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The importance of human capital for economic outcomes

Virtual meeting, 16 February 2022, 12:00 – 16:00 (CET, Paris time)

This background note on the importance of human capital for economic outcomes is intended to inform Session 1 of the High-Level Seminar on Value for Money in Post-Covid Education.

Human capital is widely regarded as a fundamental input in the theoretical growth literature. Furthermore, recommendations to boost human capital feature prominently among structural policy priorities identified by the OECD for a great number of countries (OECD, 2021a). However, despite this emphasis in both economic theory and policy practice, the empirical evidence linking human capital with economic outcomes, especially at the macroeconomic level, has been problematic. This note provides a short selective overview of the role of human capital in determining economic outcomes, including both microeconomic and macroeconomic evidence, and concludes by summarising a proposal for a new measure of human capital, which better incorporates both quality and quantity dimensions by using OECD data from the Programme for International Student Assessment (PISA) and the Programme for the International Assessment of Adult Competencies (PIAAC). Incorporating this new measure of human capital within the OECD's standard framework for assessing structural reforms suggests substantial scope for long-run productivity gains from human capital, with greater potential from improvements in the quality than the quantity component of human capital, although the lags are typically much longer compared to other policies that boost productivity.

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Introduction

1. The fiscal response of OECD governments to the Covid-19 crisis has been swift. Across the OECD, governments have committed trillions of dollars to support public health systems, prevent massive business failures and protect households from the impact of the crisis. The additional spending (or foregone revenue) amounts to around 10% of GDP on average in OECD countries over 2020-2021, with wide disparities across countries (IMF, 2022). The aid to the health sector represents on average 1.5% of GDP. Public debt ratios in 2023 are projected to exceed 2019 levels considerably (by 14 percentage points in the median OECD economy) (OECD, 2021b). They will need to be adjusted over the medium term given future demands on public finances from long-term trends such as ageing populations (Guillemette and Turner, 2021) and climate change. Boosting growth will help reduce the debt-to-GDP ratios.

2. As substantial resources will continue to be needed for the health sector and the economic recovery over the coming years, finance ministries will be faced with complex choices and competing budgetary priorities in seeking to balance short term and long term economic and social goals. In this context, it is useful to undertake a critical assessment of the importance of various pillars of economic growth, and more specifically the importance of education, for economic outcomes.

3. From an economic perspective, sustained high quality education constitutes a long-term investment in the knowledge, skills and competencies of people, leading to higher productivity, earnings and quality of life for individuals. At the macro level, a well educated workforce is a key factor in achieving greater aggregate productivity, innovation and long term economic growth. Yet, these economic benefits are not always straightforward to measure, in part due to data constraints.

4. Human capital is widely regarded as a fundamental input in the theoretical growth literature.[1] Furthermore, recommendations to boost human capital feature prominently among structural policy priorities identified by the OECD for a great number of countries (OECD, 2021a). However, despite this emphasis in both economic theory and policy practice, the empirical evidence linking human capital with economic outcomes, especially at the macroeconomic level, has been problematic.

5. This note provides a short selective overview of the role of human capital in determining economic outcomes, including both microeconomic and macroeconomic evidence, and concludes by summarising a proposal for a new measure of human capital, which better incorporates both quality and quantity dimensions by using OECD data from the Programme for International Student Assessment (PISA) and the Programme for the International Assessment of Adult Competencies (PIAAC). Incorporating this new measure of human capital within the OECD's standard framework for assessing structural reforms suggests substantial scope for long-run productivity gains from human capital, with greater potential from

[1] For a recent survey of the economic growth literature, including the role played by human capital, see Jones (2016).

improvements in the quality than the quantity component of human capital, although the lags are typically much longer compared to other policies that boost productivity.

6. This background note is organised around five sections:

i. First, the note provides a brief account of the literature on the role of human capital for economic outcomes, and its importance as a key structural policy priority in OECD countries.

ii. Second, the note elaborates on the definition of human capital and the conceptual framework underpinning the concept.

iii. Third, the note reviews the empirical microeconomic evidence on rates of return to education for individuals, in terms of employability premia and equilibrium effects.

iv. Fourth, the note outlines the empirical macroeconomic evidence deriving from growth accounting and cross-country regression analyses.

v. Finally, the note offers a proposal for a new measure of human capital based on OECD PISA and PIAAC and mean years of schooling data, and examines the effects of this new measure of human capital on multi-factor productivity.

Human capital is among the main OECD structural policy priorities

The OECD has consistently singled out education and skills development as a key structural policy priority in its economic reviews of OECD and non-OECD countries…

7. Boosting human capital is one of the main structural policy priorities recommended by the OECD for a large number of OECD and non-OECD countries (OECD, 2021a and Figure .1). In both cases, recommendations related to education and skills development account for the second largest share of total policy priorities behind product market reform. Further, the recommendations concern all levels of formal education and training in the workplace (Figure .2) :

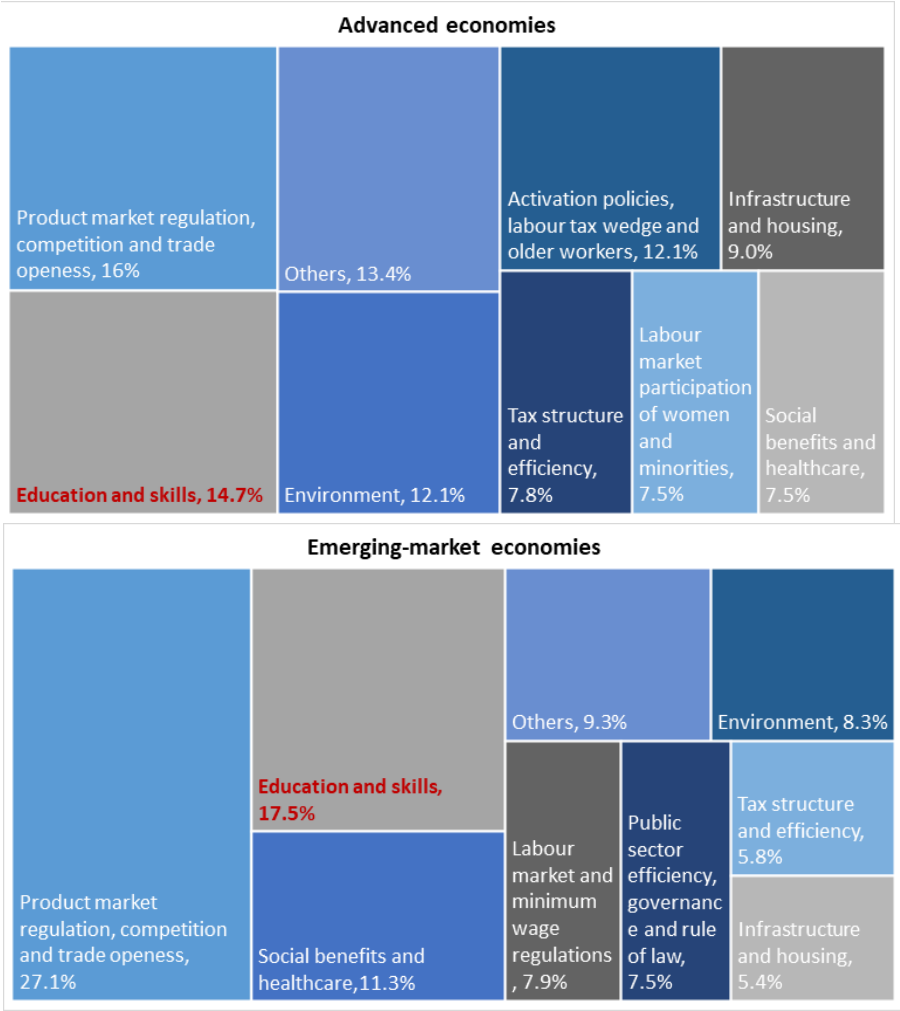
- **Expanding the quality of pre-school childcare.** Evidence shows that early childhood education and care provides the basis for a child's future skills development and learning. This is particularly true for disadvantaged children (OECD, 2018). Expansion of pre-primary education improves educational attainment, labour market attachment and welfare dependency (Braga et al. (2013), Havnes and Mogstand (2011)).
- **Improving teacher quality**. Within schools, teaching quality is the single most important factor that affects students learning (OECD, 2005). The quality of teachers is an elusive concept that cannot be directly measured reliably, but it has been proxied, for instance, by the share of certified teachers, the PIAAC score of teacher or teachers wages, which have all been found to show a positive association with student test scores (Hanushek et al (2013), Hanushek et al. (2018) and Dolton and Marcenaro-Gutierrez (2011)). These findings suggest that teacher quality does indeed matter, although the exact mechanisms at play remain to be investigated.
- **Improving tertiary education**. Tertiary education has an impact on wage earnings of the graduates. Higher education institutions that have the autonomy to manage their financial resources, staff policies and the selection of students have been often shown to achieve better educational outcomes (Oliveira Martins et al., 2007).
- **Developing lifelong learning**. While technology is evolving rapidly, workers need to adapt quickly to the new requirements of the labour market. Skills acquired in formal education or in previous jobs become obsolete more quickly. Lifelong learning is key to help workers upgrade and expand their skills and adapt to technological change (OECD, 2021c). On average across

OECD countries, 57% medium and high-income adults participate in adult learning, while they are only 35% among the low-income adults (OECD, 2019b). Policies should aim at involving people with low levels of education into lifelong learning. Denmark, Sweden and Norway managed to attain the same participation of workers regardless of income level (OECD, 2019a).

This emphasis on education and skills development is consistent with the prominence of human capital as a key driver of productivity and growth in economic theory

8. The prominence of education policy recommendations in structural reform priorities is not surprising considering the strong theoretical underpinnings of the importance in human capital in productivity and income developments. However, efforts at providing empirical evidence have been more mixed, not least because of the difficulties in developing a measure of human capital that can adequately capture intangible characteristics such as knowledge and skills. This is briefly reviewed in the next sections.

Figure .1. Human capital among the main structural policy priorities



Source: OECD, Economic Policy Reforms 2021: Going for Growth: Shaping a Vibrant Recovery, OECD Publishing, Paris.

Figure .2. Policy recommendations regarding human capital

Source: OECD, Economic Policy Reforms 2021: Going for Growth: Shaping a Vibrant Recovery, OECD Publishing, Paris.

Human capital as a driver of economic outcomes: definition and conceptual framework

Economic theory has long envisaged human capital as a limited stock of knowledge and skills conceived as a production factor with a finite impact on GDP per capita

9. Human capital can be broadly defined as the stock of knowledge, skills and other personal characteristics embodied in people that help them to be more productive. Investment in human capital includes investment in formal education (early childhood, formal school and higher education system, adult training programmes), but also informal and on-the-job learning and work experience. A wider definition includes health as well.

10. Understanding the determinants of the growth of economies has involved the work of many economists for decades. Starting with a standard aggregate production function where the output of the economy is a function of labour, capital and technological change (Solow, 1956), the augmented neoclassical growth models incorporated human capital as a production factor (Mankiw et al. 1992). In these models, the change in gross domestic product per worker is linked to the change in human capital, the latter having only a limited impact as the capacity for a country to invest in human capital faces natural constraints (Hanushek and Woessman, 2021).

But endogenous growth models have reinforced interest in human capital, arguing that it also contributes to long term growth indirectly, through innovation diffusion and TFP[2]

11. By contrast, the endogenous growth literature argues that growth is eventually driven by innovation and that human capital is key to raise the innovative capacity of a country (Schumpeter (2006), Lucas (1988), Romer (1990), and Aghion and Howitt (1998)). In these models, the changes in GDP per worker

[2] Total Factor Productivity.

are linked to the level of human capital, the latter influencing long-run growth rates. A last strand of literature argues that human capital facilitates the diffusion of technologies (Nelson and Phelps (1966), Welch (1970), and Benhabib and Spiegel (2005)). In these models, human capital influences growth directly and indirectly through its impact on total factor productivity.

12. A key question is whether the relationship between human capital and growth is causal i.e. if higher human capital generates more growth or if higher growth leads to higher human capital. This question is essential as policymakers expect the policies directed to improve human capital to have a positive effect on long-term growth. The first studies analysing the link between the years of schooling and growth may have encountered reverse causality issues (Bils & Klenow, 2000 and Hanushek and Woesmann, 2021). By contrast, the use of student performance should prevent a misinterpretation, as it is unlikely that higher growth leads to higher student performance. Indeed, the literature has found little impact of an increase in education spending on student performance, so there is little chance that higher growth-induced expenditure have an impact on student performance (Hanushek & Woessmann, 2011).

Empirical microeconomic evidence of the outcomes of education for individuals

13. In human capital theory (Becker, 1967), schooling is seen as an optimising investment decision based on future benefits and the costs of education. While there are costs associated with the pursuit of studies, the individual returns to education can be large (Schultz (1961) and Mincer (1974)). More education is supposed to increase the productivity of individuals that will translate into higher salaries and higher employability probability.

Empirical estimates of rates of return to education show positive returns to more time spent in education

14. A general view is that the demand for education depends on the economic incentives associated to studying (Becker, 1967; Freeman, 1986). The common use of mean years of schooling (MYS) in many panel regressions as a proxy measure of human capital relies on two assumptions: i.) returns to education do not differ across countries and over time; ii.) returns are linear to the quantity (years) of education. The second assumption is based on microeconomic evidence using Mincerian wage equations according to which log wage earnings is a linear function of the time spent in the education system (and a positive, but decreasing, function of work experience). The specification is named after Jacob Mincer (1958, 1974) and has been described as "*one of the most widely used models in empirical economics*".

15. Against this background, empirical studies from the late 1990s started to question the assumption of linear returns to years of schooling and instead adopt decreasing marginal returns, so that primary education had the biggest marginal returns, followed by secondary education, with tertiary education having the lowest returns. A first wave of studies relied on piece-wise linearity assuming returns of 13.4%, 10.1% and 6.8% for primary, secondary and tertiary education, respectively (Hall and Jones, 1999; Caselli, 2004; and Feenstra et al. 2015). A second wave relied on a polynomial specification, advocated by Morrisson and Murtin (2013), which smoothed out the step decreases in the piece-wise linear form of decreasing returns.

16. The most recent and reliable data suggest that average returns to primary, secondary and tertiary education are U-shaped relative to the time spent in education (Psacharopoulos and Patrinos (2004); Montenegro and Patrinos, (2014)). The pattern of returns has important implications for measures of human capital. In particular, assuming U-shaped, increasing or decreasing returns yields considerable differences not only in the level, but also in the slope, of the human capital variable.

Education also translates into employability premia

17. Acquiring more of education means having a lower risk of unemployment and a higher likelihood of participation in the labour market. The gap in unemployment risk across the different levels of education is particularly large for the young, and it tends to narrow with age (Blondal et al, 2002). Using the Heckman two-step method to assess and correct for the selection bias (Heckman, 1979; Heckman et al. 2005), evidence shows that the estimated conditional probability of employment for a tertiary education holder is around two percentage points higher than for an upper-secondary degree holder (Boarini and Strauss, 2007).

But microeconomic studies cannot easily integrate general equilibrium effects to estimate the overall macroeconomic impact of a policy change

18. A weakness of microeconomic studies is that they cannot easily integrate general equilibrium effects, as the returns to education are estimated on data corresponding to a given state of the economy, with given prices and policies. Thus, the estimated marginal impact on any individual's income may not be representative of the overall macroeconomic impact on the economy if a new policy is applied widely.

Empirical macroeconomic evidence of the aggregate impact of education

19. While theoretically human capital is a key determinant of growth, finding an empirically robust relation between human capital and growth at the macroeconomic level is not an easy task because, among other things, there is no widely accepted definition of human capital.

In growth accounting studies, the contribution of human capital to differences in cross-country income depends on the measure of human capital used

20. The growth accounting methodology consists in decomposing income differences across countries into the variation of their components: physical capital, human capital, and a residual, the total factor productivity, which represents the technical progress. The exercise requires income and its components to be measured correctly and is dependent on the assumed functional form of the production function (Flabbi and Gatti, 2018).

21. The contribution of human capital to differences in cross-country income depends on the measure of human capital used. Using secondary school enrolment, Mankiw et al. (1992) find that the difference in human capital explains 50% of income differences. Using years of schooling attainment, Klenow and Rodriguez-Clare (1997) find that human capital accounts for only 10 to 30 percent of income differences. Adjusting human capital for quality leads to broadly the same finding that human capital explains a smaller share of income differences (Caselli, 2004). Under the assumption of perfect substitutability of skilled and unskilled workers, those studies aggregate the different types of human capital into a single measure.

22. Removing the perfect substitutability assumption leads to different results (Flabbi and Gatti, 2018). Jones (2014) suggests computing aggregates by taking into account the different returns of the different categories of human capital (skilled and unskilled workers) as a function of their relative scarcity and the possible complementarities between them. Based on the same data used by Caselli (2004), he concludes that physical and human capital variations can fully explain output differences between countries. Removing also the perfect substitutability assumption and using a broader definition of skills, Malmberg (2016) argues that human capital accounts for the bulk of income differences across countries.

Likewise, cross country growth regressions provide mixed evidence on the relationship between quantity-based measures of human capital and economic outcomes

23. Macroeconomic cross-country growth regressions provide mixed evidence on the relationship between economic outcomes and quantity-based measures of human capital, including literacy, enrolment rates and mean years of schooling (Benos and Zotou, 2014). Past OECD studies looking at OECD countries confirm the difficulty of finding a robust positive effect of human capital on income per capita or productivity levels. First, including a large number of control variables in the regression analysis tends to reduce or eliminate the statistically significant positive effect. Human capital may be correlated with other variables, in particular those representing good governance, and may have indirect effects through such variables. They are likely to weaken the estimated effect of human capital (Fournier and Johansson, 2016). Second, using common time fixed effects appears to weaken the estimated effect of human capital as it has a similar time trend across OECD countries (Égert, 2017). Thirdly, the estimated effect is sensitive to the measure of human capital and to the estimation method (Guillemette *et al*., 2017).

24. One major criticism of many of these macroeconomic studies is that they use quantity-based measures of human capital that do not capture quality aspects. The same length of schooling does not mean the same amount of knowledge and skills if the quality of education differs across countries and evolves over time. In a first new strand of the literature, MYS was adjusted by the returns to education. However, the available estimates of returns to education may not capture this sufficiently, especially if they are averaged over countries or time, particularly because returns may differ due to other factors such as labour market conditions. Moreover, MYS, even if adjusted for work experience, do not account for training received after leaving the formal education system and for a possible depreciation of skills.

25. Another strand of the literature has attempted to model both quantity and quality dimensions of human capital to explain macroeconomic variables (such as productivity or GDP per capita) following two main approaches:

- Including a measure of quality (e.g. student test scores) and quantity (MYS) as separate explanatory variables in panel or cross-country regressions (for example: Altinok, 2007; Hanushek and Kimko, 2000; Hanushek and Woessmann, 2012; Fournier and Johansson, 2016; Barro and Lee, 2015). However, the usual unsatisfactory result of such an approach is that either the quantity or (more often) the quality variable is dominant and the other is statistically insignificant and quantitatively unimportant. Moreover, such effects can become fragile if additional control variables are added (Fournier and Johansson, 2016).
- Another approach takes a combination (usually a product or geometric mean) of MYS and a variable representing the quality dimension, usually based on student test scores and often relative to a benchmark country (for example: Altinok, 2007; Fournier and Johansson, 2016; Islam *et al*., 2014). The resulting composite variable is sometimes being referred to as *learning-adjusted years of schooling* (LAYS). A weakness with these approaches is that the relative weighting of quality and quantity components is arbitrarily imposed during the construction of the composite variable (so that typically an equal percentage increase in the quality or quantity dimensions has the same effect on the composite measure).

A new measure of human capital to improve estimates of the macroeconomic outcomes of education

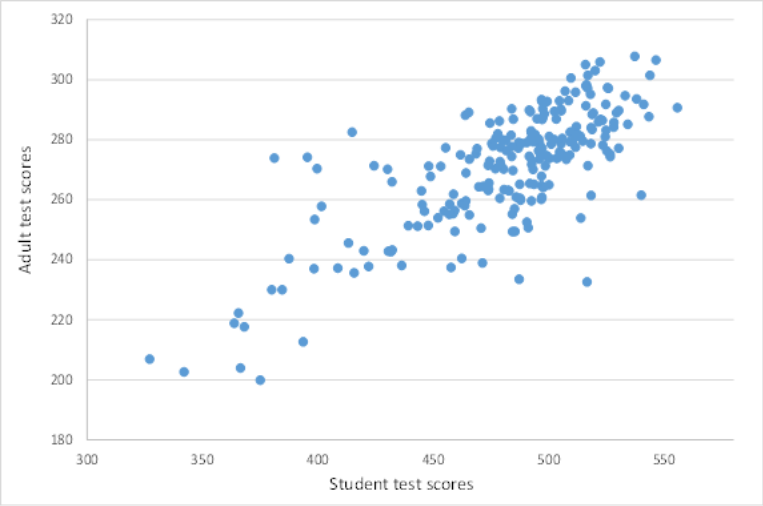
To address the shortcomings of previous empirical studies, a new measure of human capital is developed using PIAAC, PISA and MYS data to account for quality and quantity of education

26. A new stock measure of human capital has been developed recently by exploiting data from the OECD Programme for International Student Assessment (PISA) and the Programme for the International Assessment of Adult Competencies (PIAAC) (OECD, 2022). It attempts to overcome inherent problems with using either in isolation: PIAAC provides a measure of skills for the entire adult working population, but has no time series and limited country coverage; PISA, especially when combined with similar international test scores, has a much longer time series and country coverage, but only applies to those aged 15. Moreover, conceptually, PISA measures the quality of education in primary or secondary schooling resulting in quality effects transmitted to the stock of working-age population with very long delays.

27. The analysis shows that skills at the age of 15 (measured by student test scores) have a strong empirical relationship with skills (measured by PIAAC) observed later in adulthood of the same cohorts (Figure .3). Regression analysis estimates that, depending on the specification, the elasticity of cohort-specific adult skills with respect to student test scores is three to four times higher than the elasticity with respect to mean years of schooling. Exploiting this link, a new stock measure of human capital, covering the working age population and reflecting both the quality and quantity of education, is calculated as the cohort-weighted average of past student test scores and mean years of schooling of current cohorts.

Figure .3. Student and adult test scores are correlated

Adult test scores of specific cohorts matched with earlier student test scores of the same cohorts 35 OECD and non-OECD countries



Note: Adult test scores of specific cohorts, obtained from surveys of adult skills, are matched with earlier student test scores of the same cohorts for the 35 countries for which both PIAAC and PISA scores are available. Student test scores denote the average scores for reading, maths and science. Adult test scores stand for the average of scores on literacy, numeracy and problem solving.
Source: OECD (2022), "A new macroeconomic measure of human capital exploiting PISA and PIAAC", OECD Economics Department Working Papers, forthcoming.

This new human capital measure shows a strongly significant correlation with multi-factor productivity…

28. The effect of the new measure of human capital is evaluated within the OECD Economics Department's *Quantitative Assessment of Structural Reforms* framework (Égert and Gal, 2017). The framework quantifies the impact of structural reforms on per capita income and includes a multi-factor productivity (MFP) regression. In addition to human capital, the policy determinants of MFP include an indicator of product market regulation; a measure of innovation intensity; trade openness (an intermediate policy outcome, which proxies trade policies) and the output gap as a cyclical control variable.

29. When added to the cross-country time-series regression, the new measure of human capital has a strongly significant correlation with MFP. To assess the potential productivity gains from improvements in human capital, the effect of closing the gap between the median OECD country and the top three performers, in both quantity and quality components of the new human capital variable are separately considered:

- A sustained improvement in PISA student test scores by 5.1%, equivalent to an improvement by 25.5 points from the median OECD country (496.2, the average of the Czech Republic and Norway in 2018) to the average of the leading three countries (Estonia, Japan and Korea in 2018), is estimated to increase MFP by between 3.4% and 4.1 % in the long run (for details see OECD, 2022).
- A sustained increase in mean years of schooling by 9.3% equivalent to an improvement by 1.2 years from the median OECD country (12.7 years, the average of the cohort of 20 to 24 years in Lithuania and Poland in 2020) to the leading 3 countries (Ireland, Australia and Japan), is estimated to increase MFP by between 1.8% and 2.2 % in the long run (OECD, 2022).

… and much larger potential productivity gains from improvements in the quality of human capital than its quantity

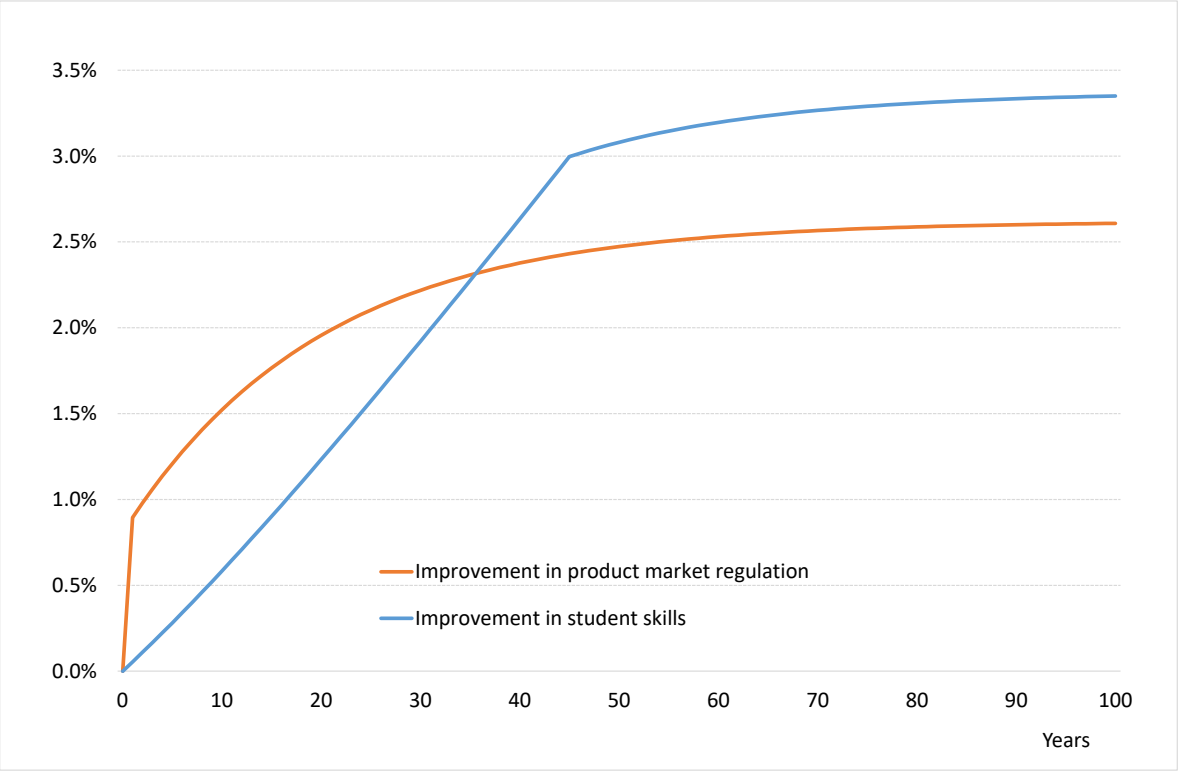
30. These stylised calculations suggest that the potential for productivity gains is much greater from improvements in the quality than quantity component of human capital. Moreover, the magnitude of these potential gains in MFP is comparable to a similarly standardised improvement in product market regulation, which together with human capital are the reform categories where OECD recommendations are most concentrated (Figure 1). A similarly scaled improvement in the OECD's product market regulation indicator (equal to the difference from the median to the top three performing countries) generates a long-run increase in MFP of 2.6% (for details see OECD, 2022).

However, while an improvement in student skills has a broadly similar long-run impact on multi-factor productivity as improving product market regulation, it may take four decades to fully show

31. There are, however, unusually long lags between policies that affect the skills of students in compulsory schooling and their long-run macroeconomic effect. The calculations described above all assume that any improvements are sustained in successive cohorts of students, but it then takes nearly 50 years before these student cohorts are fully reflected in the working age population. There is then a further lag before this complete improvement is fully reflected in MFP. To underline these longer lags the effect of a policy that brings about a sustained improvement in student skills can be compared with a policy that leads to a step improvement in product market regulation (in both cases the shocks are again calibrated to close the gap between the median and top three performing countries). So while an improvement in student skills has a broadly similar long-run impact on MFP as compared to improving product market regulation, it may take four decades before this ranking is observed (Figure .4). On the

other hand, avoiding these long lags underlines the potential of policies to pursue upskilling and life-long learning of the existing workforce.

Figure .4. Comparing policy responses to improve skills and product market competition



Note: The chart displays the dynamic response of mfp to a standardised shock to student skills and product market regulation. The shocks are standardised by calibrating the magnitude of the shock as the difference between the OECD median country and the top three performing countries in terms of the shocked indicator (see text for further details). The shock for human capital assumes that skills are upgraded gradually as students gradually enter the workforce.
Source: OECD (2022), "A new macroeconomic measure of human capital exploiting PISA and PIAAC", OECD Economics Department Working Papers, forthcoming.

Questions for discussion

- Are PISA and PIAAC survey results taken into consideration for education policy decisions in your country?
- Does your country have an analytical framework to assess the impact of education policies on student and adult test scores? Which policies do you consider to have the biggest impact?
- Does your country have an analytical framework to estimate the impact of PISA and PIAAC survey results on productivity and/or GDP per capita? Are you able to differentiate the effect of quality versus quantity of education on economic outcomes?
- Are returns to public investment in education vis-à-vis other types of public investment considered in public policy making in your country? Do they influence budget allocation across different types of investment and different ministries? How are returns compared which materialise at very different time horizons?

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