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Policies to Create and Destroy Human Capital in Europe

James J. Heckman & Bas Jacobs

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James J. Heckman◊

The University of Chicago

University College Dublin

American Bar Foundation

Bas Jacobs‡

Universiteit van Tilburg

Universiteit van Amsterdam

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◊ Department of Economics, The University of Chicago, 1126 East 59^{th} Street, Chicago, IL 60637. E-mail: jjh@uchicago.edu.

‡ Corresponding author: Department of Economics, Universiteit van Amsterdam, Roetersstraat 11, 1018 WB Amsterdam, The Netherlands. Fax: +31 – 20 – 525 4254. Phone: + 31 – 20 – 525 4367. E-mail: b.jacobs@uva.nl.

Abstract

Trends in skill bias and greater turbulence in modern labor markets put wages and employment prospects of unskilled workers under pressure. Weak incentives to utilize and maintain skills over the life-cycle become manifest with the ageing of the population. Reinvention of human capital policies is required to avoid increasing welfare state dependency among the unskilled and increasing inefficiencies in human capital formation. Policy makers should acknowledge the strong dynamic complementarities in skill formation. Investments in the human capital of children should expand as the returns are high and rising. There is no trade-off between equity and efficiency at early ages of human development but a substantial trade-off at later ages. Later remediation of skill deficits acquired in early years is ineffective. Active labor market and training policies should therefore be reformulated. Skill formation is impaired when the returns to skill formation are low due to low skill use and insufficient skill maintenance later on in life. High marginal tax rates and generous benefit systems reduce labor force participation rates and hours worked and thereby lower the utilization rate of human capital. Tax-benefit systems should be reconsidered as they increasingly redistribute resources from outsiders to insiders in labor markets which is both distortionary and inequitable. Early retirement and pension schemes should be made actuarially fairer as they entail strong incentives to retire early and human capital is written off too quickly.

Keywords: skill formation, human capital, labor supply, retirement, training, dynamic complementarity, inequality, returns to education, (non)cognitive skills, family policy, training policy, active labor market policy, tax policy, benefit systems, pension policy, welfare state.
JEL codes: H2, H5, I2, I3, J2, J3.

1 Introduction

The labor market prospects of unskilled workers are jeopardized by skill-biased technical changes and the globalization of the world's production activities (e.g. Katz and Autor, 1999). Moreover, some argue that the position of unskilled workers has become more vulnerable in recent, more turbulent labor markets (Ljungqvist and Sargent, 1998; 2002). As the relative demand for unskilled labor diminishes, and governments or unions attempt to protect workers with low skills through labor market regulations or minimum wages, non-employment among the unskilled will increase (Bertola, 2003). Raising payroll taxes to support such efforts also reduces demand. Reinvention of human capital policy is required to combat the emergence of an underclass.

All available evidence shows that welfare state dependency in Europe is heavily concentrated among unskilled persons. For example, unskilled persons have higher unemployment rates, higher take-up rates of welfare benefits and larger participation rates in active labor market policies (OECD 2005a; 2006a; 2006b). In addition, many social problems are associated with lack of skill, such as deviant social behavior (drug use), working in the unofficial economy, criminal behavior, teenage pregnancies, and so on (European Commission, 2005). Social cohesion may be undermined further as migrant populations are predominantly low skilled and their welfare dependency rates are high.

Another feature of European labor markets is that European human capital stocks remain idle during large parts of the life-cycle due to non-employment and (early) retirement. However, human capital needs be utilized and maintained over the life-cycle for human capital investments to earn a sufficiently high return. High levels of taxation, generous social benefits and strong labor market regulations reduce labor force participation rates, hours worked and employment and thereby lower the utilization rates of human capital. Generous early retirement and pension schemes make older people retire many years before statutory retirement ages (Gruber and Wise, 1999). Low labor force participation rates of older workers imply that the time-horizons over which investments in human capital are harvested are short. In addition, there are often weak economic incentives to maintain skills through training on-the-job. Insurance schemes for disability, unemployment, and sickness create important moral hazard problems. Once out of work, (older) workers will often never be able to find a new job. Due to population ageing the utilization rate of European human capital falls

and substantial parts of human capital stocks will be written off as workers retire.

Reinvention of human capital policies is required for both efficiency and equity reasons. In order to address the challenges imposed by skill-biased labor demand shifts resulting in larger wage-premiums for skilled workers, investments in human capital should expand. Such a policy also helps to contain the growing divide between the skilled and the unskilled. Governments should put a strong emphasis on interventions early on in the life-cycle. Once individuals drop out of high school, labor market institutions or government policies often prevent them from finding employment at established wage minimums. If one wishes to maintain high levels of minimum income support and redistribution towards the poor, human capital policy is more urgent than ever to avoid increasing dependency on welfare states. Only when individuals acquire sufficient human capital at the beginning of their life-cycles, they can avoid getting stuck in poverty and productivity traps later on in life.

In addition, policies to foster human capital cannot be seen in isolation from labor market policies, tax and benefit systems and pension schemes. Current welfare state arrangements often create substantial implicit tax burdens on human capital investments because the incentives for investments in human capital are undermined by low utilization rates of human capital and short time horizons over which investments in skill materialize. Labor force participation, hours worked, training on-the-job and later retirement are all complementary to human capital investments. Reforms in labor markets, pension systems and tax-benefit systems may not only have beneficial static effects on labor market performance, but also have important dynamic efficiency gains by lowering implicit tax wedges on skill formation over the life-cycle.

We ground our policy analysis in insights from previous research on the technology of skill formation (Cunha, Heckman, Lochner and Masterov, 2006). Human capital accumulation is a dynamic process. The skills acquired in one stage of the life-cycle affect both the initial conditions and the technology of learning at the next stage. Human capital is produced over the life-cycle by families, schools, and firms. Different stages of the life-cycle are critical to the formation of different types of abilities. When the opportunities for formation of these abilities are missed, remediation is costly, and full remediation is often prohibitively costly. These findings highlight the need to take a comprehensive view of skill formation over the life-cycle so that effective policies for increasing the

low level of skills in the workforce can be devised.

The present paper extends this line of reasoning to the rest of the life-cycle. We argue that, due to the same dynamic complementarities in skill formation over the life-cycle, skill formation is impaired when the returns to skill formation are low due to low skill use and insufficient skill maintenance later on in life. We develop a theory of earnings, schooling, training and retirement which is capable of describing some stylized features of Europe's labor markets and illustrates the impact of various policies. The consequences of low skill formation both in the Anglo-Saxon world and mainland Europe are equally present. However, when it comes to skill use and skill maintenance, we show that mainland Europe differs markedly from the Anglo-Saxon world due to low skill use and poor skill maintenance. Europe's future problems with low skills are therefore exacerbated by labor market institutions and government policies that lower utilization rates of human capital and promote steep depreciation of human capital over the life-cycle.

The rest of this paper is organized as follows. Section 2 gives some stylized facts on trends and developments that are crucial for devising an appropriate human capital policy for Europe. Section 3 summarizes the evidence on the technology of skill formation. Section 4 of develops a theory of skill formation, skill utilization and skill maintenance. Section 5 summarizes and gives the policy conclusions of our analysis.

2 Stylized facts on skill formation, skill use and skill maintenance in Europe

This section describes in detail some of the most salient stylized facts on inequality, skill-formation, skill use and skill maintenance, between countries and developments over time. Wherever possible we distinguish between the Anglo-Saxon countries (United Kingdom, Australia, Canada and the United States), the Nordic countries (Denmark, Norway, Sweden, and Finland), Continental European countries (Netherlands, Belgium, France, and Germany) and Mediterranean countries (Portugal, Spain, Italy, and Greece).

2.1 Economic environment

2.1.1 Growing earnings and income inequality

Davis (1992), Gottschalk and Smeeding (1996), Katz and Autor (1999) and Brandolini and Smeeding (2006) analyze trends in earnings inequality and conclude that inequality has been steadily increasing in Western countries during the last decades of the twentieth century although the rapid growth in the 80's appears to be levelling off in the 90's.[1] Figure 1 plots the trends in 90/10, 90/50 and 50/10 percentile earnings ratio's from the OECD Labor Force Statistics Database. The increase in inequality is most notable in the Anglo-Saxon countries. The Nordic countries appear to have contained the increase in inequality. As noted by Bertola (2003) and Atkinson (2006), the rise in inequality countries is mainly concentrated in the upper part of the earnings distribution and not so much in the lower part of the earnings distribution. Gottschalk and Smeeding (1996) and Brandolini and Smeeding (2006) have shown that inequality in net disposable household income did increase as well but to a much lesser extent than labor earnings. Piketty and Saez (2003), and Atkinson and Salverda (2005) document large increases in earnings inequality at the very top of the income distribution for the US and the UK. Piketty (2003) and Atkinson and Salverda (2005) show that the income distribution at the top did not change much in France and the Netherlands. Figure 1 is consistent with these findings.

2.1.2 Minimum wages, inequality and growing unemployment in the bottom of the earnings distribution

Falling minimum wages appear to have caused growing inequality at the bottom of the earnings distribution in the US, see also Katz, Autor and Kearny (2005). Many European countries have witnessed a steady decrease in the ratio of minimum wages to median earnings as Figure 1 shows. Minimum wages reduce inequality for workers at the cost of lower employment. Indeed, inequality at the bottom of the earnings distribution did not increase much for European countries but unemployment rates among the low income earners have been increasing instead (Davis, 1992). Figure 2, from Bertola (2003), shows that employment declines (unemployment rates increase) es-

[1] This finding is also reported for the US by Katz, Autor and Kearney (2005).

pecially in those countries where inequality in the lower part of the earnings distribution remained rather constant. Increases in unemployment rates are disguised to an important extent by enrolling unemployed workers in active labor market and training programmes. Figure 3 from Heckman, Ljunge and Ragan (2006) shows that many European countries and especially corporatist countries (Denmark, Finland, Norway, and the Netherlands) almost halve their open unemployment rates by placing more unemployed workers in Active Labor Market (ALM)-programmes, where they are no longer counted as unemployed workers. Adding these trainees back to the unemployed substantially boosts the unemployment rate.

2.1.3 Trade-off between equality and incentives for human capital investment

Low inequality may not only be a virtue, but may also be a vice when low inequality reflects weak economic incentives. Figure 4 plots higher educational attainment rates of 25-34 year old cohorts against earnings inequality as measured by the 90/10 percentile ratio. Both variables are taken from the OECD Labor Force Database. A clear positive correlation emerges between earnings inequality and higher educational attainment. This positive correlation remains robust using tertiary attainment rates of 25-65 year old cohorts, employing 90/50 or 50/10 percentile ratios for inequality or doing panel regressions that allow for country-specific fixed effects. There is not only a trade-off between the *quantity* of employment and equality but also between the *quality* of employment and inequality. More compressed wage distributions imply weaker incentives for skill formation. Frederiksson (1997) is one of the few studies that directly estimates the effect of a larger skill-premium on enrolment and finds very substantial effects for Sweden. The empirical general equilibrium model for the US of Heckman, Lochner, and Taber (1998) also predicts a quite elastic response of investments in human capital to larger skill premia.[2]

[2]Numerous studies find only small impacts of larger tuition rates on enrolment (Kane, 1994, 1995; Hilmer, 1998; Heckman et al. 1998; Dynarski, 1999; Card and Lemieux, 2001; Cameron and Heckman, 2001). Part of the explanation is that tuition costs are a relatively minor fraction of the total costs of education since forgone labor earnings are by far the most important part (Becker, 1964). Another explanation is that psychic costs play a substantial role in explaining college choices (Cunha, Heckman and Navarro, 2005).

2.1.4 Patterns of income mobility

Larger inequality is not necessarily a reflection of more unequal chances in life if larger inequality is the result of higher income mobility (Friedman, 1962). Figure 5 plots the results of the meta-analysis of mobility studies in Corak (2006). All studies discussed in Solon (2002) are included. The empirical evidence strongly suggests that the US and the UK feature much less generational income mobility for example the Nordic countries.[3] Surprisingly, also France and, to a lesser extent, also Germany have high levels of intergenerational persistence of income for reasons that are not entirely clear.[4]

As stressed by Corak (2006) a general problem with the income mobility literature is that there is little focus on and appreciation of the causal mechanisms underlying income mobility processes. Recently, some analysts have attempted to correct mobility estimates for intergenerational transmissions of ability as, for example, embodied in genetic transfers from parents to children. Plug and Vijverberg (2002) use adopted children as a natural experiment to estimate that about one half of intergenerational income mobility correlations can be attributed to genetic links between parents and children. Their identification strategy rests, however on the absence of interactions between genetic transfers and the family environment which appear to be relevant, see also Björklund, Lindahl and Plug (2006) and Cunha, Heckman, Lochner and Masterov (2006).

Often income data are not available or subject to important measurement problems and researchers resort to education levels as proxies for income levels to estimate intergenerational mobility. Behrman and Rosenzweig (2002), Antonovics and Goldberger (2003), Plug (2004), and Björklund et al. (2006) all show that correlations between parental education and the child's education are driven down substantially (sometimes almost to zero for women) once corrections are made for parental transfers of ability. They do so by using quasi-experimental methods using twins or adopted children to isolate genetic transfers from parents to children. Björklund et al. (2006) furthermore present some suggestive evidence for the importance of non-linearities between genetic

[3] Jäntti et al. (2006) find that the strong intergenerational persistence of income in the US is driven mainly by low mobility in the lower and top tails of the income distribution. Corak and Heisz (1999) appear to find exactly the opposite pattern for Canada: high mobility in the tails, low mobility in the middle.

[4] Corak suggests that France's high income persistence is driven by the high returns to education, but the return estimates given in Harmon et al. (2003) do not suggest that returns to education are exceptionally high in France (and also in Germany).

transfers and parental education. Especially maternal education improves educational outcomes of the child if there are larger genetic transfers from the mother to the child. These findings bolster the notion that genes and family environments jointly produce skills of children.

Becker and Tomes (1986) show that, as long as there are non-binding bequest constraints, intergenerational correlations in education are not driven by financial resources, but by transmissions of cultural and biological endowments, such as genes, parenting skills and family environments. This is exactly what the literature appears to find. Therefore, the empirical findings, probably unintendedly, show that long-run income and bequest constraints are much weaker determinants of intergenerational education correlations than commonly believed.

Findings of high income mobility may not only suggest more equality of opportunity, but may again also be a sign of weak economic incentives. As Solon (2004) and Corak (2006) argue, patterns of income mobility are indeed affected by incentives. Stronger incentives (as for example measured by rates of returns to education) typically result in *less* intergenerational income mobility even if there is complete equality of opportunity. The reason is that more able and therefore richer parents invest relatively more in the education of their children when the returns increase and parental ability is positively correlated with the child's ability. Therefore, it is not surprising that measured intergenerational mobility is higher in the Nordics than in the Anglo-Saxon countries because the returns to education are much lower. Low income mobility in the US may therefore also be a reflection of strong incentives rather than unequal chances in life.

Non-cognitive skills are transmitted as well over the generations. Empirical work by Duncan and Brooks-Gunn (1997), Duncan and Dunifon (1998), Duncan et al. (2004) shows that the apple falls close to the tree. Children from parents who work hard are also inclined to work more themselves. The same holds true as well for attitudes towards the importance of work, education, endurance, patience, and so on, for success later in life (Lindbeck and Nyberg, 2006). Consequently, estimates for income and education mobility are biased downwards if the transmission of effort and non-cognitive skills is important.

2.1.5 Literacy spreads cause larger inequality

Figure 6 gives the distribution of the OECD (2004a) PISA math scores for 15 year old children. As can be seen, differences in both means and spreads are large across countries. In most countries shown in this figure 50% or more of their children score in the bottom two levels of mathematical performance. It is perhaps surprising that the Scandinavian countries – with the exception of Finland – are not found in the top ranks given the large amounts of resources being spend on education. Literacy scores for adults also published by OECD (2003) shows similar patterns (not shown).

Figure 7 shows that there are large gaps of PISA math scores between migrant children and native children. No clear pattern across countries is visible in the performance of migrant children on the absolute scale of PISA scores. However, the absolute gaps are much larger in Continental European and Nordic countries than they are in the Anglo-Saxon countries. In particular, Canada has a very high average score and a small spread between migrants and natives. The migrant gap is to a large extent driven by differences in the social economic backgrounds between migrant and native children in most countries (OECD, 2004a). Another intriguing finding is that differences in school-related factors hardly matter in explaining the variance of PISA scores (OECD, 2004a). This is consistent with the Coleman Report (1966) as well as more recent work by Carneiro and Heckman (2003), Neal (2006), and Raudenbush (2006).

Figure 8 shows that there are gaps in literacy for adults having different levels of education. The levels of literacy for individuals with less than secondary schooling in countries such as the United States and Portugal is particularly worrisome. Across countries there is not much difference in the literacy skills of those with a tertiary education. The differences across countries emerge mostly for those who have low levels of educational attainment. This pattern is observed even within a younger cohort of individuals who are 20–25 years of age at the date of this test. The problem of the low skilled is not less dramatic for this younger cohort.

Nickell (2003) documents that the problem of low literacy is not getting much better in the adult population across a variety of countries. In fact, for countries such as the US and the UK it is getting worse. Nickell also shows that there is a strong association between inequality in literacy scores

and inequality in income across countries: the countries with the higher level of literacy inequality, such as the Anglo-Saxon countries and Portugal, also have the highest levels of income inequality. Leuven, Oosterbeek and Van Ophem (2004) find a robust association between wage inequality and net supply of skills using IALS literacy data, see Figure 9. Coulombe, Tremblay and Marchand (2004) from Statistics Canada have constructed time series of literacy over time for teenagers and young adults based on the IALS data, see also Figure 10. When it comes to the development of literacy over time we see a pattern similar to the development in the wage structure. Especially Anglo-Saxon countries with increasing inequality have witnessed decreasing levels of literacy. Also notable is the decline in Sweden. Most countries had rather stable patterns of literacy over time. Finland, Italy and Belgium featured increasing literacy rates.

2.1.6 Rising returns to education

Income inequality is increasing in part because the returns to education display an upward trend. Studies for the US have documented a strong and steady increase in the college-premium during the 80's and 90's (Katz and Autor, 1999; Katz, Autor, Kearny, 2005). Peracchi (2006) reviews a large number of country studies and shows that in general skill premia have been constant or increasing in recent years for most Western countries. Gottschalk and Smeeding (1996) in their cross country comparison find that an important driving force behind growing earnings inequality is the growing skill-premium. Using a panel of selected OECD countries, Nahuis and De Groot (2003) show that rising skill-premia during the 80's and 90's are not only present in the US but in the whole of the Western world.[5]

By now there is a firmly established consensus that the mean rate of return to a year of schooling, as of the 1990's, exceeds 10 percent and may be as high as 17 to 20 percent (Carneiro, Heckman, and Vytlacil, 2006).[6] This return is higher for more able people (Taber, 2001; Carneiro and Heckman, 2003) and for children from better backgrounds (Altonji and Dunn, 1996). Those from better backgrounds and with higher ability are also more likely to attend college and earn a higher rate of return from doing so. This evidence is robust to alternative choices of instrumental variables and

[5]Carneiro and Lee (2006) show that standard measures for skill-premia between higher and lower educated workers are even biased downwards due to selection into higher education on non-observed characteristics.

[6]Heckman, Lochner and Todd (2006) discuss the relationship between Mincer returns and true rates of return.

to the use of alternative methods for controlling for self-selection. Both cognitive and noncognitive skills raise earnings through promoting schooling and through their direct effects on earnings (see the evidence in Taber 2001; Heckman, Hsee, and Rubinstein 2001; Carneiro, Hansen, and Heckman 2001; 2003; Cunha, Heckman, Lochner, and Masterov, 2006; Heckman, Stixrud and Urzua, 2006).

Carneiro, Hansen, and Heckman (2001; 2003) extend the analysis of Willis and Rosen (1979) to identify distributions of outcomes of schooling. About 7 percent of college graduates earn ex post negative returns. For them, going to college turns out to be a financial mistake. It would be a mistake for a greater proportion (14 percent) of those who stay in high school and do not go on to college. Cunha, Heckman, and Navarro (2005) show that this remains true under a wide variety of market environments, ranging from complete capital and insurance markets to markets with liquidity constraints and non-insurable income risks. See also the evidence in Heckman, Lochner and Todd (2006) and Cunha and Heckman (2006b).

Cunha and Heckman (2006a) and Heckman, Lochner and Todd (2006) survey a large number of studies that show that nonpecuniary factors (associated with psychic costs, motivations and the like) play a major role in explaining why minorities and persons from low-income families do not attend college even though it is financially profitable to do so. Returns to schooling for marginal entrants attracted into college by changes in tuition are below those of the average participant. Returns to schooling are lower for people less likely to attend college.

2.1.7 Skill problems cause many non-economic problems

Many countries are confronted with large drop-out rates especially among minority groups. Disadvantaged students enter primary education with substantial deficits in knowledge, literacy and individual capacities. Figure 11 shows the fractions of young birth cohorts not in school or employment. The Nordics (except Finland, which seems an outlier) do well in keeping their youngsters in school or included in the labor market. This could also be due to enrolling these youngsters in active labor market and training programmes (see Heckman, Ljunge and Ragan, 2006).

Continental European countries do a somewhat better job than the Anglo-Saxon and the Mediterranean countries. The latter have 5–10% of the 15–19 year old cohort not in school or work. Drop-out of youngsters causes many social problems such as larger unemployment rates,

working in the black market, crime, deviant behavior and teenage pregnancies.[7]

2.2 Skill creation

2.2.1 Slowing down of the growth in supply of skills

Educational attainment has grown enormously in most of the Western world. Figure 12 plots higher educational attainment rates (as a fraction of each birth-cohort) over the 1960-1995 period for various countries from the De la Fuente and Domenech (2006) data set.[8] Enrolment rates doubled virtually everywhere. Figure 13 gives the development in the average number of years of education across countries. A striking feature is the large heterogeneity between countries in higher educational attainment. The Mediterranean countries lag miles behind the Nordic and Anglo-Saxon countries. The Continental European countries are somewhere in the middle. We have to note here that institutional differences between countries make good comparisons difficult due to, for example, differences in the duration of higher educational programmes. The literacy scores indicate that high levels of educational attainment in some countries do not necessarily match with high levels of literacy. Education systems differ across different countries and these comparable tests may provide a better measure of the stock of skills of a country, at least for the purpose of international comparisons. Hanushek and Kimko (2000) use these tests as a measure of the quality of the labor force and argue that these are an important determinant of economic growth.

The massive increase in the level of education of Europe's workforces probably cannot be maintained indefinitely. Figure 14 shows that there are strongly decreasing returns to raising education levels as the growth rate of in education levels during 1960-1995 is negatively correlated with the initial level of education in 1960. Therefore, one can expect that the returns to education will be rising in the years to come because the demand for college educated workers outstrips supply.

[7] See European Commission (2005).

[8] De la Fuente and Domenech (2006) have constructed a panel data set for OECD countries of educational attainment for various education levels and average years of education based on data from national statistical offices which are supplemented by data from the OECD.

2.2.2 Resources invested in human capital stagnant

Resources invested in human capital in Europe also remain rather stagnant despite the rising returns. Figure 15 plots the real investments per student in higher education for the time period 1991-2001 from OECD sources. The financial resources per student in higher education invested are roughly constant in Continental European and Mediterranean countries. In Anglo-Saxon and Nordic countries, resources invested in higher education increase. Overall investment levels as a fraction of GDP do not change much over time as well in Continental and Mediterranean countries, see Figure 16. Notable are and the decreases in some of the Nordic countries (Finland and Norway).

Figure 17 reveals that invested resources per student in primary, secondary and tertiary education vary a lot. Resources per student in primary education are especially high in Denmark ($7572, Norway ($7404) and the US ($7560). Also Italy spends substantial amounts per student on primary education ($6783). The other Mediterranean countries do invest little, i.e., around $4200 for Portugal and Spain and even lower amounts per student ($3299) for Greece. There is also substantial heterogeneity in spending per student in secondary education varying from $3768 in Greece to $9040 in Norway. No clear pattern is visible which is probably due to the differences in education systems across countries. With regards to spending on higher education large differences are found. The US leads with more than $20.000 per student invested per year. Then follow the Nordics, Autralia and the Netherlands with $13.000-15.000 per year. Mediterranean countries have very low investments per student (below $9.000).

Figure 18 plots the share of private contributions to the direct costs of education for different countries. Virtually all European countries heavily rely on state funding for education and that is probably also the reason why budgets haven't kept pace with increasing enrolment rates. Primary and secondary education are virtually free everywhere. As regards higher education, tuition is subsidized and students receive (means tested) grants and study loans with interest subsidies. Again, only the Anglo-Saxon countries have a non-trivial share private investments whereas especially the Nordic and Mediterranean countries almost exclusively rely on state funding for education. From figure 19 follows that resources are shifted away from higher education towards primary and secondary education. Indeed, the share of public funding for higher education has decreased

especially in Australia and the UK. These countries introduced income contingent loan schemes in higher education.

Although larger skill premia would naturally give stronger incentives to invest in more human capital, it is by no means certain that this will also happen in the stiffly regulated higher education sectors in Europe. Due to the ageing of the population and the EMU criteria for deficits and debts, most government budgets are under pressure. There is currently not much hope for extra public funding whereas there are good reasons to channel for more private investments in higher education. Nevertheless, most governments obstruct private funding by repeatedly raising accessibility issues and failing to understand the basic incentive issues facing schools and students (see Jacobs and Van der Ploeg, 2006).

2.2.3 Migration and the inflow of low skilled workers

Figure 20 shows that the fraction of non-OECD migrants in current populations is not large but certainly is not negligible.[9] There is substantial variation among countries. Mediterranean countries have the lowest non-OECD migrant populations. Continental European and Scandinavian countries are in the middle and the Anglo-Saxon countries have the largest migrant populations.[10] Figure 21 gives the differences in education levels of the non-OECD migrants and population consisting of OECD migrants and natives (called 'natives' for short). The figure plots the difference in the population shares at each education level (differences add up to zero). This figure shows that the Continental European and Scandinavian countries have migrant populations that are on average much lower skilled than the native population. Migrants in the Mediterranean countries are on average slightly better educated than the native population. Portugal has an especially better educated migrant population. Migrants in the Anglo-Saxon countries are much better skilled than the native population, with the exception of the United States, which has large inflows of both high skilled and low skilled migrants. The likely explanation for these patterns is that virtually

[9] We focus on non-OECD migrants rather than foreign born migrants. Approximately one half of overall migration occurs within EU borders, but within-EU migrants are typically not the concern of policy makers. This proxy may give a downward bias on the actual number of non-EU migrants because for example Turkey is an important emigration country in the OECD.

[10] Since Mexico is in the OECD, the plot for the U.S. importantly understates the size of the immigrant population in the U.S.

no European country officially endorses labor migration policies for non-EU countries as have been common in the US, Canada, the UK and Australia. In general, migration is possible only through asylum procedures or family reunification, see also Figure 22.

The low qualifications of non-OECD migrants in Continental European and Nordic countries are a continuous worry for policy makers as migrants are relatively more dependent on welfare state arrangements and feature prominently in poverty figures. Children from non-OECD migrants have higher drop out rates in secondary school and end up disproportionally in the informal economy or in crime. In addition, a continuous inflow of low skilled migrants may put wages of low skilled workers under pressure (see also Borjas, 1999).

A completely different story applies to migration within EU borders. With the entrance of the former communist countries to the EU, a potentially large pool of less skilled workers may enter Western-European labor markets. According to EU treaties there is in principle free mobility of labor within the EU. Although within-EU labor mobility is low, it is increasing and many voice concerns about the sustainability of welfare states, maintaining minimum wages and erosion of union power. Most Western European countries have responded to this development with tightening border controls, increasing red tape, reducing length of work permits and shutting off access to welfare systems (Boeri and Brücker, 2005).

2.2.4 Skill-biased demand for labor

The sharp increase in educational attainment in some countries in Europe has put downward pressures on skill-premia. That is probably why returns to education have not been rising so much in some European countries as opposed to the US where growth in the supply of skilled workers choked off already in the 90's (Carneiro and Heckman, 2003; Katz, Autor, and Kearney, 2005). Nevertheless, overall wage inequality did increase and returns to education certainly did not decrease to a large extent. Gottschalk and Smeeding (1996) and Peracchi (1996) show that skill-premia remained rather constant in most countries and generally increased in recent years. Everywhere in Europe labor markets have absorbed the enormous influx of skilled workers without large reductions in skill-premia. In other words, the demand for skilled workers has been increasing at the same or even higher speed than the supply of skilled workers. Many explanations have been put forward

for these labor demand shifts but skill-biased technical changes appears to be the most important one. Increasing international trade and capital-skill complementarities could be supplementary explanations for this phenomenon, see also Katz and Autor (1999).

The outward shift of relative demand for skilled workers is radically transforming labor markets and economies. To get an impression of its quantitative importance one may ask the counterfactual question how much wage differentials would have increased had the supply for skilled workers remained constant. In the US wage differentials between skilled and unskilled workers would have increased at a rate of 3% per year (Katz and Murphy, 1992) and about the same is found for Canada (Murphy, Riddell and Romer, 1998). Jacobs (2004) documents a skill-bias of about 2% per year in the Netherlands. A skill-bias of a 1% increase in college premium per year is found in Sweden by Edin and Holmlund (1995).

2.2.5 Low skilled workers have weak incentives to train

Unskilled individuals receive little training on the job, either because they opt out of it when it is offered to them, or because employers choose to offer training to workers with better skills. This is illustrated in Figure 23, from OECD (2003), which shows the proportion of people at each literacy level who receive job training. As emphasized by Carneiro and Heckman (2003), there are strong complementarities between early human capital investments and adult human capital investments. Low skilled workers have difficulty in benefiting from adult training because they have a low stock of human capital on which adult investments can build on and be productive. Remediation investments in adulthood are very costly and ineffective for low skilled individuals (Knudsen, Heckman, Cameron and Shonkoff, 2006). Preventive investments that take place earlier in the life-cycle of individuals generate much larger returns.

2.2.6 Large spending active labor market programmes

Many European governments spend large amounts of resources on active and passive labor market programmes, as demonstrated in Figure 24. Continental European countries lead in total spending, followed by the Nordics. Mediterranean countries have some labor market programmes, especially Spain. Anglo-Saxon countries have virtually no labor market programmes compared to the rest.

Below we will argue that these programmes are largely ineffective in lifting individuals out of poverty and raising their standards of living.

2.2.7 Taxes, subsidies and the incentives to acquire skills

Flat labor income taxes do not harm skill formation as long as all costs are subsidized or deductible at the flat income tax rate. Direct costs and the opportunity costs of education – forgone labor earnings while in education – are then taxed at the same rate as the future labor earnings (Heckman, 1976). Only if marginal costs are taxed at lower rates than the marginal benefits, tax distortions on skill formation emerge. If marginal tax rates on labor incomes are increasing with income, future earnings are taxed at higher rates than forgone labor earnings and taxation discourages investment in human capital. This is the case in most European countries, see also Figure 36 which gives Musgrave and Musgrave's coefficient of residual income progression.[11]

Also if education requires non-deductible expenses or effort costs, labor taxation reduces investment in human capital. Education expenses for formal schooling or training are generally not deductible for the income tax. Some exceptions are Italy, the Netherlands and Portugal (see also Gordon and Tchilinguirian, 1998). Large subsidies on education and training do however correct for tax disincentives on skill formation (Bovenberg and Jacobs, 2005). Indeed, many governments seem to over-subsidize higher education from a fiscal perspective, i.e., there is a net subsidy rather than a net tax on education and training (De la Fuente and Jimeno-Serrano, 2005; Bovenberg and Jacobs, 2005). Also, training costs are generally deductible by firms.

Non-pecuniary costs and benefits escape the tax system and cannot be subsidized either. Given the high returns on human capital investments one is tempted to conclude that non-pecuniary costs of education appear to be empirically more important than the non-pecuniary benefits. Findings by Carneiro et al. (2001, 2003) and Cunha, Heckman and Navarro (2005) suggest that non-pecuniary costs can be very important indeed. Therefore, it can still be the case that taxation distorts skill formation even though direct costs are heavily subsidized. Additionally, large subsidies on observable inputs in human capital formation (like years enrolled in education) will crowd out non-

[11]This coefficient gives the ratio (1 – marginal tax rate)/(1 – average tax rate) and is smaller than one if the marginal taxes are higher than average taxes.

subsidized complementary inputs in human capital formation like study effort (see Bovenberg and Jacobs, 2005; Jacobs, 2006a). High subsidies on education may then go hand in hand with long study durations, high drop-out rates and low student performance.

Finally labor income taxation depresses labor supply and thereby the utilization rate of human capital. Consequently, labor income taxation indirectly depresses human capital investments, even if all costs are deductible and labor taxes are flat, see also Jacobs (2005, 2006a).

2.2.8 Slowing growth in skills lowers productivity growth

Researchers have established a robust, causal relation between education and earnings at the microeconomic level (see for example Card, 1999; Harmon, Oosterbeek and Walker, 2003; Heckman, Lochner and Todd, 2006) although there is a debate about the magnitude of the relationship. A growing body of evidence suggests that the macroeconomic returns are of the same magnitude as the conventional microeconomic estimates (Heckman and Klenow, 1998; Sianesi and Van Reenen, 2002; Krueger and Lindahl, 2001; De la Fuente and Doménech, 2006; Ciccone and Peri, 2006). The fact that education appears to be roughly equally productive at the macroeconomic level as at the micro-level largely disqualifies the 'signalling-hypothesis' as put forward by Arrow (1973).[12] Skills are crucial determinants of labor productivity. These findings can also be taken as evidence that — at current levels of public spending — external effects of education are absent. Figure 25 gives the average annualized growth rates of labor productivity during the last 20 years. This graph shows that the Continental European and Mediterranean Countries have witnessed the lowest rates of productivity growth. Unsurprisingly, the countries with large levels of investment in human capital (Nordics and Anglo-Saxon countries) appear to generate the highest levels of productivity growth. A slowdown in the rate of skill acquisition therefore appears to threaten the standards of living of future generations.

[12] This was first noted by Heckman and Klenow (1998).

2.3 Skill utilization

2.3.1 Small labor force attachment reduces the utilization rate of human capital

A possible reason for low average returns to education is that labor force participation rates are low. This causes acquired human capital to remain idle. Hence, a lower utilization rate of human capital reduces the returns to investments in schooling and training. Figure 26 shows that labor force participation rates are lowest in Mediterranean and Continental European countries. Nordic and Anglo-Saxon countries have higher participation rates. However, labor force attainment has been increasing in recent years in many countries as women started to participate in especially the Nordic and Continental European countries. Growth in participation rates was more modest in Anglo-Saxon countries where participation rates were already high. Mediterranean countries seem to be stuck in a trap of low participation rates.

Labor force attachment strongly increases with the level of education as can be seen from Figure 27. This patterns holds across all countries. Although often overlooked in the human capital literature, an important benefit of higher skills is therefore the increased labor force attachment of more educated workers, especially in Europe where employment rates are low. Figure 28 shows that unemployment rates (by level of education) are not that diverging between countries. The Mediterranean and Continental European countries (except the Netherlands) perform worst. The Netherlands, the Nordics and the Anglo-Saxon countries have similar unemployment rates. Again, note the strong dependency of unemployment on the level of education. As already noted, official unemployment statistics are misleading because many countries enroll unemployed workers in ALM programmes, see Figure 3 from Heckman, Ljunge and Ragan (2006). The latter authors show that real unemployment rates can be twice as high as official statistics suggest. Some corporatist countries may just be good in hiding unemployment.

European countries have also hidden a lot of unemployment in sickness and disability benefits. Figure 29 gives the non-employment rates of disabled workers as a fraction of the population aged 20-64. This depressing picture shows that a fraction of around 8% of the population aged 20-64 receives a sickness or disability benefit and does not work. Large fractions of workforces are disabled or sick and not participating in the labor market especially in the Netherlands, Germany,

Portugal, Denmark, Sweden and the UK where the rate of sickness/disability is around 10% or higher. Disability related expenditures are especially high in the Netherlands and some Nordic countries (between 4-5% GDP). The other Continental European countries and the Anglo-Saxon countries do not have a lot of disability spending: between 1-2% of GDP, see Figure 30.

2.3.2 Falling working hours lower utilization rates of human capital

Not only is the employment rate of European workforces low in comparison to the Anglo-Saxon world, but also hours worked. This fact is documented many times and one of the suggested reasons is the high level of taxation. However, also unionization of labor markets and collective labor agreements on reductions in working hours and holidays matter (see, for example, Prescott, 2004; Alesina, Glaeser and Sacerdote, 2005). From Figure 31 can be seen that the average number of hours worked is falling quite steadily over time in many countries in the last two decades. The only exception is Sweden where average hours worked actually increased. Anglo-Saxon countries featured rather stable patterns of hours worked over time with the exception of the UK. Part of this development is the mirror image of increasing labor force participation rates by female workers who tend to work more in part-time jobs, see also Figure 32. This pattern cannot readily be explained by increasing tax rates everywhere because tax rates have been falling in recent years in many countries, see also Figure 36.

2.3.3 Generous benefit entitlements reduce employment

Replacement incomes when unemployed can be high as indicated in Figure 33. Replacement incomes for the unemployed in Nordic and Continental European countries are around 50-60% of earned income. Anglo-Saxon countries have much lower replacement rates in the order of 20% of earned income or even less on average. The Mediterranean countries are in the middle with replacement rates of about 30% with a notable exception of Italy. Figure 34 shows how eligibility for unemployment benefits changes over time. Individuals quickly loose their benefits in the Anglo-Saxon, Nordic and Mediterranean countries. Only in the Continental European countries unemployment benefits often extend to 5 years or more without large reductions in benefit levels.

Theoretical work by Layard et al. (1991), Bovenberg and van der Ploeg (1994), Pissarides

(1998), Sørensen (1999) and others, shows that larger replacement benefits reduce employment in both competitive and non-competitive labor markets characterized by unions, efficiency wages or matching frictions. In a neoclassical world, unemployment benefits lower labor supply through income effects and act as subsidies on leisure. In labor markets with unions, higher replacement rates raise unions' wage demands and this lowers employment. In labor markets with frictions or efficiency wages, higher replacement incomes increase reservation wages for workers and thereby lower employment as workers receive higher wages. So both in competitive and non-competitive labor markets, higher (unemployment) benefits reduce employment (or increase unemployment).

Generous benefit entitlements are probably one of main the reasons why unemployment rates are high, but also extensive duration of benefits, strict labor market regulations with respect to hiring and firing of workers and large union coverage, see also Layard et al. (1991) and Nickell (1997). The main problem however with these macroeconomic studies is that the time-series variation within countries is rather limited and identification of effects heavily relies on the cross-country dimension. Adding country fixed effects often destroys the cross-country correlations found, see also Van Ours and Belot (2001) and Blanchard (2006).

In contrast to the macroeconomic literature, a pile of microeconomic studies suggests that employment sharply decreases with the generosity and duration of benefits because workers search less actively for work both in the US and in European countries, see the overview in Lalive et al. (2006) and the estimates they present. Abbring et al. (2005) and Lalive et al. (2005) and the references they cite, find that sanctions on benefit levels and durations may be highly effective in getting unemployed workers back to work.

Some recent studies document strong cohort effects in the take-up rates of benefits (Lindbeck and Nyberg, 2006; Ljunge, 2006). Younger generations are more likely to collect some benefit than older generations which can be due to the erosion of work ethic.[13] These arguments provide an alternative explanation for the high level on which European unemployment rates have been stuck since the end of the 1980's.

[13]These findings are consistent with a 'social multiplier' for leisure demand as hypothesized by Alesina et al. (2005).

2.3.4 Labor market protection harms labor market performance

Figure 35 gives the OECD summary statistic on labor market regulations. This statistic summarizes the severity of legal restrictions on hiring and firing, flexibility in labor contracts, working time restrictions, minimum wages, and employees' representation rights (work councils, company boards). Mediterranean countries have the least flexible labor markets, followed by the Continental European countries. Nordic countries, and especially Denmark, appear to have more flexible labor markets. It goes without saying that the Anglo-Saxon countries have most flexible labor markets in the world.

Measures of labor market protection appear to be associated with bad labor market performance in macroeconomic studies (see Layardet al. 1991; Nickell, 1997; Groot et al., 2004). Again, time-series variation in these cross-country panel analyses is often too limited and solid conclusions cannot be drawn in general. Heckman and Pagés (2003) present evidence from microeconomic studies for Latin American countries to assess the impact of labor market regulations. They find that job security regulations indeed have large efficiency costs. In addition, the distributional consequences appear to be perverse. Insiders gain from labor market regulations at the expense of outsiders: young and unskilled workers. However, using a panel of both Latin American and OECD countries and exploiting exogenous variation induced by various policy reforms, the macroeconomic evidence on the impact of labor market regulations remains fragile. Payroll taxes are the only really robust variable in explaining lower employment and higher unemployment rates.

2.3.5 Large tax burdens weaken labor market performance

Figure 36 gives the average and marginal tax burdens on earned income including the value added or sales taxes. Large average and marginal tax burdens suggest that labor supply is distorted substantially (Prescott, 2004; Alesina et al. 2005). Marginal tax rates are generally in the order of 60–70% in Continental European and Nordic Countries. Marginal tax rates are substantially lower in the Mediterranean countries and the Anglo-Saxon world. Here, the Continental European Countries have the steepest graduation in tax rates. The other countries are relatively close in terms of tax rate progression.

A huge micro literature shows that high levels of taxation depresses labor supply in terms of

hours worked. See Pencavel (1986), Killingsworth and Heckman (1986), and Blundell and MaCurdy (1999), for extensive overviews. Substitution effects in labor supply are dominant (especially for women) and income effects appear to be rather small. Much less empirical evidence can be found on the effects of taxation on other choice margins than hours worked. As stressed by Heckman (1993) and Saez (2002) the participation ('extensive') margin is more elastic than the hours worked ('intensive') margin.

The effects of higher taxes are not clear-cut in non-competitive, European style labor markets, see for example Bovenberg and van der Ploeg (1994), Sørensen (1997), Pissarides (1998), Bovenberg (2006) and Van der Ploeg (2006). Higher marginal taxes (lower average taxes) yield lower employment in neoclassical theories of labor supply due to substitution (income) effects. In labor markets with frictions, unions or efficiency wages this can be exactly the opposite. Higher marginal taxes generally *increase* employment, for given labor supply. Unions are punished to ask higher wages when marginal tax rates increase as the government taxes away wage increases at higher rates. This moderates wage demands, labor demand expands and unemployment falls. In labor markets with frictions and workers and firms bargaining over a firm-worker match, unemployed workers moderate their wage demands if governments set more progressive taxes. Hence, labor demand expands, labor market tightness increases and equilibrium unemployment falls. In market environments characterized by efficiency wages, firms find it harder to recruit, retain or motivate workers by increasing wages when governments tax away these wage increases at higher rates. Therefore, firms pay lower wages, labor demand expands and equilibrium unemployment falls.

In non-competitive labor markers, higher average income taxes may also have opposite effects in comparison with neoclassical models as long as benefits are not indexed to net wages. A higher average income tax increases net replacement rates (net benefit divided by net wage). Unions will demand higher wages as the position of their working members worsens in comparison with the non-working members and unemployment rates go up. Firms paying efficiency wages see that it becomes more difficult to recruit, retain or motivate workers because net replacement rates increase, so equilibrium unemployment increases as labor costs rise. With search frictions, higher average tax rates on wage income increase wage demands of workers, which pushes up wage costs, labor market tightness falls and unemployment increases. When benefits are indexed to net wages, replacement

rates remain fixed and unions, firms or workers do not change wage setting behavior (a lot) and there are much smaller (or even zero) effects of higher average tax rates on unemployment.

Non-competitive behavior of unions, firms and workers dampen the adverse effects of higher marginal income taxes (lower average income taxes) on employment through various mechanisms of wage determination. Bovenberg et al. (2000) use a general equilibrium model for the Netherlands which is empirically grounded in the data and incorporates labor supply on the intensive and extensive margins, on-the-job training, search frictions and wage-setting by unions. The negative (positive) effects of high marginal (average) tax burdens on labor supply and training dominate the countering effects through the Dutch wage setting institutions and labor market frictions. Therefore, higher marginal taxes and lower average taxes is still harmful for overall employment, but much less so than in non-distorted labor markets.

2.4 Skill maintenance

2.4.1 Decreasing retirement ages causes quicker depreciation of skills

Apart from labor force participation and hours worked, the age of retirement also constitutes an important element of the utilization of human capital over the life-cycle. At the retirement age, human capital is written off completely. If workers retire later, they will have larger returns on their investments in education and training as the time-horizon over which the investments mature expands.

Figure 37 shows that that labor force attachment of the average worker is rapidly declining with age. This development is also carefully documented by Gruber and Wise (1998). Labor force participation rates of 55-64 year old workers are only in the order of 1/2 or even less. Especially the Continental European and Mediterranean countries have low participation rates of older workers. Nordic countries outperform the Anglo-Saxon countries as regards the labor force participation rates of 55-59 year old workers, but the Anglo-Saxon countries do better on the 60-64 year cohorts.

Figure 38 shows the development of labor force participation rates of cohorts of workers aged 55-59 year. Generally the labor force participation rates have been falling and show a turn around in recent decades. However, if there has been an increase in overall labor force participation rates of

55-59 year old cohorts, it is mainly driven by the general increases in female force participation rates. Belgium (slightly), Denmark, Finland and the Netherlands are the only four countries who have witnessed both an increase in male and female labor force participation rates and in recent years which is probably due to policy changes in early retirement schemes. All countries have witnessed declines of labor force participation rates of 60-64 year old cohorts, see Figure 39. Dramatic declines are found in Finland, France, Germany, Netherlands, and Spain. In Australia, Canada, Denmark, Norway, Sweden, and the United States the decline in overall labor force participation rates of 60-64 year old cohorts is to an important extent off-set by increases in female force participation. In the other countries this off-setting effect of higher female participation rates has been largely absent as they were falling too. However, recent increases of labor force participation rates in Canada, Netherlands and Sweden (as from 1990) are the result of increasing male and female labor force participation rates. This is, again, likely to be the result of changes in early retirement schemes.

Figure 40 plots the effective age of retirement, conditional upon being in the labor force. There has been a landslide in effective retirement ages. Over the last 40 years effective retirement ages went down massively everywhere in the Western world, including the Anglo-Saxon countries. Again, the Continental European countries have witnessed the largest decreases in the retirement ages (see also Gruber and Wise, 1999). In recent years we see that the decrease in effective retirement ages has come to a halt at a low plateau.

Figure 41 shows that labor force participation rates of 55-59 and 60-64 year old cohorts are much higher when individuals have more initial education. Better skilled workers retire much later. This graph reinforces our notion that labor supply and skill formation over the life-cycle are strongly complementary activities.

2.4.2 Generous pensions and early retirement schemes reduce labor force participation of older workers

Pension benefits can be generous as can be read from Figure 42. Pension replacement incomes in Continental European are quite high and about 60-80% of pre-retirement earnings for an average worker. Mediterranean countries have exceptionally generous pension schemes which entail pension benefits of 80-100% of last earnings (up to 100% in Greece). The Nordics, on the contrary, have much

more modest pension benefits in the order of 40-60% of pre-retirement earnings. The Anglo-Saxon countries have on average the lowest pension benefits which are around 40-50% of final earnings. Another interesting feature is that pension systems are PAYG state pensions almost everywhere. Exceptions are the Anglo-Saxon countries, the Netherlands, Sweden and Denmark that also heavily rely on substantial private funding, either through DB/DC occupational pensions or individual saving schemes see also OECD (2005e). Note finally that net pension incomes are always larger than gross pension incomes. The reason is that all governments give tax-deductions or subsidies on pension savings.

Many workers retire long before statutory retirement ages via all kinds of early-retirement schemes. It is not easy to make international comparisons because the institutional details vary from country to country. However, we can summarize the impact of early retirement schemes on the labor market by the implicit marginal tax rates imposed on an additional year of work (see also Gruber and Wise, 1999). Figure 43 shows that early retirement schemes do indeed cause very high marginal tax rates on pre-retirement incomes. Moreover retirement ages and benefit generosity are very negatively related. Gruber and Wise (1999) present strong evidence that this is a causal relation. It should therefore not come as a surprise that the Continental European and Mediterranean countries have low labor force participation rates of elderly workers because they have the most generous early retirement schemes.

In recent years some countries have attempted to reform their pension schemes. The Netherlands, Germany, France, and Italy are examples. In most countries, the effectiveness of these fiercely resisted reforms is small. In any case, labor force participation of older workers appears to be picking up in some countries recent years perhaps because workers anticipate future reforms.

3 The technology of skill formation

This section draws upon research by Heckman (2000); Carneiro and Heckman (2003); Cunha, Heckman, Lochner and Masterov (2006); Carneiro, Cunha and Heckman (2005); and Cunha and Heckman (2006a, 2006b) that develops the economic foundation for skill acquisition in modern economies.

3.1 Financial resources and heritability

Recent empirical research has substantially improved our understanding of how skills and abilities are formed over the life-cycle. The early human capital literature (Becker, 1964) viewed human capital as a rival explanation for human ability in explaining earnings. It emphasized that acquired human capital could explain many features of earnings distributions and earnings dynamics that models of innate and invariant cognitive ability could not. This point of view still underlies many recent economic models of family influence (e.g., Becker and Tomes, 1979, 1986; Aiyagari, Greenwood and Seshadri, 2002). The entire literature assumed that ability is an innate, scalar, age-invariant measure of cognitive skill. The recent economic literature on family influence on child outcomes focuses on family income constraints and heritability as the principal sources of parental influence on child development. Becker and Tomes (1979, 1986) initiated a large literature that emphasized the importance of credit constraints and family income on the schooling and earnings of children. Becker and Tomes (1986) show that there is no trade-off between equity and efficiency in making government transfers directed toward credit-constrained families because the return to human capital investment in children from such families is high due to the presence of credit constraints.

3.2 Cognitive and noncognitive abilities both inherited and created

Recent research presents a richer picture of schooling, life-cycle skill formation and earnings determination. It recognizes the importance of both cognitive and noncognitive abilities in explaining schooling and socioeconomic success. Cunha, Heckman, Lochner and Masterov (2006) develop a multi-period model of childhood in contrast to Becker and Tomes' (1979, 1986) one period models. They show that there is no trade-off between equity and efficiency for investments in younger children, but there is a substantial trade-off for investment in children at later ages. Cunha and Heckman (2006a) and Cunha, Heckman and Schennach (2006) present estimates of the technology of skill formation.

Both cognitive and noncognitive abilities matter in determining participation in crime, teenage pregnancy, drug use and other deviant activities. These abilities are themselves produced by the family and by personal actions. Both genes and environments are involved in producing these abil-

ities. Environments affect genetic expression mechanisms (see, e.g., Turkheimer, Haley, Waldron, D'Onofrio and Gottesman, 2003; Björklund, Lindahl and Plug, 2006). This interaction has important theoretical and empirical implications for skill policies. It suggests an important role for environment-enriching policies in fostering human skills.

Abilities are multiple in nature. They are both cognitive and noncognitive. Measured cognitive ability is susceptible to environmental influences, including in utero experiences. So is measured noncognitive ability. There are genetic components to both. The traditional sharp distinction between acquired skills and genetically determined cognitive ability maintained in the human capital literature is no longer tenable.

We have come to understand that achievement tests used to monitor performance in school and to determine acceptance into the military are not the same as IQ tests. Achievement test scores are determined by IQ, noncognitive inputs and by environmental factors. Even IQ can be affected by environmental interventions at least up to age 10 or so. It is hard to change IQ after this age. Differences in cognitive ability across family types appear early and persist over time (Carneiro and Heckman, 2003). Education barely affects testscore gaps by family income or socioeconomic status after the early years of schooling (Carneiro and Heckman, 2003; Neal, 2006; Raudenbush, 2006). In the popular literature, achievement tests and IQ tests are often confused. Achievement test scores are affected by IQ, schooling inputs, and noncognitive skills, and are malleable over a much greater range of ages than is IQ (see Hansen, Heckman, and Mullen, 2004; Cunha and Heckman, 2006a; and Cunha, Heckman and Schennach, 2006). Abilities have an acquired character although they differ in their malleability at different ages.

3.3 Skill is not just intelligence: the importance of noncognitive skills

Many equate skill with intelligence. Part of this is due to the difficulties in measuring noncognitive skills. However, a growing body of research stresses the importance of noncognitive skills, in addition to cognitive skills. Bowles, Gintis and Osborne (2001) highlight the importance of noncognitive skills based on self-reported measures of self esteem, optimism, time-preference and the like. Research based on objective criteria is much scarcer, however.

Heckman and Rubinstein (2001) and Heckman, Hsee and Rubinstein (2001) study the GED program[14] and show that the cognitive ability of GED participants is on average equal to that of high school graduates who do not enroll in college and even higher than the ability of high school drop-outs. However, GED recipients earn *less* than high-school drop-outs once the analyst controls for cognitive abilities. Consequently, noncognitive ability appears to be an important determinant of earnings which GED recipients lack. Heckman and LaFontaine (2006) confirm these earlier findings while addressing a battery of econometric issues.

Noncognitive abilities such as motivation, self-discipline, and time preference — associated with the development of the prefrontal cortex — are also affected by environmental influences. They are more malleable at later ages than IQ. Achievement test outcomes can be influenced until very late ages and are affected by both cognitive and noncognitive skills. Noncognitive abilities and cognitive abilities affect schooling attainment and performance, and a wide array of behaviors. Using a novel approach, Heckman, Stixrud, and Urzua (2006) are able to identify a low dimensional vector of latent cognitive and noncognitive skills which explains a diverse array of social and labor market outcomes. For many dimensions of social performance, cognitive and noncognitive skills are equally important. Noncognitive skills matter.

As is true for cognitive skills, gaps in noncognitive skills (motivation, trustworthiness, behavioral skills) emerge early and are substantially reduced once long-run family factors influencing the child's early years are controlled for (Carneiro and Heckman, 2003). I.Q. is fairly well set by ten. Noncognitive abilities are more malleable over the life-cycle than cognitive abilities. Much of the effectiveness of early childhood interventions comes in boosting noncognitive skills and fostering motivation. For overviews of the literature, see Heckman (2000) and Cunha, Heckman, Lochner and Masterov (2006). Given the quantitative importance of noncognitive traits, social policy should be more active in attempting to alter them especially for children from disadvantaged environments who receive little encouragement and discipline at home.

[14]The General Educational Development (GED) program allows individuals to obtain certification through an equivalency exam which is comparable to a high-school degree.

3.4 Ability begets ability, skill begets skill and learning begets learning

Figure 44 summarizes the major theme of Heckman (2000) and Carneiro and Heckman (2003). It plots the rate of return to human capital at different stages of the life-cycle for a person of given abilities. The horizontal axis represents age, which is a surrogate for the agent's position in the life-cycle. The vertical axis represents the rate of return to investment assuming the same amount of investment is made at each age. *Ceteris paribus* the rate of return to a dollar of investment made while a person is young is higher than the rate of return to the same dollar made at a later age. Early investments are harvested over a longer horizon than those made later in the life-cycle (Becker, 1964).

In addition, because early investments raise the productivity (lower the costs) of later investments, human capital is synergistic. Learning begets learning; skills (both cognitive and noncognitive) acquired early on facilitate later learning. Early deficits make later remediation difficult. Finally, young children's cognition and behavior are more easily malleable than cognition and behavior in adults. For an externally specified opportunity costs of funds r (represented by the horizontal line with intercept r in Figure 44), an optimal investment strategy is to invest relatively less in the old and relatively more in in the young. Figure 45 presents the optimal investment quantity counterpart of Figure 44.

Carneiro and Heckman (2003) develop an alternative interpretation of Figure 18 as an empirical description of the economic returns to investment at current levels of spending in the American economy. The interpretation appears to be equally valid for Europe. The return to investment in the young is high; the return to investments in the old and less able is quite low. A socially optimal investment strategy would equate returns across all investment levels. Children born into advantaged environments receive those investments. Disadvantaged children do not. A central empirical conclusion of their analysis is that at current investment levels, efficiency in public spending would be enhanced if human capital investment were directed more toward the disadvantaged young who do not receive enriched early environments, and less toward older, less-skilled, and illiterate persons for whom human capital is a poor investment.

3.5 High returns do not imply under-investment

Policy makers often take a high Mincerian return on education as evidence for large scale under-investment in education. They advocate expansion of schooling because the return on education yields, a higher rate of return than reducing public debt. The same misguided reasoning would suggest that the government should massively invest in the stock market and pay off the government debt with the higher returns on equity. Investment in higher education should be compared with investments with similar risk, liquidity and other properties, not with government bonds.

Cross-section estimates of the economic rate of return to schooling from OLS and IV regressions do not estimate the true *ex ante* marginal internal rate of return (Heckman, Lochner, Todd, 2006) required for policy evaluation. The returns on education are also much higher than on financial debt, because human capital is illiquid (slavery is forbidden) and risky as labor incomes fluctuate due to business cycles, sectoral shifts, technological developments, international trade, etc. (Palacios-Huerta, 2004). Carneiro, Hansen, and Heckman (2003), Cunha, Heckman, and Navarro (2005) and Heckman Lochner and Todd (2006) show that labor income risk is important and individuals should command a risk premium on human capital investments. Further, the Mincer return is only comparable to a return on a financial investment under very strict conditions, which are not met in the U.S. data (Heckman, Lochner and Todd, 2006) and are unlikely to be met in the European data either. The acquisition of human capital requires direct costs (tuition) and psychic costs (e.g. effort) which the Mincer approach assumes are negligible. There is substantial evidence of psychic costs (Cunha, Heckman, and Navarro, 2005; Cunha and Heckman, 2006b). Both direct and psychic costs and finite time horizons drive up the required returns for an investment in education. Finally, human capital investment is irreversible giving rise to option values and larger required returns (Heckman, Lochner and Todd, 2006; Jacobs, 2006b). There are good reasons why private (and social) returns are high and there is no free lunch if governments invest in education rather than pay off debt.

3.6 Early childhood interventions are effective by improving home environments

Some recent small-scale studies of early childhood investments on children from disadvantaged backgrounds show some remarkable success. Experimental evaluations (based on random assignment) of the Perry Preschool program reveal that the treated children have higher earnings over the lifecycle, lower levels of criminal behavior in their late 20's than do comparable children randomized out of the program. Measured through age 27, the program returns are $5.70 for every dollar spent. The return rises to $8.70 when the returns are also projected over the remainder of the lives of participants. The internal rate of return to this program is over 15% and passes conventional cost-benefit criteria. A very substantial fraction of the returns can be attributed to reduced crime (65%). The Syracuse Preschool program provided family development support for disadvantaged children from prenatal care through age five. Reductions in problems with probation and criminal offenses ten year later were as large as 70% among children randomly assigned to the program (Lally, Mangione and Honig, 1988). The evidence on the more universal Head Start Program is not clear as the program is quite heterogenous and less well funded than the Perry Preschool program. Overall the experimental evidence on early childhood investments suggests the following: i) Short-term increases in cognitive skills (test-scores) fade out over time. ii) Successful programs increase noncognitive skills which are more easily malleable than I.Q. and result in more social behavior and less crime. iii) Programs are more successful if parents are part of the treatment, which bolsters the notion that improvements in the home environment have long-lasting effects. See Carneiro and Heckman (2003) and Cunha, Heckman, Lochner and Masterov (2006) for evidence on a diverse array of early intervention programs.

3.7 Interventions in adolescent years partially remediate but do not remedy insufficient early childhood investments at current levels of investment

The neuroscience of child development reveals that the prefrontal cortex — which governs noncognitive skills — matures only in the mid 20's while cognitive skills mature much earlier (see Shonkoff and Phillips, 2000). Just as early intervention programs have a high payoff primarily because of the social skills and motivation they impart to the child and the improved home environment they produce, so do interventions that operate during the adolescent years, and for many of the same reasons. Recent experimental studies of mentoring programs, like the Big Brothers/Big Sisters (BB/BS) and the Philadelphia Futures Sponsor-A-Scholar (SAS) programs, have shown that these programs have broad positive social and academic impacts on participating school-aged children and adolescents.

Much like SAS, the Quantum Opportunity Program (QOP) offered disadvantaged minority students counseling and financial incentives (one dollar up front and one dollar put in a college fund) for every hour spent in activities aimed at improving social and market skills. Two years after program completion, about a third more participating students graduated from high school (or obtained a GED) than similar nonparticipants. Arrest rates for program participants, were one-half those for nonparticipants. These benefits did not come without substantial expenditures, however, as the average four-year cost per participant was $10,600. Still, a cost-benefit analysis estimated positive net social returns to QOP. See Taggart (1995) for a more detailed description of the program and an evaluation of its impacts.

The available schooling literature demonstrates that providing disadvantaged students with financial incentives to stay in school and participate in learning activities can increase schooling and improve employment outcomes. It should be noted that although programs providing such incentives have proven to influence employment and earnings positively (and, in the case of QOP, to reduce crime), they do not perform miracles. The impacts they achieve are modest, but positive.

3.8 Public training and welfare-to-work programmes are not effective

One cannot expect substantial benefits from public job training programs which primarily targeted to disadvantaged workers. Surveying mainly microeconomic studies, Heckman, Lalonde and Smith (1999); Martin and Grubb (2001); and Calmfors, Forslund and Hemström (2001) conclude that these programs are largely ineffective. Some macroeconomic cross-country studies by Layard, Nickell and Jackman (1991), Nickell (1997) and Groot, Nahuis and Tang (2004) suggest that active labor market programmes can be effective in reducing unemployment rates, but these studies do not control for country specific effects. Further, like the heterogeneity found in studies of the earnings response to education, there is considerable evidence of heterogeneity in response to treatment in job training (Heckman, Smith, and Clements, 1997). Treatment is found to be most effective for those at the high end of the wage distribution. It has no effect for those at the bottom. There are substantial gains to be realized from targeting treatment. The information required to do so effectively, however, is generally not available (see Heckman, Heinrich, and Smith, 2002). The returns to job training for older workers and displaced workers are very low.

A comparison of job training programs suggests a few important lessons. First, you get what you pay for. The recently terminated JTPA program in the U.S. cost very little but produced very few results. An exception to the rule is classroom training, for which the returns are substantial (Heckman, Hohmann, Khoo and Smith, 2000). Second, the effects of treatment vary substantially among subgroups (Heckman, LaLonde, and Smith, 1999). Third, job training programs also have effects on behavior beyond schooling and work that should be considered in evaluating their full effects. Reductions in crime may be an important effect of programs targeted at male youth. The evidence summarized in Heckman, LaLonde, and Smith (1999) indicates that the rate of return to most U.S. and European training programs is far below 10 percent, although the benefits to certain groups may be substantial. Some programs survive a cost-benefit test, but many do not. And even the most successful programs have only small impacts on poverty rates and few are lifted out of it. A prime European example is the study by Calmfors, Forslund and Hemstöm (2001), who present an extensive overview of the Swedish experience with active labor market policies and they conclude that ALMP have been inefficient. Europe's skill policy should not look to public job training to

remedy or alleviate substantially skill deficits that arise at early ages.

3.9 The problem of the transition

The wisest long term investment policy is to invest in the young. Returns are highest for investments in children from disadvantaged families where children receive inadequate parental resources (Heckman, 2006). Universal programs generate dead weight because children from advantaged families receive substantial parental investment.

Politicians face a practical problem of the transition. Older persons and disadvantaged younger persons are unemployable at current wage minimums. Investing in them has a low economic return. A better policy is to subsidize their employment to give them dignity and social inclusion, and to benefit from what they can offer society at large. The essays in Phelps et al. (2003) argue strongly for carefully constructed wage subsidies. Such subsidies should be cohort-specific and phased out over time. Otherwise newer generations will have weak incentives to develop skills and the problem of poverty will perpetuate across generations.

4 A theory of skill formation, skill use and skill maintenance

How can we reconcile the empirical findings with theory? In this section we develop a partial equilibrium life-cycle model of schooling, on-the-job-training, labor supply, saving and retirement. By simultaneously analyzing schooling, training, labor supply and retirement decisions, the model allows us to spell out various complementarities over the life-cycle. First, we show that human capital investments feature the dynamic complementarities over the life-cycle that were the subject of the previous section. Both initial schooling and later on the job training are complementary activities. The returns to initial schooling are larger when individuals engage more in on-the-job training later on during their working careers. And, individuals will invest more in on-the-job training when they have more initial schooling. Second, complementarities exist between skill formation and labor market participation in its broadest sense. That is, the more individuals work

and the later they retire, the larger will be the returns to investments in initial schooling and on-the-job training. The reason is that the costs of leisure and retirement increase when individuals become better skilled. Also the reverse holds. Later retirement and more hours of work boost skill formation by increasing its financial rewards.

Our model integrates Mincer (1974) and Ben-Porath (1967) and adds an endogenous retirement decision. We focus on labor supply on the intensive (hours) margin and retirement. We maintain the assumption of full employment as labor markets are perfectly competitive and frictionless.[15]

4.1 Model

We assume that a representative individual is born at time $t = 0$ and has a life-span T which is exogenously given. This individual undergoes initial education at the beginning of his life. Then the individual works. After the working career the individual retires. The life-time time constraint states that total time in school S, in the labor market $T - S - R$ and in retirement R should equal the life-span T of the individual:

$$T = S + (T - S - R) + R. \tag{1}$$

At each date, the individual derive instantaneous utility $U(C_t)$ from consumption C_t. Only when the individual is in the labor market ($S < t \leq R$), he may also derive utility form leisure $\mathcal{L}_t$, i.e., $V(\mathcal{L}_t)$. Similarly, the individual do not engage in training-on-the-job before entering the labor market and stop with on-the-job training when he leaves the labor market. The time constraint while working states that the fraction of time working L_t, plus the fraction of time invested in training I_t plus the fraction time of time consumed as leisure $\mathcal{L}_t$ should be equal to the total time endowment – which is normalized to one –

$$1 = L_t + I_t + \mathcal{L}_t, \qquad S < t \leq R. \tag{2}$$

[15]We acknowledge at the outset that this is probably not the best description of the labor markets in Europe, but economic theory does not provide us yet with useful models that allow for the joint determination of labor supply, human capital formation and wages in non-competitive labor markets.

Alternatively, one could interpret L_t as the labor force participation rate, I_t as aggregate training efforts, and $\mathcal{L}_t$ as the non-employment rate in this representative agent setting.

Individuals derive utility $X(T-R)$ from the years they are retired $T-R$ where R denotes the retirement age. Retirement is a discrete decision to exit the labor market completely. The individual does not derive direct (dis-)utility from being in school.

Life-time utility of the individual is a time-separable function of instantaneous consumption and leisure felicities and retirement utility

$$\int_0^T U(C_t)\exp(-\rho t)dt + \int_S^R V\left(\mathcal{L}_t\right)\exp(-\rho t)dt + X(T-R), \tag{3}$$

with $U'(C_t) > 0, U''(C_t) < 0$, $V'(\mathcal{L}_t) > 0$, $V''(\mathcal{L}_t) < 0$, $X'(T-R) > 0$ and $X''(T-R) < 0$ where ρ is the subjective rate of time preference. These preferences avoid double counting in time constraints. The costs of forgone labor time are measured by forgone labor earnings. Adding disutility from education effort would double count the time costs of education. The value of retirement leisure is governed by $X(T-R)$. Adding leisure utility of retirement through $V\left(\mathcal{L}_t\right)$ would double count the benefits of leisure in retirement.[16]

The representative individual optimally decides the number of years S in education. $W(S)$ is the rental rate of on human capital of type S. This rental rate is assumed to be constant over time and differs between individuals with different skill levels. $W(S)$ features positive but diminishing marginal returns of additional initial schooling: $W'(S) > 0$, $W''(S) < 0$. Alternatively, one may interpret $W(S)$ as the production function of human capital. The costs of education are the forgone earnings $W(S)$ while not working and the direct costs P per year of education. Without loss of generality, we keep the direct costs of education fixed.

The individual starts his life with A_0 in financial assets which are normalized to zero for convenience ($A_0 = 0$). He borrows on a perfect capital market at constant real interest rate r to finance the costs of living and the costs of education in the periods when he is enrolled in initial education.

[16]The separability between leisure and retirement from consumption in the utility function is needed to avoid discontinuities in the marginal utility of consumption.

The flow budget constraint of the individual while still in school ($t \leq S$) is therefore given by

$$\dot{A}_t = (1 - \tau_A) r A_t - C_t - (1 - \sigma) P + \tau_0, \quad 0 \leq t \leq S, \tag{4}$$

where a dot denotes a time-derivative. Since $A_0 = 0$, and C_t and P are both positive, the individual accumulates debt in the first periods of his life. τ_A is the tax on interest income, hence interest payments of education loans may be deductible for the interest tax. σ is the subsidy rate on direct educational costs. τ_0 denotes time invariant lump-sum transfers (or taxes).

After graduation, the individual starts earning gross labor income $W(S)H_tL_t$. H_t is the stock of human capital which is gathered through training on-the-job in a manner that is made precise below. The flow budget constraints after graduation until retirement ($S < t \leq R$) state that the increase in financial assets should equal total interest income (which is negative when individuals repay debts), net labor income $(1 - \tau_L)W(S)H_tL_t$ minus consumption

$$\dot{A}_t = (1 - \tau_A) r A_t + (1 - \tau_L) W(S) H_t L_t - C_t + \tau_0, \quad S < t \leq R, \tag{5}$$

where τ_L is the labor income tax rate.

After retirement, until death ($R < t \leq T$), the representative individual does not work anymore and runs down his accumulated assets for consumption purposes:

$$\dot{A}_t = (1 - \tau_A) r A_t + B - C_t + \tau_0, \quad R < t \leq T, \tag{6}$$

where B is the retirement benefit in each year spent in retirement. The individual has no bequest motive and ends his life with zero wealth: $A_T = 0$.

The representative individual can increase his human capital by allocating time I_t to learning activities, while foregoing labor earnings or leisure time. It's assumed that on-the-job training does not require direct costs. The individual starts out with one unit of on-the-job human capital when he enters the labor market, i.e., $H_S \equiv 1$. On-the-job human capital accumulates according to a

Ben-Porath (1967) type of production function

$$\dot{H}_t = G(S)F(I_t, H_t) - \delta H_t, \quad S < t \leq R, \tag{7}$$

where $F_I(I_t, H_t) > 0$, $F_H(I_t, H_t) > 0$, $F_{II}(I_t, H_t) < 0$, $F_{HH}(I_t, H_t) < 0$ and $F_{IH}(I_t, H_t) > 0$. $G(S)$ denotes the productivity of on-the-job-training, which increases with the initial level of education at a diminishing rate: $G'(S) > 0$ and $G''(S) < 0$. This captures the main idea of dynamic complementarity in skill-formation. Larger levels of initial education increase the productivity of investments in on-the-job training. Furthermore, there is dynamic complementarity in human capital formation on-the-job because the marginal product of training investments $G(S)F_I(I_t, H_t)$ increases with the level of human capital H_t as indicated by the positive cross-derivative $F_{IH}(I_t, H_t) > 0$. Larger levels of human capital increase the productivity of later human capital investments. δ denotes the rate of depreciation of human capital.

Integration of the asset accumulation constrains and imposing the initial and terminal conditions on financial wealth gives the life-time budget constraint of the individual

$$\begin{aligned} &\int_0^T C_t \exp(-r^*t)dt + \int_0^S (1-\sigma)P \exp(-r^*t)dt \\ = \; &\int_S^R (1-\tau_L)W(S)H_t L_t \exp(-r^*t)dt + \int_R^T B \exp(-r^*t)dt + \int_0^T \tau_0 \exp(-r^*t)dt, \end{aligned} \tag{8}$$

where $r^* \equiv (1-\tau_A)r$ is the net discount rate.

The individual maximizes life-time utility by choosing consumption, labor supply, leisure, on-the-job training, education, and retirement subject to the household budget constraint, the time constraints and the accumulation equation for on-the-job human capital.[17]

[17] We assume that first-order conditions are necessary *and* sufficient. The latter condition is not necessarily fulfilled due to the feedbacks between labor supply and human capital accumulation (see also Bovenberg and Jacobs, 2005). In order to guarantee an interior solution, elasticities of human capital decisions (schooling and training) and labor supply decisions (work effort, retirement) should not be too high. Otherwise higher investments in human capital (schooling and training) will boost labor supply (work effort and retirement), which, in turn, increases the return to human capital investments. This increases human capital investment and labor supply expands in a second round, which again increases human capital investments, etc. Only sufficiently strong decreasing returns in schooling and training and a sufficiently concave leisure and retirement sub-utility functions ensure an interior solution. We assume that these conditions are met.

Using standard routines we obtain the Euler equation for consumption

$$\frac{\dot{C}_t}{C_t} = \theta_t \left(r^* - \rho\right), \qquad 0 \leq t \leq T, \tag{9}$$

where $\theta_t \equiv \left(-\frac{U''(C_t)C_t}{U'(C_t)}\right)^{-1}$ is the inter-temporal elasticity of substitution in consumption. If the rate of time preference is lower than the real after-tax return on financial saving, consumption features an upward sloping profile over the life-cycle. A larger intertemporal elasticity of substitution results in a stronger upward sloping consumption profile and a stronger sensitivity of savings with respect to after-tax returns.

The labor supply equation is given by

$$\frac{V'(\mathcal{L}_t)}{U'(C_t)} = (1-\tau_L)W(S)H_t, \qquad S < t \leq R. \tag{10}$$

The marginal willingness to demand leisure time decreases with the net wage rate and increases with the level of taxation. The gross wage rate increases with education S and on-the-job human capital H_t. Hence, better skilled workers supply more labor if the substitution effect dominates the income effect in labor supply (which is the empirically plausible case). Therefore, this equation implies that labor supply and skill formation are complementary activities. Indeed, the data show that higher educated workers have higher participation rates and lower unemployment rates.

The optimal number of years in initial education follows from the first-order conditions for education, leisure demand, labor supply and training[18]

$$\begin{aligned} & \int_S^R (1-\tau_L)W'(S)H_t L_t \exp(-r^*(t-S))dt + \frac{G'(S)}{G(S)}\frac{F(I_S,1)}{F_I(I_S,1)}(1-\tau_L)W(S) \qquad (11) \\ = \;& (1-\sigma)P + (1-\tau_L)W(S)\left(L_S + \frac{\mathcal{L}_S}{\epsilon_S}\right), \end{aligned}$$

where $\epsilon_t \equiv \frac{V'(\mathcal{L}_t)\mathcal{L}_t}{V(\mathcal{L}_t)} > 0$ is the elasticity of the leisure sub-utility function at time t.

This is the modified Mincer equation stating that the net present value of marginal returns to initial education (evaluated at the time of graduation S) should be equal to net marginal costs on

[18]Note that $H_S \equiv 1$, since individuals do not train if they are not in the labor market yet.

additional year of schooling. The latter comprise direct, subsidized expenditures and net forgone labor earnings. Years spent in initial education increase when the returns to human capital investments are larger. This is the case when the working life is longer and individuals retire later (R larger). Returns also increase when individuals invest more in on-the-job training during their working lives (H_t larger) and supply more labor (L_t larger). The standard Mincer equation ignores the interaction with labor supply and training on-the-job. In addition, the time horizon is finite and direct costs of education are not negligible as also noted by Heckman, Lochner and Todd (2006).

In the absence of an endogenous labor supply and training after graduation, the term $L_S + \frac{1-\mathcal{L}_S}{\epsilon_S}$ equals one. This term originates from the fact human capital investment only increases the effective working time endowment after graduation. In contrast to Heckman (1976) human capital formation does not augment leisure time. If initial education augments working time and leisure time equally, then $L_S + \frac{1-\mathcal{L}_S}{\epsilon_S} = 1$ in the absence of training on-the-job. The feedback between labor supply and human capital investment would vanish in that case. When the sub-utility function over leisure is linear, $\epsilon_S = 1$, and we find that $L_S + \frac{\mathcal{L}_S}{\epsilon_S} = 1 - I_S$. This is intuitive as the opportunity costs of education are lowered when the individual engages in more training after graduation.

Furthermore, individuals with a higher level of education have a larger return on investments in on-the-job human capital as indicated by $\frac{G'(S)}{G(S)} \frac{F(I_S,1)}{F_I(I_S,1)}(1-\tau_L)W(S)$ which denotes the discounted value of larger human capital investments in training due to more initial education.

All these results underscore the second important complementarity. Educational investments increase when the utilization of human capital is larger and when skills are better maintained through on-the-job training. Initial schooling is therefore complementary to later retirement, hours worked and on-the-job training. Again, this is in conformity with the data presented earlier.

Labor taxation directly reduces investments in in initial education as long as the subsidy rate is smaller than the tax rate ($\tau_L > \sigma$). If the subsidy rate σ equals the tax rate on labor τ_L taxation is neutral with respect to human capital investments because then all costs and benefits of human capital formation are symmetrically affected by the tax and subsidy rates. Capital income taxation (as reflected in a lower r^*) boosts initial education. The reason is that higher capital income taxation lowers the net discount rate at which marginal benefits of education are discounted. Alternatively, one can say that higher taxes on capital income induce substitution in

household life-time asset portfolio's from financial towards human assets (see also Heckman, 1976). Labor taxation nevertheless reduces labor supply and lower the retirement age (shown below), hence labor taxation still discourages investments in initial education by lowering the utilization rate of human capital.

Optimal retirement is given by (note that $I_R = 0$ at the end of the working life)

$$\frac{X'(T-R)}{U'(C_0)} = \left((1-\tau_L)W(S)H_R\left(L_R + \frac{1-L_R}{\epsilon_R}\right) - B\right)\exp(-r^*R). \tag{12}$$

If the retirement benefit is a constant fraction of last earned net income (including the effect on the working time endowment), i.e., $B \equiv \varrho(1-\tau_L)W(S)H_R\left(L_R + \frac{1-L_R}{\epsilon_R}\right)$ we can write

$$\frac{X'(T-R)}{U'(C_0)} = (1-\varrho)(1-\tau_L)W(S)H_R\left(L_R + \frac{1-L_R}{\epsilon_R}\right)\exp(-r^*R), \tag{13}$$

ϱ is the implicit marginal tax rate on additional years of work due to the presence of (early) retirement incomes. This representation of early retirement incomes assumes that early retirement benefits are actuarially completely unfair. However, if individuals know ex ante that their early retirement benefit is ex post a constant fraction of their net incomes, the disincentive vanishes and $\varrho = 0$. The marginal willingness to pay for an additional year in retirement should be equal to the marginal costs of an extra year in retirement. The marginal benefit is the marginal rate of substitution between retirement utility and consumption at the date of retirement. The marginal costs are given by the value of net the forgone labor earnings in the last year on the labor market.

Again there is a correction term for the impact of later retirement on labor supply decisions. If $\epsilon_R < 1$ a larger time endowment due to later retirement affects income and utility from leisure differently. In the absence of an endogenous leisure demand decision or linear sub-utility over leisure time, this term would vanish.

The individual has stronger incentives to retire later if the individual has more initial education S, has accumulated a higher stock of on-the-job human capital H_R, and supplies more labor effort L_R in the retirement year R. A higher effective marginal tax on working additional years $(1-\varrho)(1-\tau_L)$ results in earlier retirement (ceteris paribus income). $U'(C_0)$ captures wealth effects in

the retirement decision. Richer individuals, with a lower marginal utility of income, retire earlier – ceteris paribus.

The third complementarity is therefore that retirement is delayed when individuals utilize and maintain their skills better through working life. Hence, more skilled workers retire later when the income effect of higher skills are outweighed by the substitution effects of higher skills. Again, this is in conformity with the data.

Investment in on-the-job training is governed by the following equation

$$\frac{\mu_t}{\lambda \exp(-r^* t)} G(S) F_I(I_t, H_t) = (1 - \tau_L) W(S) H_t. \tag{14}$$

This equation states that the marginal costs of on-the-job human capital investment should be equal to the discounted value of marginal benefits in terms of higher wages. The benefits and costs of OJT investments increase when schooling levels are higher and when the individual has a higher stock of human capital. The benefits also increase when the shadow value μ_t of human capital is large. Now we see that higher levels of initial education both increase the opportunity costs of training on-the-job and the marginal benefits of training on the job. The same holds for a higher stock of on-the-job human capital.

We assume that $F(I_t, H_t) \equiv [\Phi(I_t, H_t)]^{\phi}$, where $0 < \phi < 1$ and $\sigma_{IH} \equiv \frac{\Phi_I(I_t,H_t)\Phi_H(I_t,H_t)}{\Phi_{IH}(I_t,H_t)\Phi(I_t,H_t)}$. ϕ is a returns to scale parameter and σ_{IH} is the elasticity of substitution between I and H in the homothetic constant returns to scale sub-production function $\Phi(I_t, H_t)$. Then, we find an arbitrage equation between on-the-job human capital investments and financial saving:

$$\begin{aligned} &G(S) F_H(I_t, H_t) + G(S) \frac{F_I(I_t, H_t) L_t}{H_t} + \\ &\left(1 - \frac{\omega_H}{\sigma_{IH}} + (1 - \phi)\, \omega_H\right) \frac{\dot{H}_t}{H_t} + \left(\frac{\omega_H}{\sigma_{IH}} + (1 - \phi)(1 - \omega_H)\right) \frac{\dot{I}_t}{I_t} = r^* + \delta, \end{aligned} \tag{15}$$

where $\omega_H \equiv \frac{\Phi_H(I_t,H_t)H_t}{\Phi(I_t,H_t)}$.[19] The left-hand-side gives the total returns of one extra unit of human capital. The right-hand-side gives the required rate of return on investments in OJT; the net returns on financial savings plus the rate of depreciation.

[19] Ben-Porath (1967) is a special case of the current model.

The fourth complementarity in skill formation follows from the last equation. First, individuals with more initial education S will engage in more on-the-job training because the productivity of OJT investments is enhanced by higher initial education. This is again in conformity with the data; more educated workers engage more in training. Second, if labor supply increases and human capital is more heavily utilized, the marginal returns to investments in on-the-job training increase. Therefore, individuals who work more hours or participate more in the labor market have higher returns on training. Third, if individuals maintain their skills though their working career, later investments in human capital become more profitable. σ_{IH} measures the dynamic complementarity of on-the-job human capital investments. If $\sigma_{IH} = 0$ it is not possible to remedy neglect of on-the-job training in the early years of the working career. Early and late investments are perfect complements. If $\sigma_{IH} > 0$ it is to some extent possible to remedy ill skill maintenance early in working careers. If $\sigma_{IH} = \infty$ initial and later investments are perfect substitutes. ω_H then measures the plasticity of investments in human capital. If $\omega_H > 1/2$ plasticity is smaller at later ages than at early ages. If ω_H is close to 1 it may be very costly to remediate deficient early career investment in on-the-job training. When $\omega_H = 1$, it is impossible.

In a steady state, with a constant stock of human capital and constant investment in on-the-job training the last equation can be written as

$$G(S)F_H(I,H) + G(S)\frac{F_I(I,H)L}{H} = r^* + \delta. \tag{16}$$

The first term gives the direct gain on wages of an additional unit of human capital. The second-term gives the gain of a higher level of human capital because future investments become more profitable due to the dynamic complementarity in OJT investments. Marginal benefits of training should be equal to the opportunity rate of return r^* plus the rate of depreciation.

The tax rate on labor incomes is absent in the training arbitrage equation. Linear income taxes affect marginal costs and benefits of training equally and therefore do not directly reduce training investment (direct costs of training are absent). Note, however, that labor supply is distorted by higher taxes. So taxes do indirectly affect the returns to training by lowering the marginal benefits as the utilization rate of the stock of on-the-job human capital falls. The capital income tax boosts

training by lowering the required rate of return on training investments. Intuitively, a higher capital income tax increases the net present value of additional labor earnings resulting from larger training efforts.

4.2 Policy impacts

In general, explicit analytical solutions to the model can be found only if one imposes (strong) functional form restrictions on preferences or technologies. To illustrate some of the important interactions described in the previous section, this section presents numerical simulations of the model while – for simplicity – assuming that OJT investments are fixed ($H_t \equiv 1$, $I_t \equiv 0$).[20]

The model shows that that the direct impact of labor taxation is to distort labor supply and human capital formation (schooling and training). Education subsidies directly increase human capital formation. Further, non-actuarially fair pension schemes and labor income taxes directly distort retirement decisions. Capital income taxation distorts the consumption profile over the life-cycle and gives incentives to accumulate too much human capital in initial education and training. The indirect impacts can be very important, however. We have shown that initial schooling, labor supply, on-the-job training and retirement are all complementary activities over the life-cycle. Any policy that harms one of these activities, will ultimately harm them all due to the dynamic complementarities between human capital investments and labor supply decisions.[21]

For simulation purposes we translate the previous continuous time model in a discrete time setting where utility is specified as

$$\sum_{t=0}^{T} \frac{\frac{C_t^{1-1/\theta}}{1-1/\theta}}{(1+\rho)^t} - \sum_{t=S}^{R} \frac{\gamma \frac{(1-\mathcal{L}_t)^{1+1/\varepsilon}}{1+1/\varepsilon}}{(1+\rho)^t} + \eta \frac{(T-R)^{1-1/\beta}}{1-1/\beta},$$

$\theta,\ \delta,\ \beta,\ \varepsilon,\ \eta > 0$, where θ is the intertemporal elasticity of substitution in consumption. ε governs the compensated wage elasticity of labor supply. γ is a parameter for the preference for leisure. β governs the elasticity of retirement with respect to final earnings and η is a parameter denoting the

[20] Our conjecture is that allowing for endogenous on-the-job training would strengthen the results further and we leave this for future research.

[21] For example, Bovenberg and Jacobs (2005) and Jacobs (2005) have shown in simpler optimal taxation settings that distortions of taxes on human capital formation increase non-trivially when the interactions between human capital formation and labor supply are taken into account.

preference for retirement.

The production function for human capital is also a constant elasticity function featuring positive but diminishing returns to initial education:

$$W(S) \equiv AS^{\alpha}, \quad 0 < \alpha < 1, \quad A > 0, \tag{17}$$

where A denotes the productivity of time invested in human capital. A may be interpreted as a measure for ability.

The discrete time version of the life-time household budget constraint is

$$\begin{aligned} &\sum_{t=0}^{T} \frac{C_t}{(1+r^*)^t} + \sum_{t=0}^{S} \frac{(1-\sigma)P}{(1+r^*)^t} \\ = \; &\sum_{t=S}^{R} \frac{(1-\tau_L)W(S)L_t}{(1+r^*)^t} + \sum_{t=R}^{T} \frac{B}{(1+r^*)^t} + \sum_{t=0}^{T} \frac{\tau_0}{(1+r^*)^t}, \end{aligned} \tag{18}$$

Maximizing life-time utility gives the Euler equation for consumption:

$$C_{t+1} = \left(\frac{1+r^*}{1+\rho}\right)^{\theta} C_t. \tag{19}$$

The labor supply equation is given by

$$L_t = \left(\frac{1}{\gamma}(1-\tau_L)AS^{\alpha}C_t^{-1/\theta}\right)^{\varepsilon}. \tag{20}$$

The first-order condition for the optimal years of education and retirement are non-linear:

$$\sum_{t=S}^{R} \frac{(1-\tau_L)\alpha AS^{\alpha-1}L_t}{(1+r^*)^{(t-S)}} = \frac{(1-\tau_L)AS^{\alpha}L_S}{1+\varepsilon} + (1-\sigma)P, \tag{21}$$

$$\frac{\eta(T-R)^{-1/\beta}}{C_0^{-1/\theta}} = \frac{(1-\varrho)(1-\tau_L)AS^{\alpha}L_R}{(1+\varepsilon)\,(1+r^*)^R}. \tag{22}$$

This model can be reduced into a system of three non-linear equations – the first-order condition for retirement, the first-order condition for education and the household budget constraint – in three unknowns C_0, S, and R. For given C_0, the Euler equation for consumption fully specifies the time

path of consumption. For education level S and initial consumption C_0 (and therefore C_t) we can derive the full time path of labor supply. The education decision is a function of the retirement decision R only. The retirement decision fully determined by education S and initial consumption C_0. Hence, for a given level of initial consumption C_0 the last two equations jointly determine optimal years of education and the retirement age. The level of consumption then follows from the household budget constraint. We numerically solve this set of equations subject to the Euler equation for consumption and the labor supply equations.

Whenever possible we use empirical estimates of the behavioral elasticities, see also Table 1. After an extensive review of the literature Trostel (1993) sets the elasticity of the production function of human capital at $\alpha = 0.6$. We use a slightly lower value of $\alpha = 0.5$. The price of education P is 10 (thousand dollar) per year. An intertemporal elasticity of substitution equal to $\theta = 1.2$ is chosen. This is substantially larger than a value of $\theta = 0.5$ which is suggested by most empirical research, see for example Hall (1988) and Attanasio and Weber (1995). However, a value of θ below unity implies that labor supply and retirement curves become backward bending with our preference structure. By setting $\theta = 1.2$, we sacrifice on the realism of the savings part of the model to get more realistic labor supply behavior, since our main focus is on the labor market and not savings. A pure rate of time preference of $\rho = 0.02$ is chosen. The real interest rate is set at $r = 0.04$. The parameter governing the compensated wage elasticity of labor supply is set at $\varepsilon = 0.3$. ε is the upper bound of the compensated wage elasticity of labor supply in the absence of income effects ($\theta = \infty$). With our preference structure the compensated elasticity is about 0.24 at zero non-labor income. This is somewhere in the middle of empirical estimates for men and women, see also Blundell and MaCurdy (1999) for a review of estimates. The retirement elasticity is set at $\beta = 0.5$. Figure 43 implies an elasticity of about 0.3. The baseline set of policy variables is $\tau_L = 0.5$, $\tau_A = 0.3$, $\sigma = 0.6$, and $\varrho = 0.3$. These values roughly match averages in the Western world.[22] The remaining parameters (A, γ, η) are calibrated such that the individual is enrolled for 12 years in initial education, he retires at 61 years, and spends 90% of his time endowment supplying labor after graduation. Assuming that the individual enters initial education at 6 years of age, he enters

[22] A relatively low level of education subsidies may be justified if direct costs also include the monetary value of immaterial costs (effort costs, psychic costs) which are not subsidized.

the labor market at 18 years. In addition, the individual's gross earnings per year are 35 (thousand dollar) at full-time employment. This implies that forgone earnings are roughly three quarters of the total costs of education, which is in conformity with the data (Becker, 1964; Trostel, 1993).

In order to focus only on the efficiency properties of various policies we transfer all tax revenues back in the form of lump-sum taxes. If we did not do so, various income effects would enter the story as well and the comparisons between the simulations would be blurred as more money would be taken out of one economy with the higher tax levels and 'thrown in the sea'. We investigate only the potential efficiency losses of welfare state arrangements aimed at reducing inequality.[23]

Figures 46, 47, 48, and 49 plot the simulated life-cycle labor supply patterns for various policy experiments. Each figure shows that individuals are enrolled in initial education for the first years of their life-cycle, then labor is supplied during working life, and the final years of life are spent in retirement. The time path of labor supply during working fives is downward sloping over the life-cycle due to income effects as the consumption profile rises with age (not shown). All figures show that various decisions over the life-cycle are affected by policy.

Interesting wealth dynamics emerge from our model, see Figure 50. Like in any life-cycle model, total wealth, defined as the present discounted value of remaining life-time consumption, declines continuously with age until it becomes zero at the end of life. In contrast to models with exogenous human capital formation, financial wealth drops heavily while the individual is enrolled in education to negative levels at the time of graduation that are in the same order of magnitude as *total* life-time wealth. At the moment the individual enters the labor market, he repays initial debts and starts to save for retirement. The drop in financial wealth in the initial years reflects the substantial amounts of borrowing needed to finance education and costs of living. The evolution of life-time financial wealth shows that capital markets to smooth consumption over the life-cycle are very important.[24] The evolution of human wealth is the mirror image of the evolution of financial wealth. Human

[23]Some could argue that some countries have high tax rates because of a larger preference for public goods and that the valuation of these public goods should be taken into account in our analysis as well. This is not entirely correct. If the government was solely interested in provision of public goods, and not income redistribution, it would use non-distorting lump-sum taxes to finance a larger supply of public goods.

[24]In real life individuals do not borrow such large amounts as children receive transfers from their parents to finance consumption and costs of education. We may modify the life-time wealth constraint in such a way that individuals start with a positive level of assets which are bequeathed by their parents and have to end life with the same amount of assets to bequeath to their children. This only shifts the time-path of financial wealth upwards.

wealth increases in the initial years when the individual is enrolled in education. Human wealth steadily decreases while working as the remaining life-time earnings diminish. At the moment of retirement, human wealth has become negative reflecting the value of forgone labor earnings while the individual is retired. Human wealth starts rising again towards the end of life as forgone earnings from retirement decrease to zero at the end of life.

As expected, Figure 46 shows that higher labor taxes result in less education, lower labor supply and earlier retirement. We note that the compensated wage elasticity of labor supply is not extreme (0.24 at zero non-labor income). Much of the impact of taxation is due to the interactions between labor supply and human capital decisions which reinforce each other so that very substantial declines in labor supply, retirement ages and years of education are found as labor taxes increase.

Figure 47 shows the impact of education policy. This graph most clearly illustrates the importance of the dynamic interactions over the life-cycle. The subsidy only directly increases human capital investments, not labor supply and retirement. However, higher education subsidies indirectly boost labor supply and the retirement age as individuals become better educated. The costs of leisure and retirement increase with the level of human capital and quite strong effects of higher education subsidies on labor supply and retirement decisions are found in the simulations.

Similarly a larger retirement wedge also shows that human capital investments and retirement decisions are interacting, see Figure 48. A lower retirement wedge directly results in later retirement and indirectly also in larger investment in human capital. The effects are not very large because returns to education at later points in the life-cycle are heavily discounted. Labor supply responds marginally to a lower retirement wedge. Substitution effects in wages – due to a higher education level – are relatively small and income effects – due to a longer working life – are relatively large. Both effects roughly cancel out.

Figure 49 shows that higher capital income taxes boost education as the present value of additional labor earnings increase. This increases labor supply on account of a dominant substitution effect in wages. However, as individuals have larger life-time earnings, an income effect partially chokes off the increase in labor supply. The time path of labor supply during the working years rotates counter-clockwise at higher levels of capital income taxation. The intuition is that a less steeply increasing consumption profile is chosen so that income effects at later ages become smaller.

At a capital tax of 50% the consumption profile becomes flat and therefore also the pattern of labor supply since the net interest rate equals the discount rate. A higher capital tax also delays retirement. First, because the forgone earnings while in retirement are larger as individuals are better educated. Second, because a higher capital tax lowers the effective discount rate so that costs of retirement in present value terms increases, see also equation (13).

The simulations show that the policy environment is important to understand life-cycle interactions between education, labor supply and retirement. As a final exercise we have simulated the model with an 'US-style' set of policy parameters with low taxes on labor and capital, low subsidies on education and a small retirement wedge ($\tau_L = 35\%$, $\tau_A = 25\%$, $\sigma = 50\%$, and $\varrho = 20\%$) and an 'EU-style' set of policy parameters with high taxes on labor and capital, high subsidies on education and a large retirement wedge ($\tau_L = 70\%$, $\tau_A = 35\%$, $\sigma = 80\%$, and $\varrho = 50\%$).

The high value of marginal tax rates on labor incomes in Europe reflects various types of labor market distortions on top of standard tax distortions. Labor market distortions create implicit rather than explicit wedges on labor supply. The explicit marginal tax wedges on labor in Europe are around 60%, see also Figure 36. Since our model does not capture any labor market distortions, or disincentives from welfare state arrangements, we approximate these by increasing the marginal tax rate on work to 70%. This generates labor supply patterns which can be roughly matched with the data. Good measures of marginal effective tax rates on saving are difficult to obtain as institutional details are important and because capital income taxes may be shifted to labor (consumption). We have set the marginal tax rates on capital income in the US at 25% and in Europe at 35%. The tax wedge on retirement in the US is set at 30%. This may seem a bit on the high side but lower tax wedges would give implausibly high retirement ages. The total marginal tax wedge on retirement, including labor and consumption taxes, is therefore around 55%. Part of the higher retirement wedge in Europe, due to for example early retirement schemes, is already captured by a high labor tax wedge. Therefore, we only add an additional retirement wedge of 50% on top of the labor tax wedge. Consequently, in Europe there is a total marginal tax wedge on retirement equal to 85% of final earnings. Education subsidies are roughly in line with the OECD figures presented earlier.

Figure 51 gives the model simulations with both policy packages. These simulations show that

only a few policy parameters are able to mimic observed life-cycle labor market behavior quite reasonably. During the first stages of life, the individual is enrolled in initial education. Europe follows the US closely in average educational attainment due to high education subsidies. Then the individual starts to work. Here, America's labor supply is about 15-20% larger than in Europe due to the high explicit and implicit marginal taxes on work effort. At age 55 (and 63) the Europeans (Americans) retire. The main driver behind the earlier retirement of Europeans is the larger total tax wedge on retirement.

This graph illustrates the vital importance of human capital policy for Europe. Human capital policy is needed to off-set the strong disincentives on skill formation created by various welfare state arrangements (see also Bovenberg and Jacobs, 2005). Without sufficient skill formation, explicit and implicit taxes on human capital formation would generate too much dependency on welfare states as skill formation and skill utilization would be retarded. In other words, there is not only a trade-off between equity and efficiency in the quantity of labor supply, but also a trade-off between equity and the quality of labor supply. The graph also shows that high marginal tax rates and generous early retirement schemes have not only effects on observed labor market behavior, but also on skill formation and skill utilization earlier in life. Human capital formation, labor supply and later retirement are complementary. Allowing for training on-the-job would strengthen these results further by explicitly incorporating skill maintenance.

5 Policy conclusions

European welfare states that attempt to protect incomes and labor market prospects for persons with low skills face important policy challenges. Labor demand has shifted towards the skilled workers as can be witnessed from increasing earnings inequality and the rising returns to education. The growth in the supply of human capital is likely to choke off in years to come. Despite increasing enrolment rates at higher levels of education, resources invested in Europe remain rather stagnant at all levels (except for the Nordic countries) and often more targeted on higher education than pre-school and primary education. A substantial fraction of immigrant youths have literacy problems, drop out from secondary education, do not assimilate and end up disproportionally in crime or

welfare state arrangements. Poverty traps not only result in insufficient incentives to work, but also insufficient incentives to invest in human capital. As relative demand for unskilled labor decreases, low skill workers become increasingly dependent on welfare state arrangements such as unemployment benefits, public training and labor market policies. In the end, social cohesion is undermined with a growing divide on labor markets between the skilled and the unskilled and a larger dependency of low skill workers on welfare state arrangements.

European welfare states do not only affect skill creation, but also Europe's skill utilization is low for a variety of reasons. Hours worked are low and decreasing. Labor force participation rates are relatively low – especially in Continental Europe and Mediterranean countries – but increasing which is in part due to larger female participation rates. Take up rates of benefits for unemployment, sickness, and disability are very substantial. Many unemployed workers appear to be hidden in generally ineffective active labor market and training policies. Generous social benefits and high levels of taxation lower labor force participation and hours worked and thereby lower returns on human capital investments. Therefore, generous welfare states create substantial implicit taxes on the returns to human capital investments through the interaction with the labor market.

Not only is the utilization rate of European human capital low, also the maintenance of human capital is worrisome. Effective retirement ages have fallen dramatically and have landed on a low plateau in recent years. Declining labor force participation rates of older workers are showing signs of a trend reversal in some countries (after controlling for the increase in female labor force participation rates). Individuals spend about one third of their life-time in retirement. Incentives to retire long before statutory retirement ages are strong due to generous pension and early retirement schemes. Short payback times of investments in human capital and steep depreciation rates of skills undermine the incentives to create and maintain skills through education and on-the-job training.

In order to maintain welfare states, human capital policies need to be reinvented. The economic returns to initial investments in human capital are very high. The economic return to investment at older ages is, however, lower. Human capital investment is self productive and investments at different ages are complementary. Self-productivity and complementarity are the reasons why skill begets skill and learning begets learning. Complementarity implies that early investments need to be followed by later investments if the early investments are to pay off. Investments in the human

capital of children should expand for both equity and efficiency reasons. The returns to human capital are high and rising. There is no trade-off between equity and efficiency at early ages of human development but a substantial trade-off at later ages. Once skills are crystallized, complementarity implies that the returns are highest for investment in the most able. At the youngest ages, it is possible to form ability and create the stock of skills that enrich late adolescent and early adult human capital investment. Thus early interventions targeted toward the disadvantaged can be highly effective. Later investments are not.

Policy should therefore focus heavily on early childhood interventions for children from disadvantaged families. At later ages policies are generally too costly and ineffective. Given public spending constraints, resources should be shifted away from higher education to pre-school and primary education. Private funding for higher education should expand, possibly through income contingent loans to warrant access. Labor market and training programmes for older workers should be reformed or abolished in their current form as their benefits are doubtful and the costs are high. Successful policies focus on both noncognitive and cognitive skills. The benefits of lower crime rates and socially more acceptable behavior are substantial. A greater emphasis needs to be placed on family policy. Early cognitive and noncognitive deficits can be partially remedied.

Dynamic complementarities are not only important for initial investments in life, but also for the utilization and the maintenance of skills during working life. Returns to investments early in life will not materialize if early investments are not followed up by later investments. A precondition for sufficient returns to investments during working life is a sufficient level of investment early in life. European human capital policy should take into account the impact of tax-benefit and pension systems and the functioning of labor markets. European labor markets are distorted due to severe labor market regulations, high taxes, generous benefit schemes and insider-outsider problems in wage setting institutions. Eligibility for various types of benefits should become stricter and perverse income redistribution from the outsiders towards the insiders through all kinds of benefit schemes should be reduced. This is both efficient and equitable, since the outsiders on labor markets are hurt by the privileged insiders. Reducing distortions in labor markets increases the utilization rates of human capital and enlarges the benefits of initial education and skill maintenance over the life-cycle. Retirement is heavily subsidized via early retirement schemes and pension subsidies.

These policies create perverse incentives to utilize and maintain human capital over the life-cycle. Therefore, early-retirement schemes and pension plans should be made more actuarially fair.

References

Abbring, Jaap H., Gerard J. van den Berg, and Jan C. van Ours (2005), "The Effect of Unemployment Insurance Sanctions on the Transition Rate from Unemployment to Employment", *Economic Journal*, 115, 602–630.

Aiyagari, S. Rao, Jeremy Greenwood and Ananth Seshadri (2002), "Efficient Investment in Children", *Journal of Economic Theory*, 102, (2), 290-321.

Alesina, Alberto F., Edward L. Glaeser, and Bruce Sacerdote (2005), "Work in the US and Europe: Why so Different?", *NBER Macroeconomic Annuals*, 2, forthcoming.

Altonji, Joseph, and Thomas Dunn (1996), "The Effects of Family Characteristics on the Return to Education", *Review of Economics and Statistics*, 78, (4), 692-704.

Antonovics, Kate L., and Arthur S. Goldberger (2003), "Does Increasing Women's Schooling Raise the Schooling of the Next Generation? Comment", *American Economic Review*, 95, (5), 1738-1744.

Arrow, Kenneth J. (1973), "Higher Education as a Filter", *Journal of Public Economics*, 2, 193-216.

Atkinson, Anthony B. (2006), "Earnings Differences among People: A Simple Race between Supply and Demand?", unpublished manuscript: Oxford University.

Atkinson, Anthony B. and Wiemer Salverda (2005), "Top Incomes in the Netherlands and the United Kingdom over the Twentieth Century", *Journal of the European Economic Association*, 3, (4), 883-913.

Attanasio, Orazio P., and Guglielmo Weber (1995), "Is Consumption Growth Consistent with Intertemporal Optimization?", *Journal of Political Economy*, 130, (6), 1121-1157.

Becker, Gary S. (1964), *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education.* Third edition 1993, Chicago: Chicago University Press.

Becker, Gary S., and Nigel Tomes (1979), "An Equilibrium Theory of the Distribution of Income and Intergenerational Mobility", *Journal of Politcal Economy*, 87, 1153-1189.

Becker, Gary S., and Nigel Tomes (1986), "Human Capital and The Rise and Fall of Families," *Journal of Labor Economics*, .4, (3), S1-S39.

Behrman, Jere R., and Mark R. Rosenzweig (2002), "Does Increasing Women's Schooling Raise the Schooling of the Next Generation?", *American Economic Review*, 92, (1), 323-334.

Ben-Porath, Yoram (1967), "The Production of Human Capital and the Life Cycle of Earnings", *Journal of Political Economy*, 75, (4), 352-365.

Bertola, Giuseppe (2003), "Earnings Disparities in OECD Countries: Structural Trends and Institutional Influences", paper prepared for the joint OECD/NDRC Understanding China's Income Disparities seminar, Paris, 20-21 October, 2003.

Björklund, Anders, Mikael Lindahl, and Erik J.S. Plug (2006), "The Origins of Intergenerational Associations: Lessons from Swedish Adoption Data", *Quarterly Journal of Economics*, 121, (3), forthcoming.

Blanchard, Olivier J. (2006), "European Unemployment: The Evolution of Facts and Ideas", *Economic Policy*, 21, (45), 5-59.

Blundell, Richard and Thomas MaCurdy (1999), "Labor Supply: A Review of Alternative Approaches", in: Orley Ashenfelter and David Card (eds.), *Handbook of Labor Economics – Vol 3A*, Amsterdam: Elsevier-North Holland, 1559-1695.

Boeri, Tito, and Herbert Brücker (2005), "Why are Europeans so Tough on Migrants?", *Economic Policy*, 20, (44), 630-703.

Borjas, George J. (1999), *Heaven's Door*, Princeton: Princeton University Press.

Bovenberg, A. Lans (2006), "Tax Policy and Labor Market Performance", in: Jonas Agell and Peter B. Sørensen (eds.), *Tax Policy and Labor Market Performance*, Cambridge-MA: CESifo and MIT-Press.

Bovenberg, A. Lans, Johan J. Graafland, and Ruud A. de Mooij (2000), Tax Reform and the Dutch Labor Market, *Journal of Public Economics*, 78, 193–214.

Bovenberg, A. Lans, and Bas Jacobs (2005), "Redistribution and Education Subsidies are Siamese Twins", *Journal of Public Economics*, 89, 2005-2035.

Bovenberg, A. Lans, and Frederick van der Ploeg (1994), "Effects of the Tax and Benefit System on Wage Formation and Unemployment", unpublished manuscript: University of Amsterdam/Tilburg.

Bowles, Samuel, Howard Gintis, and Melissa Osborne (2001), "The Determinants of Earnings: A Behavioral Approach", *Journal of Economic Literature*, 39, (4), 1137-1176.

Brandolini, Andrea and Timothy M. Smeeding (2006), "Inequality: International Evidence", in: Steven N. Durlauf and Lawrence E. Blume, *The New Palgrave Dictionary of Economics*, forthcoming.

Calmfors, Lars, Anders Forslund, and Maria Hemström (2001), "Does Active Labour Market Policy Work? Lessons from the Swedish Experiences", *Swedish Economic Policy Review*, 85, 61-124.

Cameron, Stephen V., and James J. Heckman (2001), "The Dynamics of Educational Attainment for Blacks, Hispanics, and Whites", *Journal of Political Economy*, 109, (3), 455-499.

Card, David (1999), "The Causal Effect of Education on Earnings", in: Orley Ashenfelter and David Card (eds.), *Handbook of Labor Economics – Vol 3A*, Amsterdam: Elsevier-North Holland, 1801-1863.

Card, David, and Thomas Lemieux (2001), "Dropout and Enrollment Trends in the Post-War Period: What Went Wrong in the 1970's?", in Jonathan Gruber (ed.) *An Economic Analysis of Risky Behavior Among Youth*, Chicago: University of Chicago Press for NBER, 439-482.

Carneiro, Pedro, Flavio Cunha and James J. Heckman (2005), "Human Capital Policy for Europe", unpublished manuscript: University College London/University of Chicago.

Carneiro, Pedro and James J. Heckman, (2003). "Human Capital Policy," in James J. Heckman and Alan B. Krueger (eds.), *Inequality in America: What Role for Human Capital Policy?* Cambridge, MA: MIT Press.

Carneiro, Pedro, James J. Heckman, and Edward Vytlacil (2006), "Estimating the Rate of Return to Education When It Varies among Individuals", revised version, unpublished manuscript: University of Chicago.

Carneiro, Pedro, Karsten Hansen, and James J. Heckman (2001), "Removing the Veil of Ignorance in Assessing the Distributional Impacts of Social Policies", *Swedish Economic Policy Review*, 8, 273-301.

Carneiro, Pedro, Karsten Hansen, and James J. Heckman (2003), "Estimating Distributions of Treatment Effects with an Application to the Returns to Schooling", *International Economic Review*, 44, (2), 361-422.

Carneiro, Pedro, and Sokbae Lee (2006), "Changes in College Enrollment and Wage Inequality: Distinguishing Price and Composition Effects", unpublished manuscript: University College London.

Ciccone, Antonio and Giovanni Peri (2006), "Identifying Human Capital Externalities: Theory with an Application to US Cities, *Review of Economic Studies*, 73, 381–412.

Coleman, James S. (1966), "Equality of Educational Opportunity", Washington D.C.: U.S. Dept. of Health, Education, and Welfare, Office of Education.

Corak, Miles (2006), "Do Poor Children Become Poor Adults? Lessons from a Cross Country Comparison of Generational Earnings Mobility", IZA Discussion Paper 1993, Bonn: IZA.

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

Cunha, Flavio and James J. Heckman (2006a), "Formulating, Identifying and Estimating the Technology of Cognitive and Noncognitive Skill Formation", *Journal of Human Resources*, forthcoming.

Cunha, Flavio and James J. Heckman (2006b), "Identifying and Estimating the Distributions of Ex Post and Ex Ante Returns to Schooling: A Survey of Recent Developments", *Labour Economics*, forthcoming.

Cunha, Flavio, James J. Heckman, Lance J. Lochner, and Dimitriy V. Masterov (2006), "Interpreting the Evidence on Life Cycle Skill Formation",in: Eric Hanushek and Finis Welch (eds), *Handbook of Economics of Education*, Amsterdam: Elsevier-North Holland.

Cunha, Flavio, James J. Heckman, and Salvador Navarro (2005), "Separating Uncertainty from Heterogeneity in Life Cycle Earnings", *Oxford Economic Papers*, 57, (2), 191–261.

Cunha, Flavio, James J. Heckman, and Susanne M. Schennach (2006), "Estimating the Technology of Cognitive and Noncognitive Skill Formation", unpublished manuscript, University of Chicago, Department of Economics.

Coulombe, Serge, Jean-François Tremblay, and Sylvie Marchand (2004), "International Adult Literacy Survey: Literacy Scores, Human Capital and Growth across Fourteen OECD Countries", Statistics Canada: Catalogue no. 89-552-MIE.

Davis, Steven J. (1992), "Cross-Country Patterns of Changes in Relative Wages", in: Blanchard, Oliver J. and Stanley Fischer (eds), *NBER Macroeconomic Annuals 1992*, 239- 400.

De la Fuente, Angel, and Rafael Doménech (2006), "Human Capital in Growth Regressions: How Much Difference Does Data Quality Make?, *Journal of the European Economic Association*, 4, (1), 1-36.

De la Fuente, Angel, and Juan Francisco Jimeno-Serrano (2005), "The Private and Fiscal Returns to Schooling and the Effect of Public Policies on Private Incentives to Invest in Education: A General Framework and Some Results for the EU", CES-Ifo Working Paper 1392, Munich: CES-Ifo.

Duncan, Greg J., and Jeanne Brooks-Gunn (1997), *Consequences of Growing Up Poor*, New York: Russell Sage Foundation.

Duncan, Greg J., Amy Claessens, and Mimi Engel (2004), "The Contributions of Hard Skills and Socio-Emotional Behavior toSchool Readiness", Working Paper 05-01, North-Western University Institute for Policy Research.

Duncan, Greg J., and Rachel Dunifon (1998), "Soft-Skills and Long-Run Labor Market Success", in: Solomon W. Polachek (ed), *Research in Labor Economics*, Stamford: JAI Press, 123–149.

Dynarski, Susan (2003), "Does Aid Matter? Measuring the Effect of Student Aid on College Attendance and Completion", *American Economic Review*, 93, (1), 279-288.

Edin, Per-Anders, and Bertil Holmlund (1995), "The Swedish Wage Structure: The Rise and Fall of Wage Policy?", in: Richard B. Freeman and Lawrence F. Katz, *Differences and Changes in Wage Structures*, Chicago: Chicago University Press, 307-343.

European Commission (2005), "Study on Access to Education and Training, Basic Skills and Early School Leavers (Ref. DG EAC 38/04); Lot 3: Early School Leavers Final Report", Brussels: European Commission DG EAC.

Frederiksson, Peter (1997), "Economic Incentives and the Demand for Higer Education", *Scandinavian Journal of Economics*, 99, (1), 129-142.

Friedman, Milton (1962), *Capitalism and Freedom*, Chicago: University of Chicago Press.

Gordon, Kathryn, and Henry Tchilinguirian (1998), "Marginal Effective Tax Rates on Physical, Human and R&D Capital", OECD Working Paper No. ECO/WKP(98)12, Paris: OECD.

Gottschalk, Peter and Timothy M. Smeeding (1996), "Cross-National Comparisons of Earnings and Income Inequality", *Journal of Economic Literature*, 35, (2), 633-687.

Groot, Henri L.F., Richard Nahuis and Paul J. G. Tang (2004), "Is the American Model Miss World? Choosing Between the Anglo-Saxon Model and a European-style Alternative, CPB Discussion Paper 40, The Hague: CPB Netherlands Bureau for Economic Policy Analysis.

Gruber, Jonathan, and David Wise (1998), "Social Security and Retirement: An International Comparison", *American Economic Review*, 88, (2), 158-163.

Gruber, Jonathan, and David Wise (1999), *Social Security and Retirement around the World*, Chicago: Chicago University Press.

Hall, Robert E. (1988), "Intertemporal Substitution in Consumption", *Journal of Political Economy*, 96, (2), 339-357.

Hanushek, Eric, and Dennis D. Kimko (2000), "Schooling, Labor Force Quality, and the The Growth of Nations", *American Economic Review*, 90, (5), 1184-1208.

Hansen, Karsten, James J. Heckman, and K.J. Kathleen Mullen (2004), "The Effect of Schooling and Ability on Achievement Test Scores", *Journal of Econometrics*, 121, (1-2), 39-98.

Harmon Colm, Hessel Oosterbeek, and Ian Walker (2003), "The Returns to Education: Microeconomics", *Journal of Economic Surveys*, 17, 115-155.

Heckman, James J. (1976), "A Life Cycle Model of Earnings, Learning and Consumption", *Journal of Political Economy*, 4, S11-S44.

Heckman, James J. (1993), "What Has Been Learned about Labor Supply in the Past Twenty Years?", *American Economic Review*, 83, 116–121.

Heckman, James J. (2000), "Policies to Foster Human Capital", *Research in Economics* 54, (1), 3-56.

Heckman, James J. (2006), "Skill Formation and the Economics of Investing in Disadvantaged Children", *Science*, 312, (5782), 1900–1902.

Heckman James J., Carolyn Heinrich, and Jeffrey Smith (2002), "The Performance of Performance Standards", *Journal of Human Resources*, 37, (4), 778-811.

Heckman, James J., Neil Hohmann, Michael Khoo, and Jeffrey Smith (2000),."Substitution and Dropout Bias in Social Experiments: A Study of an Influential Social Experiment", *Quarterly Journal of Economics*, 115, (2), 651-694.

Heckman, James J., Jingjing Hsee, and Yona Rubinstein (2001), "The GED is a 'Mixed Signal': The Effect of Cognitive and Noncognitive Skills on Human Capital and Labor Market Outcomes", unpublished manuscript: University of Chicago.

Heckman, James J. and Peter J. Klenow (1998), "Human Capital Policy", in: Michael Boskin (ed), *Policies to Promote Human Capital Formation*, Hoover Institution.

Heckman, James J. and Paul LaFontaine (2006), "Bias Corrected Estimates of GED Returns", *Journal of Labor Economics*, in press.

Heckman, James J., Robert J. Lalonde, and Jeffrey A. Smith (1999), "The Economics and Econometrics of Active Labor Market Programs", in Orley Ashenfelter and David Card (eds.), *Handbook of Labor Economics – Vol 3A*, Amsterdam: Elsevier-North Holland, 1865-2097.

Heckman, James J., Martin Ljunge, and Kelly S. Ragan (2006), "What are the Key Employment Challenges and Policy Priorities for OECD Countries", University of Chicago Department of Economics unpublished manuscript, presented at the "Boosting Jobs and Incomes" conference, Toronto, Ontario, Canada, June, 2006.

Heckman, James J., Lance J. Lochner, and Christopher Taber (1998), "Explaining Rising Wage Inequality: Explorations with a Dynamic General Equilibrium Model of Labor Earnings with Heterogeneous Agents", *Review of Economic Dynamics*, 1, 1-58.

Heckman, James J., Lance J. Lochner, Petra E. Todd (2006), "Earnings Functions, Rates of Return and Treatment Effects: The Mincer Equation and Beyond", in Eric Hanushek, and Finis Welch (eds), *Handbook of Economics of Education*, Amsterdam: Elsevier-North Holland.

Heckman, James J., and Carmen Pagés (2003), "Law and Unemployment: Lessons from Latin America and the Carribbean", NBER Working Paper 10129, Cambridge MA: NBER.

Heckman, James J., and Yona Rubinstein (2001), "The Importance of Noncognitive Skills: Lessons from the GED Testing Program", *American Economic Review*, 91, (2), 145-149.

Heckman James J., Jeffrey Smith, and Nancy Clements (1997), "Making the Most out of Social Experiments: The Intrinsic Uncertainty in Evidence from Randomized Trials with an application to the National JTPA Experiment", *Review of Economic Studies*, 64, (4), 487-535.

Heckman, James J., Jora Stixrud, Sergio Urzua (2006), "The Effects of Cognitive and Noncognitive Abilities on Labor Market Outcomes and Social Behavior", *Journal of Labor Economics*, in press.

Hilmer, Michael J. (1998), "Post-Secondary Fees and the Decision to Attend a University or a Community College", *Journal of Public Economics*, 67, 329–348.

Jacobs, Bas (2004), "The Lost Race between Schooling and Technology", *De Economist*, 152, 1, 47-78.

Jacobs, Bas (2005), "Optimal Income Taxation with Endogenous Human Capital", *Journal of Public Economic Theory*, 7, (2), 295-315.

Jacobs, Bas (2006a), "Optimal Tax and Education Policies and Investments in Human Capital", in: Hartog, Joop, and Henriëtte Maassen van den Brink, *Human Capital: Moving the Frontier*, Cambrige: Cambridge University Press, fortcoming.

Jacobs, Bas (2006b), "Real Options and Human Capital Investment", paper presented at the IZA conference on Schooling and Risk, Bonn April 7-8, 2006.

Jacobs, Bas, and Frederick van der Ploeg (2006), "Guide to Reform of Higher Education: A European Perspective", *Economic Policy*, 21, (47), 536-592.

Jäntti, Markus, Bernt Bradsberg, Knut Røed, Oddbjørn Raaum, Robin Taylor, Eva Österbacka, Anders Björklund, Tor Eriksson (2006), "American Exceptionalism in a New Light: A Comparison of Intergenerational Earnings Mobility in the Nordic Countries, the United kingdom and the United States", IZA Discussion Paper 1938, Bonn: IZA.

Kane, Thomas J. (1994), "College Entry by Blacks since 1970: The Role of College Costs, Family Background and the Returns to Education", *Journal of Political Economy*, 102, (5), 878-911.

Kane, Thomas J. (1995), "Rising Public Tuition and College Entry: How well do Public Subsidies Promote Access to College", NBER Workingpaper, 5164, Cambridge MA: NBER.

Katz, Lawrence F., and Kevin M. Murphy (1992), "Changes in Relative Wages 1963-1987: Supply and Demand Factors ", *Quarterly Journal of Economics*, 107, 35-78.

Katz, Lawrence F., and David H. Autor (1999), "Changes in the Wage Structure and Wage Inequality", in: Orley Ashenfelter and David Card (eds.), *Handbook of Labor Economics Vol. 3A*, Amsterdam: Elsevier-North Holland, 1463-1555.

Katz, Lawrence F., David H. Autor, and Meslissa S. Kearny (2005), "Trends in U.S. Wage Inequality: Re-Assessing the Revisionists", NBER Working Paper 11627, Cambridge MA: NBER.

Killingsworth, Mark R., and James J. Heckman (1986). "Female labor Supply: A Survey", in: Ashenfelter, Orley and Richard Layard (eds), *Handbook of Labor Economics - Vol. I*, Amsterdam: Elsevier-North Holland, 103-204.

Knudsen, Eric, James J. Heckman, Judy Cameron, and Jack Shonkoff (2006), "Economic, Neurobiological and Behavioral Perspectives on Building America's Future Workforce", *Proceedings of the National Academy of Sciences*, 103, (27), 10155–10162.

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

Lalive, Rafael, Jan C. van Ours, and Josef Zweimuller (2005), "The Effects of Benefit Sanctions on the Duration of Unemployment", *Journal of the European Economic Association*, 3, 1386-1417.

Lalive, Rafael, Jan C. van Ours, and Josef Zweimuller (2006), "How Changes in Financial Incentives Affect the Duration of Unemployment", *Review of Economic Studies*, forthcoming.

Lally, J. Ronald, Peter Mangione, and Alice Honig (1988), "The Syracuse University Family Development Research Program: Long-Range Impact on an Early Intervention with Low-Income Children and Their Families", in: Douglas Powell (ed), *Parent Education as Early Childhood Intervention*, Norwood, N.J.: Ablex.

Layard, Richard, Stephen Nickell and, Richard Jackman (1991), *Unemployment*, Oxford: Oxford University Press.

Leuven, Edwin, Hessel Oosterbeek, and Hans van Ophem (2004), "Explaining International Differences in Male Skill Wage Differentials by Differences in Demand and Supply of Skill", *Economic Journal*, 114, 466–486.

Lindbeck, Assar, and Sven Nyberg (2006), "Raising Children to Work Hard: Altruism, Work Norms and Social Insurance", *Quarterly Journal of Economics*, 4, forthcoming.

Ljunge, Martin (2006), "Half the Job Is Showing Up: Returns to Work, Taxes, and Sick Leave Choices", Ph.D. Dissertation, University of Chicago, June 2006.

Ljungqvist, Lars and Thomas J. Sargent (1998), "The European Unemployment Dilemma", *Journal of Political Economy*, 106(3), 514–550.

Ljungqvist, Lars and Thomas J. Sargent (2002), "The European Employment Experience", CEPR Discussion Paper 3543, London: CEPR.

Martin, John, and David Grubb (2001), "What Works and for Whom: A Review of OECD Countries' Experience with Active Labour Market Policies", *Swedish Economic Policy Review*, 8, (2), 9-56.

Mincer, Jacob (1974), *Schooling, Experience, and Earnings*. Cambridge MA: NBER, distributed by Columbia University Press, New York.

Murphy, Kevin M., W. Craig Riddell, and Paul M. Romer (1998), "Wages, Skills, and Technology in the United States and Canada", in: Elhanan Helpman (ed.) (1998), *General Purpose Technologies and Economic Growth*, Cambridge MA: MIT Press, 283-309.

Nahuis, Richard, and Henri L.F. de Groot (2003), "Rising Skill Premia: You Ain't Seen Nothing Yet?, CPB Discussion Paper No 20: The Hague: CPB Netherlands Bureau for Economic Policy Analysis.

Neal, Derek A. (2006), "Why Has Black-White Skill Convergence Stopped?", in: Eric Hanushek and Finis Welch (eds), *Handbook of Economics of Education*, Amsterdam: Elsevier-North Holland.

Nickell, Stephen (1997), "Unemployment and Labor Market Rigidities: Europe versus North America", *Journal of Economic Perspectives*, 11, (3), 55-74.

Nickell, Stephen (2003), "Poverty and Worklessness in Britain", *Economic Journal*, 114, C1-C25.

OECD (2003), *Education at a Glance*, Paris: OECD.

OECD (2004a), *Learning for Tomorrow's World First Results from PISA 2003*, Paris: OECD.

OECD (2004b), Benefits and Wages, Paris: OECD.

OECD (2004c), The Labor Force Participation of Older Workers: The Effects of Pension and Early Retirement Schemes, Working Paper, OECD Economics Department, May 2004.

OECD (2005a) *Education at a Glance*, Paris: OECD.

OECD (2005b), OECD Factbook, Paris OECD.

OECD (2005c), OECD Social Indicators, Paris: OECD.

OECD (2005d), *Pensions at a Glance*, Paris: OECD.

OECD (2005e), OECD in Figures, Paris: OECD.

OECD (2005f), OECD Tax Database, Paris: OECD.

OECD (2006a), OECD Labor Force Statistics Database, Paris: OECD.

OECD (2006b), OECD Social Indicators, Paris: OECD.

OECD (2006c), OECD Database on Immigrants and Expatriates, Paris: OECD.

OECD (2006d), *Where Immigrant Students Succeed - A Comparative Review of Performance and Engagement in PISA 2003*, Paris: OECD.

OECD (2006e), OECD Education Database, Paris: OECD.

Ours, Jan C. van, and Michèle Belot (2001), "Unemployment and Labor Market Institutions: An Empirical Analysis", *Journal of Japanese and International Economies*, 15, (4), 403-418.

Palacios-Huerta, Ignacio (2004), "An Empirical Analysis of the Risk Properties of Human Capital Returns", *American Economic Review*, 93 (3), 948-964.

Pencavel, John (1986), "Labor Supply of Men: A Survey", in: Ashenfelter, Orley, and Richard Layard (eds), *Handbook of Labor Economics - Vol I*, Amsterdam: Elsevier-North Holland, 3-102.

Peracchi, Franco (2006), "Educational Wage Premia and the Distribution of Earnings: An International Perspective", in: Eric Hanushek and Finis Welch (eds), *Handbook of Economics of Education*, Amsterdam: Elsevier-North Holland.

Piketty, Thomas (2003), "Income Inequality in France, 1901-1998", *Journal of Political Economy*, 111, 1004–1042.

Piketty, Thomas, and Emmanuel Saez (2003), "Income Inequality in the United States 1913-1998", *Quarterly Journal of Economics*, 118, (1), 1-39.

Pissarides, Cristopher A. (1998), "The Impact of Employment Tax Cuts on Unemployment and Wages: The Role of Unemployment Benefits and Tax Structure", *European Economic Review*, 42, 155–183.

Phelps, Edmund S.(ed) (2003) *Designing Social Inclusion: Tools to Raise Low-End Pay and Employment in Private Enterprise*, Cambridge: Cambridge University Press.

Ploeg, Frederick van der (2006), "Do Social Policies Harm Employment? Second-Best Effects of Taxes and Benefits on Labor Markets", in: Jonas Agell and Peter B. Sørensen (eds.), *Tax Policy and Labor Market Performance*, Cambridge-MA: CESifo and MIT-Press.

Plug, Erik J.S. (2004), "Estimating the Effect of Mother's Schooling on Children's Schooling using a Sample of Adoptees", *American Economic Review*, 94, (1), 358–368.

Plug, Erik J.S., and Wim Vijverberg (2003), "Schooling, Family Background, and Adoption: Is it Nature or Is Nurture", *Journal of Political Economy* 111, (3), 611–41.

Prescott, Edward C. (2004), "Why Do Americans Work So Much More Than Europeans?" *Federal Reserve Bank of Minneapolis Quarterly Review*, 28, (1), 2–13.

Raudenbush, Stephen W. (2006), "Schooling, Statistics and Poverty: Measuring School Improvement and Improving Schools", Inaugural Lecture, Division of Social Sciences, University of Chicago.

Saez, Emmanuel (2002), "Optimal Income Transfer Programs: Intensive Versus Extensive Labor Supply Responses", *Quarterly Journal of Economics*, 117, 1039-1073

Sianesi, Barbara, and John van Reenen (2002), "The Returns to Education: Macroeconomics", *Journal of Economic Surveys*, 17, 2, 1-114.

Shonkoff, Jack P., and Deborah Phillips (2000), *From Neurons to Neighborhoods: The Science of Early Child Development*, Washington, DC: National Academy Press.

Solon, Gary (2002), "Cross-Country Differences in Generational Earnings Mobility", *Journal of Economic Perspectives*, 16, 59-66.

Solon, Gary (2004), "A Model of Intergenerational Mobility Variation over Time and Place", in: Miles Corak (ed), *Generational Mobility in North America and Europe*, Cambridge: Cambridge University Press.

Sørensen, Peter B. (1999), "Optimal Tax Progressivity in Imperfect Labour Markets", *Labour Economics*, 6, (3), 435-452.

Taber, Christopher (2001). "The Rising College Premium in the Eighties: Return to College or Return to Unobserved Ability?", *Review of Economic Studies*, 68, (3), 665-691.

Taggart, Robert (1995), *Quantum Opportunity Program Opportunities*, Philadelphia: Industrialization Center of America.

Trostel, Philip A. (1993) "The Effect of Taxation on Human Capital", *Journal of Political Economy*, 101, (2), 327-350.

Turkheimer, Eric, Andreana Haley, Mary Waldron, Brian D'Onofrio, and Irving I. Gottesman (2003), "Socioeconomic Status Modifies Heritability of IQ in Young Children", *Psychological Science*, 14, 6, 623-628.

Willis, Robert, and Sherwin Rosen (1979), "Education and Self-Selection", *Journal of Political Economy*, 87, (5), S7-S36.