses including civic education. The study found that the reform had no impact on the pre-existing gap in levels of democratic citizenship, such as political participation, political knowledge and political attentiveness, between students in theoretical and vocational gymnasium study programmes.

V. Policy conclusions

When one observes the obvious excess of benefits education provides, compared to its costs to the educated individual, it seems likely some sort of market failure is present. This may, first and foremost, be caused by financial constraints that prevent individuals (children and their parents, students, trainees) from investing more in education so as to reap all its potential future monetary and non-monetary benefits. Second, it may be that the individuals fail to sufficiently perceive some of those future benefits as a result of their long time horizon and hidden causal links, or the individuals' limited access to complete and precise information and the costs of searching for it . Third, the individuals' incentives to invest in education might be less than socially optimal if the benefits of better education are already being enjoyed by numerous others, such as peers or co-workers and fellow citizens (spillovers).

Evidence of the existence of persistent sizeable externalities, including spillovers, is a justification for public intervention. The choice and design of suitable interventions should reflect the character of the particular market failure, the type, scale, and scope of the externalities in question and, if possible, the actual processes through which education causes those externalities. A theoretical understanding of these processes accompanied by solid empirical evidence is therefore indispensable. Once the scale and scope of the externalities are known, and the processes causing them are understood, then a cost-benefit analysis of the overall public investment in education should be elaborated. In a detailed cost-benefit analysis, as stipulated by Lochner (2011): *"It is important to determine whether individuals implicitly or explicitly pay for benefits associated with greater education (e.g., for better health insurance or more expensive treatments). This is crucial for determining the net return on education and the value of education as a benefit generating policy goal, since additional costs should be netted out. Second, it is important to determine whether benefits accrue exclusively to the individual who becomes educated, to other family members, or to broader social networks [peers], neighbours, and society at large."* Naturally, the difficulty of measuring education's non-monetary benefits and assigning them appropriate values presents a very limiting factor when it comes to following this advice. It is also important to disentangle whether the potential benefits come at some direct cost to the individual (other than through the costs associated with schooling) and whether the benefit comes from the individual's own education or whether it results from the education of others (family members, peers, colleagues, fellow citizens). It is important to distinguish the different channels through which education causally translates into these benefits, and in particular to understand the extent to which these benefits are driven by differences in demand by individuals, in which case they are likely to be paid for via costly inputs and foregone opportunities.

It is always important to ask to what extent are individuals aware of future benefits associated with additional schooling. If more education makes someone better off, living longer and so on, and if individuals are well aware of this, one can assume that individuals (students, children and/or their parents) will take this into account when making their education decisions and investments. However, if individuals are not fully aware of the future benefits additional education can generate,

or if the effects come in form of a spillover via peers such as crime or health, then policy interventions are relevant.

If it becomes clear that individuals are unaware of the benefits of additional education, or fail to incorporate them fully when making their education decisions, governments may wish to subsidize education or to make a higher level of education mandatory. Alternatively, or simultaneously, governmental interventions may also take the form of public information provision, to lower the individuals' costs of making a more informed decision.

The growing role of education in modern societies, underscored by ever growing public schooling budgets, a longer average time spent in education and training, and growing educational attainment and achievements, suggests that yet greater challenges lie in store for future research efforts in the area of educational externalities. Since the existing empirical findings primarily take the form of case studies from particular countries and times, which cannot be easily generalised, future research should look at the Member States more broadly rather than concentrating on just a few. The focus of the research effort should primarily be on major and costly educational programmes and on processes and phenomena more susceptible to externalities (with the help of evidence from other countries). Furthermore, the Member States should support research of a competitive nature, in which various research teams critically compare the findings from their own investigations and approaches. Providing institutional conditions for the collection and processing of good quality data for research purposes is therefore key institutional and policy element.

Since there is currently limited empirical evidence from the Member States, policy debates are frequently based substantially on evidence from the US where empirical studies in this area are more abundant. It should be kept in mind that estimates emanating from the US environment have tended to find that education has larger causal impacts than research from the Member States. In this respect it should be noted that the impacts of increased education and externalities within the EU on the current margin (at current levels) might not be as strong as in the US. This can easily be explained by territorial and socio-economic differences in access to quality education, universal health care and social support, and the fact that the US society exhibits notably higher socio-economic inequalities.

Beyond these general policy recommendations, there are a number of specific issues relevant to the particular types of externalities we have reviewed in this report.

Many methodologically serious studies suggest that additional education for young people brings about (private) health benefits and that the peer effects of risky youth behaviours such as smoking and drinking may amplify the effects of educational policies on youth. At the same time, the extent to which education spills over to health via peer effects and social interactions in the adult population differ a lot, as do the processes by which this happens, and the evidence is not strong enough to enable us to draw any strong general conclusions.

As far as the causal link between education and crime is concerned, local environmental conditions seem to be quite an important intervening factor. It is more likely that programmes that are intentionally focused on children at risk of crime will have greater impact than general programmes. Numerous studies have found that merely increasing school attendance among the disadvantaged youth appears to be successful in substantially reducing their criminal activity, while it does not necessarily improve their academic outcomes. Given the mixed findings, the impacts of better schools on crime appear to be driven largely by school quantity and not “quality.” In other words, educational policies may achieve a reduction in crime without increasing educational attainment. In general, targeted policies specific to crime-prone groups are likely to have a greater impact on crime reduction than general policies. Targeted policies may also reflect the fact that the incidence of crime is notably greater among men than among women, given

education. At a very practical level, existing computations[16] suggest that targeted skills enhancement policies are at least comparable in efficiency to more traditional law enforcement and punishment-based policies.

[16] Lochner and Moretti (2004) and Donohue and Seigelman (1998)

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