13 | Optimal tax and education policies and investments in human capital

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13.1 Introduction

When one starts to think about schooling and training as investments in human capital, one realizes that public policies are particularly important for the incentives to acquire human capital. First of all, progressive taxes on labour income, taxes on capital income and taxes on consumption are major sources of government revenue. Furthermore, a large part of taxation is used for social insurance and redistributional purposes. In 2006 the total tax and non-tax revenue in OECD countries amounted about 38% of GDP (Netherlands: 49%) (see OECD 2005). Clearly, taxation affects the economic incentives to acquire skills in various ways. Education is highly subsidized by most governments. Public contributions to the direct costs (school buildings, teachers' wages, etc.) are substantial. In OECD countries governments contribute about 87% to the direct costs of education (Netherlands: 93%). Average public spending on education in OECD countries is about 4.6% of GDP (Netherlands: 4.3%) (see OECD, 2003). Furthermore, outlays on education are among the most important public spending categories of most governments. Clearly, the government must have important motivations to subsidize education to this large extent.

13.2 Brief review of the literature

After some important early studies on taxation and human capital formation (Boskin, 1975; Heckman, 1976; Kotlikoff and Summers, 1979; Eaton and Rosen, 1980; Driffil and Rosen, 1983), theoretical interest remained somewhat slack for a decade or so until endogenous growth theories came to the fore. Endogenous growth theories attributed an important role to human capital in the process of economic growth (Lucas, 1988) or technological change (Romer, 1990). At the beginning of the 1990s the literature really boomed. (See, for example,

Milesi-Ferretti and Roubini (1998) for an overview of this literature and Jacobs (2002a) for more references.) Findings from the literature are somewhat extreme. On one side of the spectrum we have the analyses by Boskin (1975) and Heckman (1976). They argue that labour taxation is generally not important for human capital formation. On the other side of the spectrum, Trostel (1993) concludes: 'Thus the conclusion that taxation significantly discourages investment in human capital seems inescapable.' This may seem very odd, but there are five mechanisms which are relevant to understanding all the results in the literature: (1) tax progression, (2) endogenous leisure demand decisions, (3) non-deductible costs of education, (4) distortions in inputs invested in human capital, and (5) implicit subsidies deriving from capital income taxes.

First, more tax progression harms investments in human capital because the benefits of learning and increases in future wage incomes are subject to higher taxes than the costs, i.e. forgone earnings, of learning, and vice versa. If the tax system is flat, future earnings are subject to the same rate of tax as forgone earnings, so that the labour tax does not distort the educational investment decision. In the real world one would expect this effect to be present because tax rates on forgone earnings while enrolled in college are typically lower than on future earnings.

Second, taxes may have an indirect effect on human capital formation through labour supply decisions. Taxation of labour incomes induces individuals to work less, if the substitution effect in labour supply is dominant.[2] Consequently, at lower levels of labour supply, the utilization rate of acquired human capital falls, and the returns on human capital investments are reduced accordingly. Therefore, investments in human capital fall when taxes are increased.

Third, non-tax deductibility of resources invested in education also harms investments in human capital. Examples are: tuition costs, costs of books and computers, effort costs, etc. The intuition is that the returns of education are taxed whereas the costs are not deductible at the same rate. Hence, education is taxed on a net basis. If, however, resources invested in education are tax-deductible, all costs and benefits are taxed at the same rate so that the tax becomes non-distortionary. In the same way, the government may subsidize these resource costs.

Fourth, the tax system distorts the optimal composition of investments in human capital if the tax treatment of different inputs is

different. For example, resources invested in education are not deductible, whereas the costs of time invested in education are deductible, since forgone earnings are taxed. Consequently, higher income taxes will make the costs of time invested in education smaller relative to the non-deductible inputs invested in education. Therefore, the optimal composition of inputs invested in education is distorted and individuals will invest too much time in education, and too little effort or direct resources, which are non-deductible. Thus, if the government subsidizes the time spent in education a lot, students will work less hard to finish in time.

Fifth, higher capital taxes increase investments in human capital since financial savings become less attractive relative to human savings. Three equivalent intuitions for this result can be given. First, the rate at which future earnings are discounted decreases so that the present value of the returns to investments in human capital increases. Consequently investments in human capital increase. Second, a lower return on financial savings implies that the return on human savings should fall, since arbitrage between financial savings and human savings should hold in an optimizing framework. This can only be accomplished by investing more in human capital, since there are diminishing returns to investments in human capital. Third, effective borrowing costs to finance investments in human capital decrease when these costs are reduced by the capital tax and investments in human capital increase. In any case, a capital tax acts as an implicit subsidy on investments in human capital.

The existence of these five channels implies that taxes will have no effect on human capital accumulation except under special circumstances that are likely to be violated in practice: (i) labour taxes are flat; (ii) labour supply is not affected by labour taxation; (iii) direct costs of education are either absent or fully deductible; (iv) tax treatment of all inputs invested in human capital is equal, and (v) capital income taxes are absent. Consequently, it is hard to argue that taxes on labour and capital income have no effect on investment decisions in human capital, at least from a theoretical perspective. Finally, education subsidies are not very much discussed in the taxation literature, although these are the natural complements to taxes. Education subsidies encourage human capital formation and may therefore be used as an instrument to offset negative incentives on learning through the tax system.

Empirically, the impact of taxes depends on the elasticities of invest-ments in human capital with respect to the taxes. Unfortunately, empirical work regarding the effects of taxes on human capital forma-tion is extremely scarce. Structural models developed by Heckman et al. (1998) suggest that human capital investments can in principle react quite substantially to policy changes.[3] Also, Leuven and Oosterbeek (2005) find empirical evidence for the elasticity of training investments with respect to income taxes that are of the same magni-tude as conventional labour supply elasticities. We also know that graduates respond to changes in tuition rates, forgone earnings and future earnings in their decision to enrol in education (see, for example, Leslie and Brinkman, 1984; Cameron and Heckman, 2001; Hilmer, 1998, and others). Since the taxes (subsidies) directly affect, for example, forgone earnings, future earnings and education costs, taxation is therefore of empirical importance.

The literature on the economics of education mainly discusses three arguments to subsidize education and skill formation: external effects, capital and insurance market failures, and merit or public good argu-ments. We discuss each of them below.

First, and often mentioned, large subsidies on education are justified on the basis of perceived externalities of education. Parents and stu-dents do not take into account that their investments in human capital may be of social value above the private return on education, so that they underinvest in human capital. If the government gives subsidies on education, it can internalize the externality.[4] The problem with the externalities argument is that it is empirically impossible to detect positive externalities from education, certainly at current levels of education: see, for example, Krueger and Lindahl (2002) and Ciccone and Peri (2006).

Second, subsidies on education may also restore incentives to invest in human capital if there is underinvestment in human capital due to failing capital and insurance markets. Human capital is generally regarded as illiquid and bad collateral: see also Friedman (1962). Individuals cannot sell a claim on their future earnings to banks. Therefore, they cannot use human capital as collateral. Consequently, in case individuals default on their loans, banks are not allowed to 'own' the human capital embodied in the individual, and banks cannot force the individual to do work for them so as to repay debts as a consequence. Legal restrictions, that is, non-slavery considerations, effectively block trade in (future) claims on

human capital. For similar reasons, as credit markets fail, insurance of the income risks associated with investments in human capital is also impossible. Insurance of human capital risks would require a so-called 'state contingent claim' on future earnings: in good states (when lucky) the individual promises to pay a certain amount of income as an insurance premium to the insurance company, whereas in bad states (when unlucky) the individual receives compensation from the insurance company. Again, it is very difficult for the insurance company to force the individuals in the good states of nature to pay their premiums, when they have decided not to do so. Consequently underinvestment is likely to occur due to capital and insurance market failures.

Furthermore, even if capital markets and insurance markets are present, they would probably not function very well due to asymmetric information between banks and borrowers and between insurance companies and the insured. If banks cannot assess the economic risks of their loan applicants, the high-risk borrowers may drive the low-risk borrowers out of the market, since the latter finance the costs of default through a premium on the interest rate. Consequently, adverse selection occurs and banks may even ration credit so as to keep the pool of loan applicants healthy (see Stiglitz and Weiss, 1981). Also income insurance is subject to problems with asymmetric information. The individuals with low risks of a low income may voluntarily underinsure themselves to avoid income redistribution to high-risk individuals. Again, adverse selection effects are important here. Also moral hazard may give rise to failures in capital and insurance markets. If banks and insurance companies cannot observe whether individuals exert enough effort to avoid default or an accident, costs of financing loans or the price of insurance increases, and underinvestment may result as well (see Arnott and Stiglitz, 1990).

Recently, some economists have begun to argue that capital market imperfections are not that important (see Carneiro and Heckman, 2003). The seemingly non-importance of capital market imperfections is highly controversial, however, and the empirical jury is still out. For example, Plug and Vijverberg (2005) find, after careful estimation, evidence for the importance of liquidity constraints in education choices.

Whether insurance markets fail to insure risks in human capital is a complicated empirical question. The average returns on human capital are in the range of the returns on equity. This could indeed reflect the

large risk of investments in human capital. However, it is quite hard to
believe that the returns on education are that high because of systema-
tic macroeconomic shocks (like the returns on equity). Graduates
typically suffer less from macroeconomic shocks, resulting in, for
example, lower unemployment, sickness and disability rates, than
non-graduates. As such, education serves as an insurance device against
macroeconomic uncertainty and the risk premium for macroeconomic
risk would be negative (see also Gould et al., 2000). Consequently, to
justify the large returns on human capital, risks in human capital are
probably individual risks, rather than macroeconomic risks which
cannot be insured. Large returns could then indeed be evidence for
the failing of the insurance market. However, the fact that individuals
cannot insure themselves may also be the result of moral hazard pro-
blems in the insurance market. Hence, non-insurability of income risks
may also reflect a rational market response. This is a version of the
'human capital premium puzzle' (see also Judd, 2000). Again, the jury
is still out. Empirical research is extremely scarce and more research is
certainly needed here, as is pointed out in chapter 8.

The third and final argument is that education is also often viewed as
a merit or public good with intrinsic and non-monetary values such as
promoting citizenship, contributing to culture, etc. To the extent that
society values education, above the private valuations of education,
there is an argument for subsidizing education. Also political mechan-
isms may explain why education is subsidized. In this research, we
abstract from these issues.

13.3 Income redistribution and human capital

Income redistribution seems to have vanished totally from the litera-
ture on taxation and human capital formation, since none of the
aforementioned studies considers redistributional concerns. Most ana-
lyses have been cast in the framework of the representative agent
without distributional concerns.[5] The lack of attention to income dis-
tribution contrasts heavily with the more traditional analyses on taxa-
tion and labour supply that originated from the Nobel-prize winning
article by Mirrlees (1971). This can be considered a serious drawback.
In our opinion, the ultimate reason for having distortionary taxes is to
correct inequalities in income distribution, otherwise governments
would use individualized lump-sum taxes (or, equivalently, Tinbergen's

talent tax). Therefore, one could say that the scientific debate has turned its attention away from the ultimate reasons for having distortionary taxes.

A related issue is the distributional impact of education subsidies. Although education subsidies are generally justified to guarantee access to education for the students from poor backgrounds, one may doubt whether they are really that equitable, especially education subsidies to higher education. The incidence of education is highly unequal, since most of the students enrolled in higher education belong to the wealthiest socioeconomic classes. And, on average, students turn out to belong to the wealthiest income groups after graduation due to the high financial returns on human capital investments.

13.4 Our contribution to the international literature

13.4.1 *The core question*

In our research we take a typical public finance perspective. The central, normative question is how the government should design tax and education policies. 'First-best' (perfect markets, no information problems, no distributional issues, etc.) is generally not attainable. Therefore, second-best considerations become important and trade-offs between policy objectives appear, such as the trade-off between equity and efficiency. Crucial to our exposition is that income redistribution is the important justification for using distortionary tax instruments since we rule out individualized lump-sum taxes (or Tinbergen's talent tax). The ultimate reason is that the government cannot observe ability or earnings capacity, only earned income (see also Mirrlees, 1971; Stiglitz, 1982). Furthermore, we pay attention to the role of potentially important non-market distortions arising from imperfect capital and insurance markets.

Up to now, standard public finance has largely ignored human capital decisions and related issues such as the failing of financial markets. By adding human capital formation to the models of optimal income taxation and redistribution we attempt to fill this gap. In doing so, this research integrates the literature on education policy and public finance. Further, we show that second-best reasoning may actually explain some salient features of current policies that cannot be understood by relying on first-best arguments. For example, why do

governments subsidize education whereas externalities cannot be found and capital market imperfections can be solved by means of loans? Why do many people believe that education subsidies (to higher education) are equitable whereas they appear to be completely perverse from a redistributional perspective? Why do governments levy positive capital income taxes whereas insights from public finance dictate that capital should not be taxed at all?

13.4.2 *Optimal labour income taxation*

How progressive should the income tax be? The answer to this question is one of the main questions in the optimal tax literature. The standard optimal taxation model with endogenous labour supply shows that there is a fundamental trade-off between achieving equality in after-tax incomes and efficiency in labour supply decisions. In the standard linear taxation model the government optimizes the combination of a flat marginal tax rate and a lump-sum transfer (or negative income tax). The income tax schedule is more progressive when the marginal tax rate is larger so as to allow for a larger lump-sum transfer. The optimal marginal tax rate increases with the desire to redistribute incomes which is, in turn, determined by social preferences. The optimal income tax decreases with the elasticity of labour supply because taxation erodes the tax base, and more so when labour supply is more elastic.

Once the optimal linear taxation model is extended with endogenous human capital formation, the elasticity of the tax base with respect to the marginal tax rate on labour income substantially increases (Bovenberg and Jacobs, 2001, 2005; Jacobs, 2002c, 2005). The reason is that not only is labour supply affected by taxation, but also human capital decisions. Labour supply and investments in human capital are complementary. The more labour is supplied, the higher will be the utilization rate of acquired human capital, and, therefore, the larger will be the return to investments in human capital. Therefore, welfare costs of marginal taxes increase when human capital formation is endogenous. The optimal linear tax rate is reduced which is in accordance with standard Ramsey intuitions: lower taxes when the tax base becomes more elastic. Numerical evidence in Jacobs (2005) shows that reductions in optimal taxes are indeed substantial when endogenous human capital formation is taken into account.

The linear taxation model is a convenient vehicle to understand the main trade-off between equity and efficiency. But in real life tax schedules are generally differentiated and not flat. Bovenberg and Jacobs (2005) generalize the optimal linear tax results to a pure non-linear income tax in the spirit of Mirrlees (1971). They also allow for imperfect substitution between tax-deductible inputs (like forgone earnings) and non-tax-deductible inputs (effort costs and direct costs) in the production of human capital. Taxes will then not only reduce the level of investment in human capital, but will also distort the optimal composition of investments in human capital. In particular, a higher income tax gives incentives to substitute the non-tax-deductible investments for tax-deductible investments in human capital. Thus a more progressive income tax may reduce the individuals' efforts in learning, and increase the number of years spent in education. Consequently, the welfare costs of the income tax increase if substitution between various inputs in skill formation is easier. Bovenberg and Jacobs (2003) show that, in a dynamic setting, the tax progression effects will give rise to another tax distortion. Individuals creep up to higher tax brackets when they become more educated. Therefore, the marginal benefits of education are taxed at higher rates than the costs in the form of (taxed) forgone earnings. As a result, welfare costs of labour taxation increase and optimal marginal taxes should be lowered accordingly.

13.4.3 *Optimal labour income taxation and market failures*

When borrowing is impossible, (poor) individuals are prevented from investing optimally in human capital. Jacobs (2002c) shows – using the linear income tax model – that the optimal tax on labour is progressive from a pure efficiency point of view, i.e. in the absence of distributional concerns. A progressive tax schedule redistributes incomes from the old (or the rich parents) to the young (or their poor parents) so that the liquidity constraints for the young are relaxed. At the optimum the government strikes a balance between, on the one hand, reducing the adverse consequences of capital market failures, and, on the other hand, reducing investments in human capital as a consequence of higher marginal tax rates. Numerical simulations show that optimal taxes substantially increase due to capital market failures even if credit constraints are binding for only 25% of the population. Therefore, the

presence of capital market imperfections substantially lowers the welfare costs of progressive income taxes.

If individuals cannot insure the risks in their future incomes, there will be underinvestment in human capital if individuals are risk averse. Also a progressive income tax is optimal from a pure efficiency point of view (Jacobs and Van Wijnbergen, 2005). The reason is that a redistributive graduate tax mimics income insurance by redistributing incomes from lucky to unlucky graduates. Future income risks are insured and underinvestment in human capital is mitigated. Thus we confirm earlier theoretical findings by Eaton and Rosen (1980) to a setting where we explicitly modelled the underlying sources of the insurance market imperfection resulting in underinvestment and adverse selection. Again, welfare losses of progressive income taxes are mitigated when non-insurable income risks are present.

13.4.4 Optimal labour and capital income taxation

There is a general consensus in the public finance literature that capital incomes should not be taxed under quite general conditions.[6] Nevertheless, capital income taxes are part of virtually any existing tax system. Theoretical predictions on the optimality of zero capital income taxes are therefore not met in practice. By allowing for the interaction between human and financial capital formation, Bovenberg and Jacobs (2001) and Jacobs and Bovenberg (2005) show that the optimal capital income tax is indeed positive, rather than zero. The reason for this result is that the capital income tax reduces the tax distortions on human capital formation arising from the labour income tax. By taxing capital incomes the government reduces the incentives to save too much in financial form and individuals substitute towards savings in human form. The capital tax should be used especially if distortions in the lifetime financial saving decisions are small. However, if these distortions are large, then the capital tax loses its benefits in boosting learning, since the welfare costs of employing the instrument increase. A trade-off emerges between distorting the labour market and the acquisition of human capital, on the one hand, and distorting the capital market, on the other hand. The more important labour market distortions become, the more the government relies on capital taxes to stimulate investment in human capital, rather than burdening employment prospects. Similarly, the more distortionary

the labour tax with respect to investments in human capital, the higher the optimal capital income tax. We show numerically that a synthetic income tax where capital and labour incomes are taxed at equal marginal rates appears to be roughly optimal. This result contrasts with the conventional wisdom in public finance but can explain why capital income taxes are so commonly observed.

13.4.5 *Optimal labour and capital income taxation and optimal education policies*

First-best arguments cannot explain the commonly observed practice of progressive income taxes and education subsidies. Redistributive governments would abstain from giving regressive education subsidies which increase the redistributive tasks of the tax system. Moreover, education subsidies need to be financed by raising distorting income taxes. In the absence of externalities or other reasons to subsidize education, this would be inefficient as well. Consequently, societies would be better off in terms of equity and economic efficiency by simultaneously lowering education subsidies and income taxes. Why, then, do virtually all governments both give regressive subsidies to education and levy progressive income taxes?

If first-best arguments, such as capital market failures and externalities, cannot justify large education subsidies, we show that substantially positive education subsidies are typically an ingredient of the optimal tax system. The reason is that education subsidies are able to offset distortions on human capital decisions caused by the tax system. If all learning efforts can be perfectly observed, and, therefore subsidized, subsidies can ensure that learning decisions are efficient and not distorted by income taxes. The efficiency losses of more progressive income taxation are lowered if education subsidies are allowed for. Therefore, the optimal labour tax is more progressive with education subsidies. Education subsidies therefore allow the government to better approach the ideal individualized lump sum or talent taxes (Plug et al., 1999). Even though education subsidies are regressive, the combination of progressive taxes and education subsidies yields more equality since non-observed ability rents are effectively taxed at higher rates. Hence, education subsidies and redistribution of incomes are Siamese twins. The more the government wishes to redistribute incomes, the larger education subsidies are even if they are regressive. Numerical

calculations reveal that tax distortions may go a long way towards explaining the current level of education subsidies.[7] The second-best interactions between redistributive income taxes and education policies can therefore provide a solid reason why governments should subsidize education even if first-best arguments are not relevant.

The argument holds for linear as well as for non-linear tax schedules. Marginal taxes are generally highest at the bottom of the skill distribution due to the presence of the poverty trap. Poor individuals face high marginal tax burdens because poverty programmes are phased out as individuals start to earn higher incomes. As a result, individuals lose their eligibility to tax credits, rent assistance, health care costs, exemptions from local taxes, and so on. We show that education subsidies should therefore be highest for the individuals who face the highest marginal tax rates on their incomes. We do not need to resort to paternalism, externalities or merit motives to justify high education subsidies for primary and secondary education. We only need redistributional motives (Bovenberg and Jacobs, 2003, 2005). Individuals are less likely to get stuck in the poverty trap when governments combine poverty reduction with education policies that keep individuals out of poverty.

If education subsidies are available to offset tax distortions on human capital formation, governments do not rely on alternative tax instruments to boost learning, such as taxes on unskilled labour, or on taxes on capital to reduce tax distortions on investments in human capital. In contrast to education subsidies, the latter instruments cause distortions in labour and capital markets. So the government can do better by employing education subsidies that avoid these distortions (Bovenberg and Jacobs, 2001; 2003b; Jacobs and Bovenberg, 2005).

If not all educational efforts can be observed, however, education subsidies can be given only on observed inputs in human capital formation (notably years spent in education). Thus, education subsidies will tend to distort optimal investments in human capital away from non-subsidized to subsidized inputs in human capital formation. For example, students may put less effort (non-observed investment) and more time (subsidized investments) in human capital formation if the government subsidizes time invested in education a lot. Thus, education subsidies lose their power as an instrument to offset tax distortions on human capital formation if substitution between various inputs in human capital formation is easier (Bovenberg and Jacobs, 2005). If not

all educational efforts can be observed, the case for taxes on capital incomes is not lost (Jacobs and Bovenberg, 2005). The capital tax will then be an instrument to boost investments in human capital as well, and the synthetic income tax remains approximately optimal.

13.4.6 *Optimal financing of education*

Many people hold firm beliefs that the government should subsidize (higher) education to guarantee universal access, especially for students from lower socioeconomic backgrounds. However, it is debated whether subsidies are really the most efficient instruments if accessibility problems originate from failures in financial markets. A priori it seems to be more efficient to tackle failures in financial markets directly by making sufficient resources available to students through income-contingent loans or a graduate tax instead of giving large tax-financed subsidies which end up in the pockets of the affluent. For these reasons, Australia introduced income-contingent loans in the 1990s (the Higher Education Contribution Scheme) and students now pay over one-third of the real costs of education themselves. Prime Minister Tony Blair introduced income-contingent loans in the UK, although he almost stumbled over his plans. Also, the Dutch government has now introduced income-contingent loans. The insights from our research have contributed to this policy change to a significant extent.

From a theoretical perspective we show that an equity-participation model implemented by the government does indeed tackle both the capital and insurance market imperfections arising from adverse selection and the impossibility of trading income-contingent contracts (Jacobs and Van Wijnbergen, 2005). Further, income risks can be pooled by the government, so that it can recoup the losses it makes on the unlucky graduates through higher 'dividend payments' from the lucky graduates. Hence the government does not need subsidies to overcome liquidity constraints and combat risk aversion.

Education subsidies are not an efficient instrument to restore inefficiencies caused by capital and insurance market failures. First, education subsidies allocate resources to individuals who are not credit-constrained. Moreover, most students are not credit-constrained in a lifecycle sense, since the returns to education are high, and students are generally better off than the average taxpayer. Further, education subsidies are not effective at all in reducing income risks; consequently

most of the subsidies will be directed towards students with relatively safe earnings prospects. Since education subsidies have to be financed from general tax revenues, these dead weight losses are costly because government revenues can only be obtained through distortionary taxes.

An equity participation scheme features no subsidies, and thereby avoids the efficiency costs of distortionary taxes to finance subsidies. Under an equity participation scheme, the government buys shares in students' human capital by funding the costs of their education and obtaining a claim on the future returns of education. In other words, graduates repay a part of their incomes as dividend to the government. Moreover, an equity participation scheme can be defended on equity grounds as well. The majority of students come from the wealthiest classes and will belong to the most wealthiest classes after graduation. Equity participation avoids perverse redistribution of incomes from the average taxpayer to students.

Equity participation can be implemented through a graduate tax. Under a graduate tax, the dividend payout is incorporated into the income tax system. Under a pure equity financing regime, there is no individual link between the size of equity stake and the dividend pay-outs to the government. An income-contingent loan scheme is a combination of equity and debt financing of higher education. It may be desirable to introduce some element of debt financing in order to give students sufficient incentives to study hard and work hard after graduation. Moral hazard problems under 100% equity financing are reduced by restoring the individual link between repayments and funds received to study.

Jacobs (2002b) illustrates the theory for the Netherlands. He studied the switch from a system with mainly subsidies to education to a system where graduates pay part of the costs of education through a graduate tax (GT) or an income-contingent loan system (ICL). Substantial reductions in government outlays can be achieved. The costs of protecting students from lower socioeconomic groups can be substantially lowered without erecting barriers to students from these groups. The reason is twofold. First, no subsidies are directed towards graduates who have sufficiently high incomes over the lifecycle to finance the costs themselves. Second, no external subsidies to cover the default risks from those with insufficient incomes are needed if the risks of default on loans are pooled amongst graduates. If, however, the costs of default are not shared amongst graduates, but financed from general

tax revenue, the savings on government outlays are less, since ex ante subsidies to every student are replaced by ex post subsidies to the graduates who default.

13.5 Directions for future research

Although this research project has given some important and policy-relevant insights, loose ends still remain. In the following we discuss some issues which seem to be interesting for future research.

Dynamic aspects and the intergenerational distribution of welfare

We have only studied the intragenerational distribution of welfare. However, as Heckman et al. (1998) and Heckman (2000) have pointed out, learning and human capital formation are by their very nature activities taking place over the entire lifecycle. In order to get a better understanding of the effects on tax and education policies it is only a natural extension of this research to look at the intergenerational distribution of welfare as well, in a multi-period model with human capital formation. An important further extension is to add formation of human capital within the family (cf. chapter 6). Most analyses have generally neglected intergenerational transfers of human capital. Heckman (2000) forcefully argues that these intergenerational effects are important ingredients for incentives to acquire skill over the life-cycle ('skill-begets-skill' and 'learning-begets-learning'); see also chapter 9. Another important extension in this respect is a more elaborate analysis of the role of credit constraints. Parents may also respond to credit constraints through savings and bequests. As a result, (means-tested) subsidies on education and capital income taxes may distort parental incentives to save for their children's education.

General equilibrium effects

We have assumed perfect substitutability of individuals' factor supplies. Wage differentials then only reflect differences in units of human capital and not intrinsic differences between the types of skills. Clearly, this is not the case in the real world. A skilled worker is not equal to twice an unskilled worker. Empirically, general equilibrium effects on

wages are important (see, for example, Hartog et al., 1993); Leuven et al., 2004); Jacobs, 2004). Recently, Dur and Teulings (2001) have argued that education subsidies can be used to provoke general equilibrium effects on wages. By subsidizing human capital formation, the supply of skilled workers increases and wage inequality between skilled and unskilled workers diminishes, because skilled workers become less scarce. As such, the government may want to subsidize education to reduce inequality. Nevertheless, the jury is still out on whether this mechanism is indeed robust. Saez (2003) has – in contrast – argued that the government should refrain from exploiting general equilibrium effects to achieve a more equal distribution of incomes by resorting to the Diamond and Mirrlees (1971) production efficiency theorem which suggests that subsidies/taxes on intermediate goods, like different types of labour, should optimally be avoided. Therefore, for future research it is interesting to explore the optimal taxation of labour incomes and optimal education policies in the presence of general equilibrium effects on wages.

Moral hazard and the optimal financing of education

In our analysis of optimal financing of education in the presence of capital and insurance market imperfections we have abstracted from problems with moral hazard in the financing of education. We expect that the presence of moral hazard may give rise to a weaker case for equity financing of education, and combinations of debt and equity will probably be optimal. This may point to a stronger case for income-contingent loans since this financing system contains both debt and equity elements. Therefore more research is needed where moral hazard is introduced in models of optimal educational financing.

Time consistency of optimal policies

Individuals may anticipate that the government may change its behaviour after announcing a set of policies. The setting of second-best policies is not credible if the government cannot pre-commit to the announced policies, such as the setting of the tax (see, for example, Andersson and Konrad, 2003). In the case of setting the optimal tax, a hold-up problem emerges: people know that the government engages in excessive taxation after the investments in human capital have been

made. Based on this expectation of government intervention, people reduce investments in human capital. The government should take this behavioural response into account when setting optimal taxes. Due to the time-inconsistency of its policies the optimal tax structure has become 'third-best'. The government can (partly) escape this problem by means of education subsidies. This may be an additional explanation for the use of education subsidies. More research may shed light on the presumed optimality of education subsidies under time-inconsistent government policies.

Human capital equity premium puzzle

Although we think that risk-aversion is very important for graduates, it could be that risk-aversion arguments may not be sufficient in explaining a real rate of return to human capital in the order of 8–9%. Empirical work is largely lacking on the causes of the high return on human capital and the effects of risk on investments in human capital (see also chapter 8). From the equity premium literature we know that conventional rates of risk-aversion are not able to produce a risk premium of 4–5%. Moreover, education is arguably less liquid than equity and options in human capital may be important, since one cannot sell a piece of human capital. That is, investments in human capital are to a large extent irreversible. Maybe the illiquidity of human capital can explain why students borrow so little. Clearly, future research should shed more light on this topic. Moreover, these issues have large practical and policy implications. For example, is there underinvestment in education and should education be subsidized more in light of the high return on human capital investments? Or are students borrowing so little for solid, rational reasons?

Notes

1. I thank Casper van Ewijk, Lans Bovenberg and Hessel Oosterbeek for their comments. Further, I thank Joop Hartog for his extremely constructive advice and suggestions, both literary and economic. Finally, I am very grateful to Henriëtte Maassen van den Brink for her support and continuous efforts to keep me in the SCHOLAR research group. This chapter is based on the introductory and concluding chapters of Jacobs (2002a).
2. This seems to be the case empirically: see Blundell and MaCurdy (1999).

3. Policy effects might, however, be countered by changes in the economic environment, such as changes in the wages due to changes in the supply of skills. These are so-called general equilibrium effects.

4. This presumes that the subsidy can be financed in lump-sum fashion, otherwise a trade-off would appear between internalizing the externalities and distorting economic incentives with taxes to finance the subsidy.

5. There are some older papers in the spirit of Mirrlees (1971) on optimal taxation and education (see, for example, Ulph, 1977; Hare and Ulph, 1979), but they all have in common that the tax system does not affect educational choices.

6. See, for example, the excellent overview by Bernheim (2002).

7. This finding implies that education decisions should be efficient if possible, even if the government wants to redistribute incomes. Tobin (1970) has argued that education policy could be useful to 'limit the domain of income inequality'. However, this research has shown that this argument is incorrect, for both efficiency and equity reasons. To 'limit the domain of inequality' is equivalent to tax education on a net basis, especially at the top end of the income distribution. We admit, though, that Tobin only considered elementary and secondary education. We show that education should be subsidized, not taxed, in the presence of a redistributive tax scheme to offset the distortions on learning, and, if possible, maintain total efficiency in human capital investments.

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Human capital can be broadly defined as the stock of knowledge, skills and other personal characteristics embodied in people that helps them to be productive. Pursuing formal education (early childhood, formal school system, adult training programmes) but also informal and on-the-job learning and work experience all represent investment in human capital. How do we measure human capital? There is no comparable and consistent measure across countries reflecting all these elements available. Economists thus rely on inferior substitutes, such as years spent in the schooling system, rates of enrolm Investment in human capital in SMEs, (meaning investment into intangible assets of the company), it is one of the ways to support this sector. In the same manner as SMEs are considered to be a driving force of the economy, human resources can be seen as its driving force, the source of success, competitiveness and added value of businesses. Human capital is one of the most valuable components of any business and that is why investment in human resources becomes a necessary step ensuring that a business prospers in a changing market environment. Current trends also point to the growing importan...Â The development of required skills of the employees is mostly provided by two key elements: personality training and education. Human Capital and Taxes: A Two Way Interaction. Interplay between HC policies and taxes. HC policies aect the income distribution - a key input for taxes. Taxes aect return and risk from HC investments. Calls for joint analysis of optimal taxation and HC policies. Optimal Taxation (Mirrlees) literature typically assumes exogenous ability. Mirlees 1971, Saez 2001...Â Is education less or more concentrated than income among high consumption. (high ability?) people? Note that relative concentration matters. This paper derives optimal income tax and human capital policies in a dynamic life cycle model of labor supply and risky human capital formation. The wage is a function of both stochastic, persistent, and exogenous "ability" and endogenous human capital. Human capital is acquired throughout life through monetary expenses.Â When the wage elasticity with respect to ability is increasing in human capital, the optimal subsidy involves less than full deductibility of human capital expenses on the tax base, and falls with age. I consider two ways to implement the optimum: income contingent loans, and a tax scheme that allows for a deferred deductibility of human capital expenses.