Lucas Papademos: Education, financial markets and economic growth

Speech by Mr Lucas Papademos, Vice-President of the European Central Bank, at the 35th Economics Conference on "Human Capital and Economic Growth" organised by the Austrian National Bank, Vienna, 21 May 2007.

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I. Introduction

"Upon the education of the people of this country the fate of this country depends", British Prime Minister Benjamin Disraeli observed over 100 years ago with great prescience. Today, his insightful observation about the crucial importance of education and human capital for the welfare of countries and the performance of their economies is widely recognised, especially in all advanced countries with their increasingly knowledge-based economies. In Europe, the Lisbon strategy has placed education high on the policy agenda – together with some key structural reforms in product, labour and capital markets – in order to make Europe a more competitive, knowledge-based and dynamic economy. It is, therefore, highly appropriate and very much appreciated that the Österreichische Nationalbank has devoted its 35th Economics Conference to the topic of "Human capital and economic growth", and I am delighted to have been invited to address this distinguished audience.

Education contributes significantly to economic growth and welfare through various channels and in many ways. [SLIDE 2] In the first part of my presentation, I will review these channels and assess their relative importance on the basis of the available empirical evidence about the quantitative significance of the effects of education on a number of key determining factors of growth. In particular, I will examine the role of education in accounting for differences in economic growth across countries and regions, as well as for the growth performance of different sectors within our economies. In the second part of my speech, I will address the role of the financial sector in fostering economic growth, concentrating on how the development, efficiency and stability of financial markets can contribute to the dynamism and growth of other sectors and of the economy as a whole. I will then explore how education, research and the diffusion of knowledge have supported and facilitated the development of financial markets; and how education can further contribute to fully realising the benefits of financial innovation, thereby supporting through this channel, our economies' growth performance. Finally, I will draw some conclusions regarding the implications of our analysis for public policy and for the effectiveness of monetary policy.

II. Education and economic growth

Through which channels does education foster economic growth? Economists have tried to explain the large cross-country variation in economic growth and, more generally, welfare, in terms of differences in the contribution of factors of production and their overall efficiency. Growth theories – both the extended neoclassical model and the new "endogenous" growth theories – specify the economy's aggregate output as a function of capital, employed labour services, that is hours worked by the economically active population, and a measure of technological progress. Capital is broadly defined to include both physical and human capital. Technological progress is usually described as the process that determines how efficiently all factors of production are used, that is, it measures total factor productivity. This general theoretical specification implies that the growth rate of per capita aggregate output can be expressed as the sum of real investment (capital deepening), human capital accumulation, the rate of change of labour utilisation and total-factor-productivity (TFP) growth. [SLIDE 3] The so-called "growth accounting" framework employed in empirical analyses, which need not be based on concrete analytical foundations, uses the same, or a similar, decomposition of output growth in terms of its basic determinants. This analytical framework provides a useful means for examining and assessing the various channels through which education fosters growth.[1] It should be kept in mind, however, that this framework depends on several simplifying assumptions that may impose limitations on the analysis. It also does not take explicitly into account the potential effects on economic efficiency of "social capital" and human development; that is, the set of institutions and

[1] See, for example, Mankiw, Romer and Weil (1992) and Caselli (2005).

social values that underpin the functioning of markets and can influence the behaviour (and collective actions) of economic agents.

Education affects economic growth both directly since it is a key determinant or component of human capital, as well as indirectly by influencing the other factors of production and total factor productivity. [SLIDE 4] Human capital is a broad concept which is determined by education – the quantity and quality of schooling – as well as by on-the-job training and learning, cognitive skills and the health status of the labour force (as proxied, for example, by life expectancy).

Direct effects of education on growth

The direct positive effects of education, and more generally of human capital, on growth have been demonstrated by empirical analyses employing both macroeconomic and microeconomic data.[2] [SLIDE 5] Several empirical studies show that more affluent countries are also richer in human capital. [SLIDE 6] This is illustrated in the chart on slide 6 that shows the relationship between the average years of schooling (using data from the most recent update of the Barro-Lee dataset) and the real per capita GDP in the year 2000 (using data from the latest update of the Penn World Tables). To further illustrate this positive relationship, the next two charts on slide 7 [SLIDE 7] show that countries in which the general education level has improved significantly over the past decades have also experienced faster economic growth.[3] For example, East Asian "tiger" economies (South Korea, Taiwan, Hong Kong, Malaysia) have not only been the fastest growing economies in the post world-war II period, but they are also those countries where the average duration of school education for the population as a whole has increased most. Recent research has tried to improve the quality of cross-country schooling data (e.g. Cohen and Soto, 2007; Domenech and de la Fuente, 2006). These studies, based on improved statistics, find that there is a stronger correlation between improvements in schooling and growth, even when other features of economic development are taken into account (such as physical capital accumulation or time-invariant country characteristics).

Correlation, however, does not necessarily imply causality. After all, improvements in education and faster growth may be both influenced by other country factors, such as institutional infrastructure, social capital, geography or culture. The correlation between schooling and growth (shown in the previous charts) may also be driven by "reverse causality" from growth to education, as individuals invest more in education when the economy's growth performance and prospects are good. It is thus difficult to establish causality employing cross-country data, because it is almost impossible to control for all the variables that could affect economic performance. [SLIDE 8] Nevertheless, using detailed data on wages for individuals and households, a vast literature in the field of labour economics has provided ample evidence that there is a significantly positive and robust causal relationship between the years of formal schooling (at the primary, secondary and tertiary level) and wages. This evidence suggests that the private, or so-called "Mincerian"[4], returns on education are within a range of 6.5%-9%, that is, an additional year of formal schooling is associated with an increase in wages of 7.5% on average over the working life. The richness of micro data also enables us to address the key issue of causality. Labour economists have employed sophisticated econometric techniques and innovative methodological approaches (such as studies of twins who followed different education and life paths) to establish causality between education and private returns.[5] Moreover, the social return to education – that is the benefit of increases in the human capital of the population for the economy and society as a whole – will, in all likelihood, be further increased as a result of so-called human capital externalities. Such externalities arise, for example, through knowledge spillovers from more educated workers to less educated ones.[6]

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[2] For general surveys of the contribution of human capital and education to economic growth, see Krueger and Lindahl (2001) and Wasmer et al. (2006). De la Fuente and Ciccone (2002) review the literature with specific reference to Europe.

[3] See, for example, Domenech and de La Fuente (2006) and Cohen and Soto (2007).

[4] The so-called "Mincerian equation" (developed by Polish-American economist Jacob Mincer) specifies a relationship an individual's education and experience and his or her wages. See Mincer (1974).

[5] For en extensive review of the micro evidence, see Card (1999).

[6] The importance of human capital externalities in the process of development has been stressed by Lucas (1998) and Azariadis and Drazen (1990), among others. Empirical studies in the US have, however, failed to detect human capital externalities at the US state and city level (e.g. Acemoglu and Angrist, 2000; Ciccone and Perri, 2006). Moretti (2004) does provide some evidence of sizable (and statistically significant) externalities at the US plant level.

The quality of education

Education, however, is only one component of the broader concept of human capital, which also involves on-the-job training and learning as well as cognitive skills. Moreover, the quality of education is at least as important as the years of formal schooling.[7] These factors are economically significant. For example, the returns on training could be as high as 5%, which is a rate comparable to the range of estimates for the private returns on the years of formal schooling of between 6.5% and 9%. There is also plenty of evidence that points to the importance of the quality of education. [SLIDE 9] This is usually measured by pupil-teacher ratios, by public spending on education, the educational level of teachers, as well as students' performance in internationally standardised tests. Measures of the quality of the labour force (at the macro level), based on internationally comparable test scores, explain a significantly larger proportion of the cross-country variation in growth rates than the simpler measure of average years of schooling which is usually employed.[8] Micro studies using individual data on wages also emphasize the importance of labour quality. Interestingly, a number of international studies also suggest that, with regard to explaining the impact of education on growth, the quality of schooling is far more important than the quantity of schooling. Put simply, spending time at school is not enough; it is what you learn, how you learn it, and from whom that very much counts.

The crucial importance of labour quality for Europe's economic performance is also corroborated by recent research at the ECB (Schwerdt and Turunen, 2007) which suggests that improvements in labour quality have made a substantial positive contribution to labour productivity growth in the euro area. Due mainly to a notable increase in college education, the average annual growth rate of labour quality in the euro area is estimated at about 0.5% in the twenty-year period 1984-2005. The relative contribution of the improvement in labour quality has also increased over time, accounting for up to one fourth of euro area labour productivity growth since 2000. What is behind the observed – and highly welcome – steady improvement in the quality of the euro area workforce? First, more educated workers work longer hours.[9] Second, both the business cycle and changes in the structural features of the labour market have influenced the human-capital composition of the euro area workforce. In the late 1990s, labour quality growth moderated, mainly reflecting entry into the labour market of low skilled workers. You may recall the debates about the "jobless recovery" and the labour market policy pursued at that time which aimed in particular at increasing the employment intensity of growth.

Indirect effects of education on growth

Education influences economic growth not only directly – as explained thus far – but also indirectly, [SLIDE 10] through its effects on a number of other growth determinants, notably: labour force participation, overall labour utilisation, total factor productivity, the so-called skill-bias of technological progress and the complementarity – or substitutability – of physical capital and skills. I will briefly discuss each of these in turn. First, education enhances growth by raising labour utilisation (and, specifically, the number of hours worked per worker). [SLIDE 11] The higher the education level, the higher the participation in the labour force: in other words, if people are more educated, they are more likely to seek or hold a job. [SLIDE 12] Let me provide you some evidence for this proposition from the euro area: in 2006, total labour force participation ranged from 70.1% for persons with below secondary education, to 84.3% for persons with above secondary education and 90.6% for persons with tertiary education. In addition, a higher level of education is usually connected with a higher percentage of the labour force being employed. In 2006, the employment rate in the euro area was 83.5% for persons with tertiary education, while only 57.2% for persons with below secondary education.

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[7] Human capital also includes health. Yet accounting for health, while of major importance in emerging and under-developed countries, is most likely of minor importance for the industrial world.

[8] See, for example, Hanushek and Kimko, (2000); Bosworth and Collins, (2003). The Appendix Table reports some simple cross-country regressions illustrating this point. Models (1) and (2) report the (standardized "beta") coefficients on initial average years of schooling and schooling quality in explaining long-term growth in the period 1960-2000. While both human capital proxies enter with highly significant coefficients in specifications (1) and (2), models (3) and (4) that jointly assess their effect show that schooling quality is a far more significant correlate of growth than schooling quantity. The estimated effects are similar if the analysis is confided to the periods 1970-2000, 1980-2000, or 1990-2000.

[9] There is evidence of increased share of the total hours worked by more educated workers and, in particular, of a sizeable increase in the share of hours worked by those with tertiary education.

A most significant and far-reaching contribution of human capital to the European economy and other advanced economies stems from its positive effect on total-factor-productivity (TFP). [SLIDE 13] Empirical studies suggest that countries that are richly endowed with human capital tend to better use existing technologies and firms and entrepreneurs in these countries also innovate much more. Building on an early contribution of Richard Nelson and Nobel Prize winner Edmund Phelps (Nelson and Phelps, 1966), the new "endogenous" growth theories have stressed the role of human capital in sustaining long-term growth, because it enables these economies to catch up with the technological frontier and innovate.[10] In line with these theories, which have also emphasised the importance of research & development and entrepreneurial activity, cross-country empirical studies show that human capital accelerates progress towards the technological frontier (e.g. Benhabib and Spiegel, 1994). There are valuable lessons for the advanced EU countries, because the contribution of human capital is especially important for economies that are closer the technological frontier and thus depend more on innovation rather than imitation.[11]

The role of human capital, and education in particular, in fostering innovation and a rapid adoption of technological advances has been crucial over the past decades, when technology has been "biased" towards highly-skilled labour. There is now a consensus that in the 1980s and 1990s (and even in the 1970s) technological progress has been favouring educated and highly trained workers.[12] For example, the private return on education in Europe and the US rose from about 6.5%-7.5% in the early 1970s to 10% in the early 1990s. This increase was almost exclusively driven by college graduates and highly trained workers, who were the beneficiaries of the higher skill-bias of recent technological innovation. If we analyse this rather general result in greater depth, and assess the effect of education in facilitating technology adoption and the skill context of recent technological innovation, we find that countries with abundant human capital managed to better utilise technological innovations in skill-intensive sectors in the 1980s and 1990s (Ciccone and Papaioannou, 2005). And it was precisely those industries that experienced higher total productivity growth globally. [SLIDE 14] The chart on slide 14 illustrates this point. It shows the relationship between the cross-country marginal return on human capital at the industry level and the industry skill-intensity. There is a clear positive relationship between the effect of schooling for industry growth and the skill-bias of an industry. To cut a long story short, education appears to be far more important for the growth of R&D intensive sectors such as drugs and pharmaceuticals and computer and office equipment than footwear and textiles. [SLIDE 15] The next chart exhibits a similar relationship but uses educational quality as a proxy for human capital. The results are even more striking, indicating that educated societies were more successful in adopting the R&D intensive technologies of the 1980s and 1990s.[13]

Finally, human capital may foster growth due to so-called capital-skill complementarities. [SLIDE 16] While capital complements both skilled and unskilled labour, it tends to be more relevant for tasks and sectors that use skilled labour more intensively. Recent work is supportive to this hypothesis. Research using very detailed data for the United States show that capital invested in information and communication technologies (ICT) strongly complements skilled workers in performing complex tasks, while it substitutes low-skilled workers in manual tasks. Similarly, studies on the adoption of computers in the US over the past three decades clearly shows that computerisation is associated with reduced labour input of routine manual tasks and increased labour input of non-routine tasks.[14] This also highlights the importance for Europe to invest in both human and physical capital, since their positive effects on growth will most likely be mutually reinforcing, and thus greater.

III. Education, financial development and economic performance

One sector which has undergone a rapid transformation in the past decades, and especially since the 1990s, partly as a result of the large-scale adoption of advanced information and communication

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[10] See, for example, Romer (1990), Grosman and Helpmann (1991), and Aghion and Howitt (1992).

[11] For a formalisation of this intuition, see Acemoglu, Aghion, and Zilibotti (2006).

[12] See, among others, Acemoglu (1998, 2002); Caselli and Coleman (2006); Berman, Bound and Machin (1998).

[13] The skill context of the recent technological revolution has also been a key force for raising inequality. If this pattern continues then it is of fundamental importance for Europe to further invest in human capital. Not only this would further sustain growth, but also help reduce social injustices.

[14] For the effect of computer adoption on wages and skill upgrading in the US, see also Autor, Katz and Krueger (2003).

technologies, is the financial sector, where the complementarity between human capital and physical capital can be expected to be particularly large. The financial sector has also played a central role in fostering economic growth in both advanced and emerging economies. This role has been supported and facilitated by education in a broad sense – involving both teaching and research in the fields of finance and the new technologies – and by the effective use of the acquired knowledge in practice. For these reasons, I would like to focus now on the relationship between financial sector development and economic growth, and the contribution of education to the development, efficient functioning and stability of financial markets.

What are the mechanisms through which the financial sector fosters economic growth? [SLIDE 17] In theory, the financial system can affect economic growth by influencing the investment and saving decisions of economic agents and by fostering innovation and productivity. A well-functioning financial system should (i) improve the available information on investment opportunities and reduce informational asymmetries; (ii) facilitate the diversification and management of risk; (iii) contribute to better corporate governance; (iv) mobilise and pool savings; and (v) foster the exchange of goods and services. The references to these functions highlights key features of the financial intermediation process, such as information availability and transformation, risk diversification and management and corporate governance, that clearly indicate the central role of education, knowledge and technological (ICT) advances in the development and efficient functioning of financial markets. And the better a financial system performs these functions – that is, the more developed and efficient it is – the greater its contribution to economic growth.

The empirical evidence supporting this proposition – that financial development and integration promote economic growth – is substantial.[15] Numerous studies have shown that countries with more liquid capital markets and developed banking systems grow on average faster, and that financial sector reforms and financial liberalisation policies positively affect GDP growth and investment. For example, evidence from emerging and developing countries shows that financial liberalisation policies are followed by a 0.5%-1% increase in investment and a significant fall in the cost of capital (by 100 basis points on average). More generally, the evidence from cross-country and country-specific studies (in both developed and emerging economies) shows that deregulation, privatisation and financial development result in an acceleration of growth and a sustained increase in total factor productivity (e.g. Bekaert, Harvey, and Lundblad, 2006). Financial development is especially beneficial for industries which for technological reasons depend predominantly on external finance (Rajan and Zingales, 1998; Guiso, Jappeli, Padula, and Pagano, 2005).

There is another important channel through which a well-developed financial system fosters innovation and sustained growth: by facilitating the rapid re-allocation of capital from declining industries to fast-growing sectors, and, in this way, raising aggregate productivity in the economy.[16] [SLIDE 18] Recent studies have confirmed this proposition which was first put forward one hundred years ago by a great Austrian, Joseph Schumpeter. He was among the first to emphasise the catalytic role of well-developed financial intermediaries in the process of “creative destruction”. The efficient functioning of this Schumpeterian capital reallocation mechanism is especially relevant in advanced economies, such as the euro area, where the promotion of entrepreneurship and openness to competition are key to raising productivity and growth.[17] Recent empirical research at the ECB demonstrates that the larger and more developed the financial markets are, the greater is the efficiency with which capital is reallocated across sectors. The two charts on slide 19 [SLIDE 19] show the relationship between a measure of capital efficiency and an indicator of financial development for a sample of 65 countries and for the OECD sample of high-income countries. The higher a country scores on the vertical axis, the faster its industries respond to investment opportunities; the horizontal axis denotes the size of the financial market: the upward slope of the line clearly indicates that capital is reallocated more efficiently in financially advanced countries.[18]

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[15] Levine (2006) provides a thorough review of the literature. Papaioannou (2007) also surveys work focusing on studies that are mostly related to advanced economies.

[16] See, among others, Fisman and Love (2004, 2007), Wurgler (2000), Ciccone and Papaioannou (2006).

[17] See Strahan (2003) for a review on the US evidence, Bertrand, Schoar, and Thesmar (2007) for the aftermath of French financial reforms of the mid-80s and Guiso, Sapienza, and Zingales (2004) for the Italian experience.

[18] These figures draw on Ciccone and Papaioannou (2007) and Hartmann, Heider, Lo Duca, and Papaioannou (2007) and are based on a methodology proposed by Wurgler (2000). Data taken from UNIDO (2005 Edition).

Financial development is thus manifestly beneficial for growth. But what is the role of education and research in this process? It would be useful to investigate further the relationship between education and (ICT) technological advances, on the on hand, and financial development and economic growth, on the other. Conceptually, such a link appears plausible, if not perfectly clear. Progress in the theory of finance and management, employing mathematical and statistical techniques, combined with the exponential growth of computing power and the diffusion of information and communication technologies – which made the application of theoretical advances technically feasible – have supported the creation of new, innovative, sometimes complex, financial instruments and the development of alternative investment vehicles. Market participants – financial institutions and investors – further elaborated this knowledge, initially developed in and learned from universities, and applied it in practice, fruitfully interacting with centres of higher education. In addition, the education pertaining to the organisation, management and governance of firms also contributed to financial development and enhanced productive efficiency. The increasing breadth and sophistication of financial markets, in turn, have been conducive to economic growth, for the reasons I outlined above. Intuition and anecdotal evidence suggest that these are reasonable propositions. It would be useful to examine the available evidence in a systematic manner and try to quantify and estimate the contribution of education and research to the development and efficiency of the financial system and the resulting direct and indirect effects on total productivity growth. It would also be valuable to examine how education and the diffusion of knowledge on risk measurement, assessment and management can help to better safeguard financial stability, by enhancing the resilience of the financial system to shocks and to the potential materialisation of risks associated with the intermediation process. And the outcome of such analysis could perhaps be discussed in a future OeNB conference on education, financial development and economic growth.

Financial education and literacy

Needless to say, this is a very broad theme. But I would like to point to an additional, important issue concerning the link between education and financial development which has attracted attention recently and let to some interesting findings. This pertains to the fact that it is not only the education and sophistication of bankers, brokers, analysts, asset managers, or risk management specialists that determines the extent to which the full benefits of financial development and risk diversification can be reaped; it is also the financial education and literacy of all savers and investors.[19] [SLIDE 20] And on that front, I am afraid, the news is not good: the evidence indicates that even in advanced countries, financial illiteracy is widespread. For example, a recent study in the United States (Lussardi and Mitchell, 2006) found that on average only 50% of those close to retirement (aged 50+) could correctly answer two simple questions regarding interest compounding and inflation; the scores were worse when questions about risk diversification were raised. Evidence from other industrial countries is similarly alarming. Of course, these averages conceal differences: more affluent people with higher education, especially those with college education, tend to be more financially literate than people from lower-income groups. But this fact is no solace.

The implications of financial illiteracy are far from negligible. Proper retirement planning, the ability to exploit diversification opportunities and the propensity to invest in high-return and high-risk assets is more widespread among financially literate households (Lussardi and Mitchell, 2006, 2007; and Calvet, Campbell and Sodini, 2005). Especially in the context of ageing populations and the expected progressive shift away from public pension provision, based on pay-as-you-go schemes, to privately funded schemes where people have to assume responsibility for their own retirement savings, enhancing financial literacy becomes essential. Aristotle's wisdom that "education is the best provision for old age", understood also in this specific sense, therefore still holds today; and it should provide guidance for public policy. Programmes to enhance people's ability to understand some basic financial and economic concepts (such as interest compounding, percentages, etc.) have demonstrated their usefulness, especially for less-educated participants. The best way, however, to enhance financial literacy so as to fully realise the benefits of financial development is to further invest in education, for there is clear evidence of a strong relationship between the level of schooling and financial literacy.

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[19] The OECD (2006) defines financial education as " The process by which financial consumers/investors improve their understanding of financial products and concepts and, through information, instruction, and/or objective advice, develop the skills and confidence to become more aware of financial risks and opportunities to make informed choices, to know where to go for help, and to take other effective actions to improve their financial well-being." The importance of financial literacy for household finance is stressed also by Campbell (2006) in his Presidential Address to the American Finance Association.

IV. Policy implications

Overall, there is widespread and robust evidence that education plays a key role in enhancing economic performance, especially in those sectors where productivity and labour utilisation is relatively low. Therefore, improving education – and quantitative and qualitative terms – has to be at the heart of policy measures aimed at raising the growth potential of the euro area in a sustainable manner. The Lisbon agenda aims at precisely this. Given the lower productivity growth in the financial sector compared to the productivity gains achieved in other sectors in the euro area, but also relative to those recorded in the United States, policies that can accelerate the integration and development of European financial markets are essential. For they will help to raise the European economy's growth potential, enhance its capacity to adapt to changing global conditions and structures and strengthen its resilience to shocks. [SLIDE 21] In particular, further financial integration and development in the euro area would allow for a more balanced systemic response of its economy to asymmetric shocks – which is, of course, of particular relevance for the smooth functioning of Economic and Monetary Union. The better risk-sharing opportunities of an integrated financial market should also help to synchronise more the business cycles across the euro area and reduce the volatility of output and employment. Last, and by no means least, more integrated and sophisticated financial markets will also enhance the smooth and effective transmission of the single monetary policy impulses across the euro area. This brings me to my final point: the links between education and monetary policy.

What are the potential implications of a rise in the level of education for the conduct of monetary policy in the euro area? [SLIDE 22] Improvements in education and in labour quality affect monetary policy in two principal ways. First, by fostering higher productivity growth and labour utilisation, a higher level of education raises potential growth and thus the "speed limit" of the economy, meaning that the economy can attain a faster rate of sustainable growth that is compatible with price stability. The second channel through which education affects the conduct of monetary policy relates to the efficient functioning of national labour markets and to the role of labour mobility as an adjustment mechanism, which is especially relevant in a monetary union. Increased labour force participation and mobility of high-skilled workers will improve job-matching efficiency in the euro area, especially when there are certain skill shortages. To the extent that more educated workers display a greater mobility across firms, sectors and borders compared to workers with fewer qualifications, a higher level of education can contribute to containing the size of economic fluctuations and mitigating the effects of shocks because labour markets can adjust faster and in a manner that reduces output and employment volatility.

V. Concluding remarks

Economic activity in the euro area is expanding at a solid pace and conditions are in place for the ongoing expansion to continue at sustained rates. The improved growth performance of the euro area economy reflects the positive influence of the policies being pursued and the reforms that have been implemented. It is essential to preserve the favourable conditions that are fostering sustained growth and to step up the efforts that can enhance the dynamism and growth potential of the euro area economy.

Monetary policy has been contributing decisively to fostering sustainable growth by having established an environment of price stability and by ensuring that medium to longer-term inflation expectations remain solidly anchored at levels consistent with price stability. And this is what our policy will continue to do. The ECB's Governing Council remains strongly vigilant and ready to act in an effective, firm and timely manner to ensure that price stability is preserved over the medium and longer term.

At the same time, the euro area's potential for higher sustained growth and it capacity to effectively absorb economic shocks can be further enhanced by the implementation of appropriate structural reforms that can increase productivity and employment growth and improve market efficiency and flexibility. In my presentation, I examined and assessed the links between education and the growth performance of our economies. There is ample and robust evidence that more and better education can foster productivity growth and raise labour utilisation. Moreover, I emphasised the important role which the development of financial markets can play in fostering innovation, entrepreneurship and productivity growth and I argued that education has contributed and can further contribute to the development and stability of the financial system. What counts now is to use these insights and to implement the necessary policy measures to enhance the quantity and quality of education in Europe. After all, as Anton Chechov reminds us, " knowledge is of no value, unless you put it into practice."

Thank you very much for your attention.

References

Acemoglu, Daron. 1998. "Why Do New Technologies Complement Skills? Directed Technical Change and Wage Inequality." Quarterly Journal of Economics, November, 113(4): 1055-1090.

Acemoglu, Daron. "Directed Technical Change." 2002, Review of Economic Studies, October, 69(4), pp. 781-810.

Acemoglu, Daron; Philippe Aghion, and Fabrizio Zilibotti. 2006. "Distance to Frontier, Selection and Economic Growth." Journal of the European Economic Association, March, 4(1): 37-74.

Acemoglu, Daron and Joshua Angrist. 2001. "How Large are the Social Returns to Education: Evidence from Compulsory Schooling Laws" in B. Bernanke and K. Rogoff (eds.) NBER Macroeconomic Annual 2000 (Cambridge, MA: The MIT Press) 9-59.

Autor, David; Frank Levy, and Richard J. Murnane. 2003. "The Skill Content of Recent Technological Change: An Empirical Exploration." Quarterly Journal of Economics, November, 118(4): 1279-1334.

Autor, David; Lawrence F. Katz, and Alan B. Krueger. 1998. "Computing Inequality: Have Computers Changed the Labour Market?" Quarterly Journal of Economics, November, 113 (4): 1169-1214.

Azariadis, Costas and Allan Drazen. 1990. "Threshold Externalities in Economic Development." Quarterly Journal of Economics, 105(2): 501-526.

Barro, Robert J. and Jong-Wha Lee. 2001, "International Data on Educational Attainment: Updates and Implications." Oxford Economic Papers, 3(3): 541-563.

Bekaert, Geert, Campbell R. Harvey, and Christian Lundblad. 2005. "Does Financial Liberalization Spur Growth?" Journal of Financial Economics, July, 7(1): 3-55.

Benhabib, Jess and Mark M. Spiegel. 1994. "The Role of Human Capital in Economic Development." Journal of Monetary Economics, October 1994, 34(2), pp. 143-174.

Berman, Eli; John Bound, and Stephen Machin. 1998. "Implications of Skill-Biased Technical Change: International Evidence." Quarterly Journal of Economics, November, 113(4): 1245-1279.

Bertarnd, Marianne, Antoinette Schoar, and David Thesmar. 2007. "Banking Deregulation and Industry Structure: Evidence from the French Banking Reforms of 1985." Forthcoming, Journal of Finance.

Calvert, Laurent, John Campbell and Paolo Sodini. 2006. "Down or Out: Assessing the Welfare Costs of Household Investment Mistakes." Mimeo, Harvard University.

Caselli, Francesco. 2005. "Accounting for Cross-Country Income Differences." in Philippe Aghion and Steven Durlauf (eds.) The Handbook of Economic Growth, North Holland, Amsterdam: 2005.

Campbell, John. 2006. "Household finance." Journal of Finance, 61, 1553-1604.

Caselli, Francesco and John Wilbur II Coleman. 2006. "The World Technology Frontier." American Economic Review,.

Ciccone, Antonio, and Elias Papaioannou. 2005. "Human Capital, the Structure of Production and Growth." Centre for Economic Policy Research (London, UK) Discussion Paper 5354 and ECB WP 623.

Ciccone, Antonio, and Elias Papaioannou. 2006. "Adjustment to Target Capital, Finance and Growth." Centre for Economic Policy Research (London, UK) Discussion Paper 5969.

Ciccone, Antonio, and Elias Papaioannou. 2007. "Financial Development and Intersectoral Investment: New Estimates and Evidence." mimeo European Central Bank and UPF.

Ciccone Antonio and Giovanni Peri. 2006. "Identifying Human Capital Externalities: Theory with Applications." Review of Economic Studies, 73(2):381-412.

Cohen, Daniel, and Marcelo Soto. 2007. “Growth and human capital: good data, good results”, Journal of Economic Growth, Springer, 12(1), pp. 51-76, March

de la Fuente, Ángel and Antonio Ciccone. 2002. "Human capital in a global and knowledge-based economy." European Commission; Directorate-General for Employment and Social Affairs

de la Fuente, Ángel and Rafael Domenech. 2006. "Human Capital in Growth Regressions: How Much Difference Does Data Quality Make." Journal of the European Economic Association.

Fisman, Raymond, and Inessa Love. 2007. "Financial Development and Growth in the Short and Long Run." Journal of the European Economic Association Papers and Proceedings.

Griliches, Zvi. 1969. "Capital-Skill Complementarity." Review of Economics and Statistics, 51(2), 465-468.

Guiso, Luigi, Tullio Jappelli, Mario Padula, and Marco Pagano. 2005. "Financial Market Integration and Economic Growth in the EU." Economic Policy, 19(40): 523-577.

Guiso, Luigi, Paola Sapienza, and Luigi Zingales. 2004. "Does Local Financial Development Matter?" Quarterly Journal of Economics, August, 119(3): 929-969.

Guiso, Luigi, Paola Sapienza, and Luigi Zingales. 2007. “Trusting the Stock-Market”. Mimeo University of Chicago, January.

Hartmann, Philipp; Florian Heider; Marco Lo Duca, and Elias Papaioannou. "Finance and Productivity." in Financial Institutions and Markets: A European Perspective. X. Freixas, P. Hartmann and C. Mayer (eds.), Forthcoming 2007, Oxford University Press, Oxford, UK.

Krueger, Alan B. and Mikael Lindahl. "Education for Growth: Why and For Whom?" Journal of Economic Literature, December 2001, 39(4), pp. 1101-1136.

Levine, Ross. 2005. "Finance and Growth: Theory, Evidence, and Mechanisms." in The Handbook of Economic Growth, ed., P. Aghion and S. Durlauf, Amsterdam: North-Holland.

Lucas, Robert. 1998. "On the Mechanisms of Economic Development." J ournal of Monetary Economics, July, 22(1): pp.3-42.

Lussardi, Annamaria and Olivia Mitchell. 2006. “Financial Literacy and Planning: Implications for Retirement Wellbeing," mimeo Wharton School and Dartmouth College.

Lussardi, Annamaria and Olivia Mitchell. 2007. “Baby Boomer Retirement Security: The Roles of Planning, Financial Literacy, and Housing Wealth” Forthcoming Journal of Monetary Economics.

Mankiw, N. Gregory, David Romer, and David N. Weil. 1992. "A Contribution to the Empirics of Economic Growth." Quarterly Journal of Economics, May, 107(2): 407-437.

Mincer, Jacob. 1974. “Schooling, Earnings, and Experience”, Columbia University Press, New York.

Moretti, Enrico. 2004. "Workers education, spillovers, and productivity: Evidence from plant-level production functions." American Economic Review, 94(3): 656-690

Nelson, Richard R. and Edmund S. Phelps. 1966. "Investment in Humans, Technical Diffusion, and Economic Growth." American Economic Review, March, 56(1/2): 69-75.

Papaioannou, Elias. 2007. "Finance and Growth: A Macroeconomic Assessment of the Evidence from a European Angle." in Financial Institutions and Markets: A European Perspective. X. Freixas, P. Hartmann and C. Mayer (eds.), Forthcoming 2007, Oxford University Press, Oxford, UK.

Rajan, Raghuram G., and Luigi Zingales. 1998. "Financial Dependence and Growth." American Economic Review, 88(3): 559-586.

Romer, Paul. 1990. "Endogenous Technical Change." Journal of Political Economy, October, 98(5): S71-S102.

Schwerdt, Guido and Jarkko Turunen. 2007. "Growth in Euro Area Labour Quality", updated version of ECB WP 575.

Strahan, Philipp E. 2003. "The Real Effects of US Banking Deregulation." The Federal Reserve Bank of St. Louis Review, July/August, 85(4): 111-128.

United Nations Industrial Development Organization. Industrial Statistics. New York, 2005.

Wasmer, Etienne; Peter Fredriksson; Ana Lamo; Julián Messina and Giovanni Peri. 2006. “The Macroeconomics of Education.” in Education and Training in Europe. Edited G. Brunello, P. Garibaldi.

Wurgler, Jeffrey. 2000. "Financial Markets and the Allocation of Capital." Journal of Financial Economics, 58(1): 187-21.

Outline

I. Education and economic growth

II. Education, financial development and economic performance

III. Policy implications

2

EUROPEAN CENTRAL BANK

Education and economic growth: conceptual framework

Aggregate Output = *f [Capital (physical and human), Employment, Technological Progress]*

Growth of per capita aggregate output:

- Investment
- Human capital accumulation
- Labour utilisation growth
- Total factor productivity growth

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EUROPEAN CENTRAL BANK

Determinants of human capital

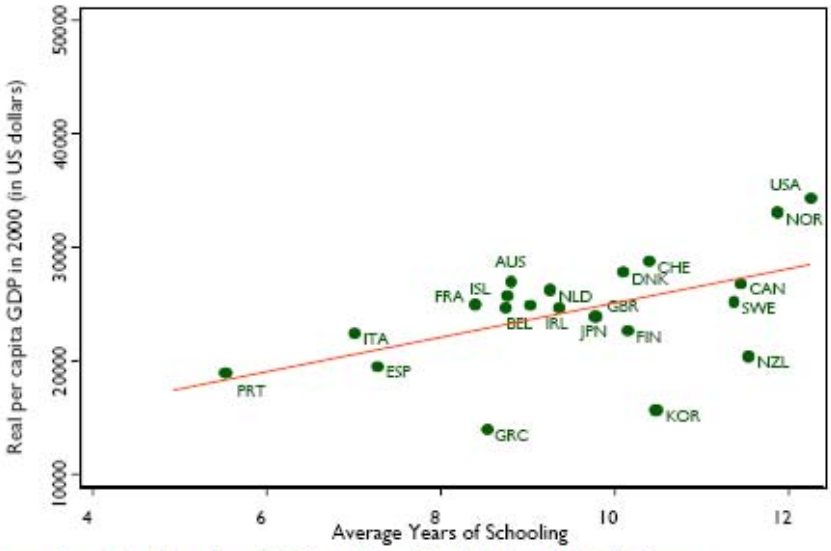
- Education
  - quantity of formal education (average years of schooling)
  - quality of education
- On-the-job training and learning, cognitive skills
- Health status (e.g. life expectancy)

Direct effects of education on economic growth (I)

- Education as a component of human capital and a factor of production (extended neoclassical growth theory)
- Macroeconomic evidence:
  - Affluent countries are relatively more richly endowed with human capital;
  - Fastest growing economies have also experienced rapid human capital accumulation;
  - Recent research based on improved statistics confirms: better schooling and faster growth go together – independently of other relevant factors of economic development (e.g. physical capital accumulation, country-specific factors).

Income and education level

High income OECD countries

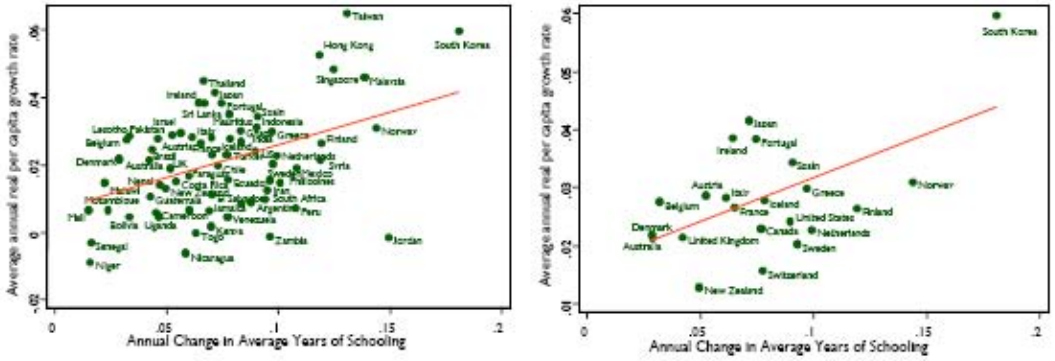


Source: Data from Barro-Lee (2001) and Penn World Tables; ECB calculations

Human capital accumulation and income growth

All countries (1960 – 2000)

High income OECD countries (1960 – 2000)



Source: Data from Barro-Lee (2001) and Penn World Tables; ECB calculations

Direct effects of education on economic growth (II)

- Education as an input of production
- Microeconomic evidence and causality assessment:
  - More years of formal schooling lead to higher wages;
  - Private returns on education estimated to be between 6.5%-9.0%: An additional year of schooling leads to 7.5% higher income on average over working life;
  - Social returns to schooling are most likely larger due to human capital externalities, i.e. knowledge spillovers from more educated workers to less educated ones;
  - Causality established by employing innovative approaches and techniques (e.g. studies of twins).

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EUROPEAN CENTRAL BANK

Labour force quality and GDP growth

Quality of education is also highly relevant, notably:

- quality of teachers (education level; graduate studies; training)
- teacher-pupil ratios
- public spending in education
- Internationally standardised tests (e.g. in math and science)

Macroeconomic evidence:

- Differences in education quality explain more of the growth variations across countries than quantity measures (such as average years of schooling; share of college graduates, etc.);
- Higher quality of the labour force also contributes to labour productivity growth (evidence from the euro area).

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EUROPEAN CENTRAL BANK

Indirect effects of education on growth (I)

Education also influences economic growth indirectly through its impact on other growth determinants, such as:

- labour force participation
- overall labour utilisation
- total factor productivity
- skill-bias of new technologies
- capital-skill complementarities

Indirect effects of education on growth (II)

Education positively influences labour force participation and labour utilisation:

- the higher the education level, the higher the participation in the labour force;
- more educated workers are more likely to be employed (e.g. in 2006, the employment rate in the euro area for university graduates was 83.5% compared to 57.2% for less educated persons);
- education decreases duration of unemployment.

Education and labour utilisation

Euro area labour force participation
(in thousands of persons in the age group 25 to 59)

	1996		2006		Diff. 1996-2006	
Education	total	females	total	females	total	females
below secondary						
total employment	*34197*	*13235*	*32561*	*12810*		
unemployed	*5348*	*2619*	*3751*	*1911*		
inactive	*20445*	*16538*	*15478*	*11737*		
participation ratio (in %)	65.9	48.9	70.1	55.6	4.2	6.7
above secondary						
total employment	*43407*	*18084*	*52171*	*23288*		
unemployed	*4220*	*2247*	*4158*	*2109*		
inactive	*10339*	*7583*	*10485*	*7497*		
participation ratio (in %)	82.2	72.8	84.3	77.2	2.1	4.4
tertiary						
total employment	*21581*	*8893*	*31681*	*14933*		
unemployed	*2619*	*1532*	*1911*	*1592*		
inactive	*2463*	*1730*	*3492*	*2492*		
participation ratio (in %)	90.8	85.8	90.6	86.9	-0.2	1.1

Source: Eurostat, Labour Force Survey; data for 2006 is up to 2006 Q3

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EUROPEAN CENTRAL BANK

Indirect effects of education on growth (III)

Education supports innovation and the rapid adoption of new technologies, especially in view of the skill-bias of modern technology:

- countries with high human capital endowments use existing technologies better and innovate more;
- education, research & development and entrepreneurial activity are especially important for advanced economies (like the euro area) that are closer to the technological frontier;
- technological advances (e.g. ICT) in the 1970s-1990s have been biased towards highly skilled labour, i.e. favoured educated workers;
- human capital is particularly important for the adoption of technologies that augment existing skills.

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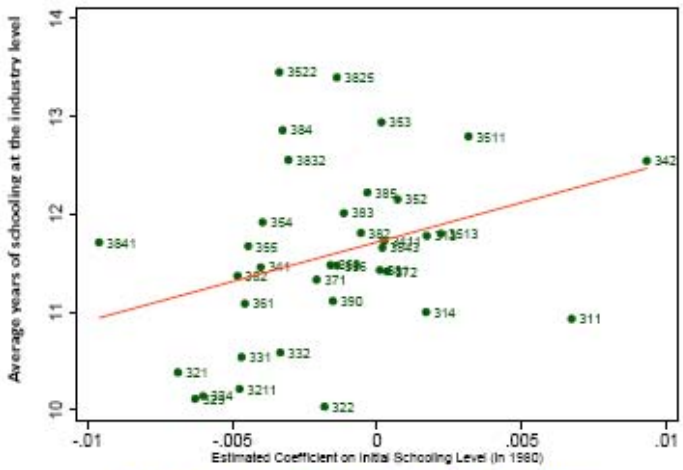
EUROPEAN CENTRAL BANK

Education and the skill-bias of technological change (I)

Education is especially important for the growth of knowledge-intensive sectors, like pharmaceuticals or computers/office equipment.



Industry Skill Intensity

High-Skill

3822: Drugs and pharmaceuticals
3825: Office and computing
353: Petroleum refineries
3511: Chemicals
342: Printing and publishing

Low-Skill

321:Textile
3211: Spinning
323: Leather
322: Apparel
324: Footwear

Source: Ciccone and Papaioannou (2005) and UNIDO

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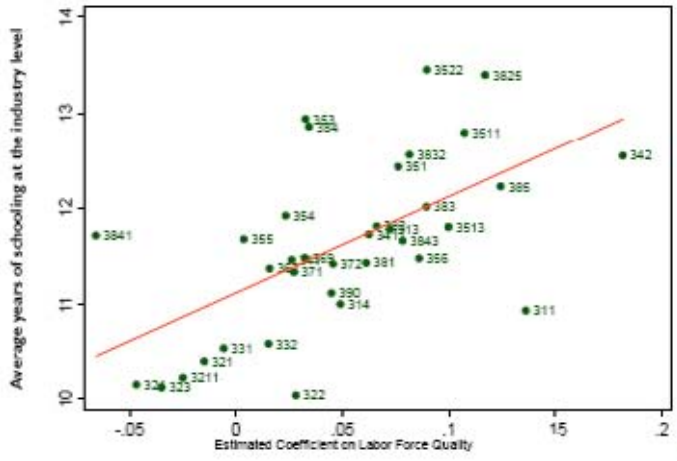
EUROPEAN CENTRAL BANK

Education and the skill-bias of technological change (II)

Educated societies (i.e. with better *quality* education) were more successful in adopting knowledge-intensive new technologies during the 1980s/1990s.



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EUROPEAN CENTRAL BANK

Indirect effects of education on growth (IV)

Education can foster investment in physical capital due to capital-skill complementarities:

- Physical capital is relatively more important for skill-intensive sectors and tasks;
- Effects of computerisation in the United States:
  - Capital invested in information and communication technologies (ICT) complements educated workers and substitutes low-skilled employees;
  - ICT capital complements cognitive tasks and substitutes manual tasks.

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EUROPEAN CENTRAL BANK

The financial system and economic growth

Financial sector development and efficiency can foster economic growth in various ways:

1. Positive impact on investment and growth:
   - see e.g. cross-country studies on effects of financial liberalisation; and banking deregulation: 0.5-1.0% increase in investment, reduction of the cost of capital by 100bp;
2. Positive impact on productivity (efficiency of production):
   - sustained increase in total factor productivity;
   - especially beneficial for industries which for technological reasons depend on external finance;

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EUROPEAN CENTRAL BANK

Financial development and capital reallocation

Well-developed financial systems support Schumpeterian "creative destruction":

- **in countries with deep capital markets and efficient financial intermediaries, capital is reallocated more rapidly across firms and sectors, thus increasing the economy's total productivity growth;**
- **in Europe especially, financial development and market integration across borders is important to facilitate capital reallocation, promote innovation and strengthen competition (see recent ECB research).**

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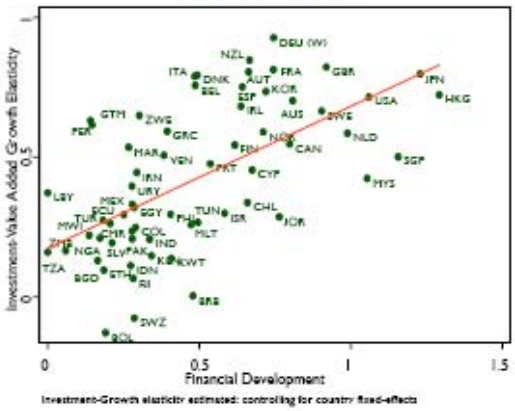
EUROPEAN CENTRAL BANK

Financial development and capital reallocation

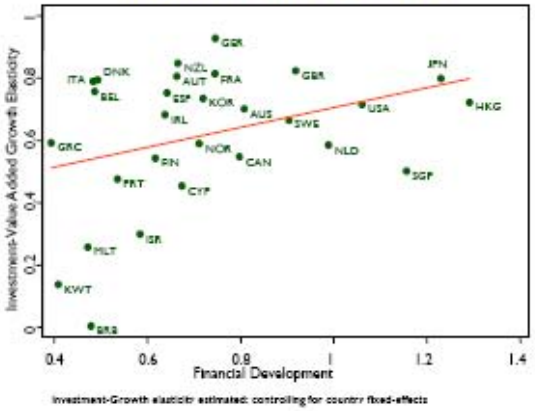
Positive relationship between the efficiency of capital reallocation (i.e. fast response to new investment opportunities) and the size of capital markets

All countries



Investment-Growth elasticity estimated: controlling for country fixed-effects

High-income countries



Investment-Growth elasticity estimated: controlling for country fixed-effects

Source: Ciccone and Papaioannou (2007); UNIDO; based on Wurgler (2000)

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EUROPEAN CENTRAL BANK

Financial literacy and education

Financial literacy is important to reap the full benefits of financial innovation:

- essential for proper retirement planning, diversification of financial risk, participation in stock markets;
- especially in context of ageing populations and shift from public to privately-funded pension schemes.

Pervasive financial illiteracy even in advanced economies:

- in particular among less educated, lower-income groups;
- programmes to enhance financial literacy are needed and can be successful;
- best means to increase the level of financial literacy is to invest in education.

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EUROPEAN CENTRAL BANK

Financial integration and development and monetary policy

Improved functioning of monetary union through the development and integration of Europe's financial system:

- deep and integrated financial markets facilitate the transmission of the single monetary policy across the euro area is a smooth and effective manner;
- better risk-sharing contributes to a more balanced systemic response to asymmetric shocks and a greater synchronisation of business cycles.

Overall, financial integration and development will help reduce the volatility of output and employment across the euro area.

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EUROPEAN CENTRAL BANK

Education, productivity and monetary policy

Education, via its positive effects on productivity growth and labour utilisation, influences the environment within which monetary policy operates:

- raises the growth potential of the economy, thus increasing the "speed limit" at which the economy can grow in a sustained manner that is consistent with price stability;
- higher potential growth in the euro area is especially important in view of ageing populations;
- fosters labour market adaptability and efficiency, as well as mobility (across sectors, firms and borders) and thus facilitates the functioning of an important adjustment mechanism, especially in a monetary union.

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