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Education and optimal dynamic taxation: The role of income-contingent student loans☆

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ABSTRACT

We study the optimal design of integrated education finance and tax systems. The distribution of wages is endogenously determined by the costly education decisions of heterogeneous individuals before labor market entry. Consistent with empirical evidence, this human capital investment decision is risky. We find that an integrated education and tax system in which the government provides education loans to young individuals coupled with income-contingent repayment can always be designed in a Pareto optimal way. We present a simple empirically driven application of the framework to US data in which individuals make a college entry decision. We find the optimal repayment schemes for college loans can be well approximated by a schedule that is linearly increasing in income up to a threshold and constant afterwards. So although the full optimum could lead to complicated non-linear schedules in theory, very simple instruments can replicate it fairly well. The welfare gains from income-contingent repayment are significant.

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1. Introduction

How should governments design their higher education finance systems? There are large differences across countries in the structure of higher education finance. In some countries, such as Denmark, Finland and Sweden, university and college students pay low or no tuition fees and in addition receive grants because of generous public subsidies for higher education. These countries have highly progressive tax systems, which finance these education subsidies. By contrast, in the United Kingdom and the United States, the burden of educational costs mainly lies on the student and higher education is less heavily subsidized by public finances. Instead, student loans offered by both the private and the public sector play a big part in financing higher education. From a policy perspective, the choice of an optimal education finance system is intimately linked to the tax system. Both underlie the same basic trade-offs, namely equity concerns in the form of redistribution and insurance against income risk versus efficiency concerns by distorting labor supply and education incentives.

In this paper, we address the optimal design of integrated education finance and tax systems. We build a novel optimal taxation framework in the spirit of Mirrlees (1971) and the vast literature following in his footsteps, which allows us to study the question from a new angle. In our framework, the distribution of wages is not exogenous but determined by the costly education decisions of individuals before labor market entry. Consistent with what is typically found in empirical studies, this human capital investment decision is risky. To solve the problem, we use an applied mechanism design approach. The benevolent government can observe total income and the education level of individuals, but it has to respect incentive compatibility—first, when individuals decide on education and second, when

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individuals decide on labor supply. The main novelty of our approach is that in our framework the government is not restricted to the use of predetermined instruments but is free to choose its own instruments, which can condition on education, income and savings. In addition, they are allowed to be fully nonlinear.

We find that an integrated education and tax system in which the government provides education loans to young individuals, coupled with income-contingent repayment rates of these loans after individuals enter the labor market, can effectively deal with all the major trade-offs underlying the education finance and tax problem. In other words, such systems can always be designed such that they are second-best Pareto efficient. This is because income-contingent repayment rates allow the government to *effectively differentiate tax distortions across education groups*, minimizing the efficiency cost of labor supply distortions. At the same time, it can subsidize education by varying the generosity of the loans.[1] Importantly, the government typically will find it optimal that some individuals partially default and never pay back the full value of their loans, while for some individuals the amount of repayment might exceed their loan values because this provides insurance.

We present a simple empirically driven application of the framework to US data in which individuals make a college entry decision. We simulate optimal income taxes and college student loans with income-contingent repayment. The optimal policy simulation provides three important insights. First, we find that the optimal repayment scheme for college loans can be well approximated by a schedule that is linearly increasing in income. Although the full optimum could lead to complicated nonlinear schedules in theory, very simple instruments can replicate it fairly well. Second, for our benchmark parameterization college graduates find it optimal to participate voluntarily in the loan schemes as compared to taking a risk-free loan on the private market. Third, we calculate the welfare gains of moving from a third-best scenario where the government optimally sets the income tax and offers a loan system with non-contingent repayment to the system with contingent repayments. We find welfare gains ranging from about 0.2% to 0.6% of lifetime consumption and we show how these gains vary with risk-aversion.

Several countries like the United Kingdom, Australia and New Zealand currently administer income-contingent college student loans, where repayment is proportional to income.[2] Very recently in the United States, "the student loan industry was effectively nationalized by provisions of the Health Care and Education Reconciliation Act of 2010" Brooks (2015, p. 251). Under the new system, student loan programs are directly administered by the Department of Education. The possibilities to opt for income-based repayment have increased since then. Whereas different options exist, they all have in common that repayment is capped at between 10 and 15% of income and they all include loan forgiveness of the remaining debt after 20–25 years (Brooks, 2015). Our framework gives these policies a theoretical second-best foundation, based on an applied mechanism design approach to the education finance and taxation problem. Our theoretical considerations suggest that it might be optimal for the government to enforce that very rich individuals pay back more than the capitalized loan value or that repayment might actually be decreasing in income. In the mentioned countries, repayment never exceeds the loan value and repayment schedules are non-decreasing in income. To address these issues, we also consider policy experiments in which we restrict income-contingent repayment not to exceed the actual loan value and to be non-decreasing in income. We find that a large share of the welfare gains from the full optimum can be reaped with these simpler policies and that they are similar to current policies in the U.S.: the marginal repayment rate is 10.5% on average.

More generally, a contribution of this paper is to extend existing studies on taxation and human capital (see the literature review below) by (i) considering ex-ante heterogeneity and uncertainty and (ii) by explicitly looking at education decisions along the extensive margin. The latter is in our view necessary to model the decision to go to college. Certainly, the college decision is not only binary in the real world. Important factors are the quality of college, the major of study, the length of study and learning effort during college—it is a multi-dimensional decision problem. Modeling education as a binary instead of a continuous variable (as usually done in the literature) is an important complementary comparison case and a necessary step towards more realistic models. Concerning (i), the joint consideration of ex-ante heterogeneity (to have some people going to college and some not) and income risk (to capture the riskiness of educational investment) is crucial to think about the desirability of income-contingent student loans. Having uncertainty in the model is necessary to include the insurance rationale of income-contingent repayment. On top, only the presence of ex-ante heterogenous individuals with and without a college degree makes it possible to study a realistic loan repayment system, in which income contingency implies that workers with the same income face different effective marginal tax rates.

1.1. Relation to existing literature

This paper makes a contribution to the literature on optimal income taxation starting with Mirrlees (1971) (see the recent survey of Piketty and Saez, 2013). In Section 3 we discuss how the expression for optimal education-dependent marginal tax rates compares to the seminal optimal tax formulas from Diamond (1998) and Saez (2001) with exogenous human capital.

Bovenberg and Jacobs (2005) and Jacobs and Bovenberg (2011) analyze how endogenous education alters the optimal tax problem and show for which specifications of the earnings function education should be subsidized at a higher or lower rate than the tax distortion. Bohacek and Kapicka (2008) study a dynamic model with certainty and obtain similar results regarding education subsidies. Those studies assume certainty whereas we take idiosyncratic human capital risk into account. Importantly, with idiosyncratic education risk, the necessity of education dependent labor wedges and income-contingent loans arises, as they can be understood as providing an additional source of insurance. As we discuss in Section 2.1, when we review some stylized empirical facts, there is strong evidence that uncertainty about college returns is important and matters for human capital investment decisions.[3]

[1] We do not model credit market imperfection in the form of borrowing constraints. If these are relevant, as is still a debated question in the literature (Carneiro and Heckman, 2005), wide availability of student loans has the additional benefit of lifting these constraints.

[2] Chapman (2006) provides a survey for practices in those and other countries. Barr (2004) discusses the trade-offs involved in designing these programs. To the best of our knowledge, the first economist to endorse the idea was Milton Friedman (1955). He envisioned repayment amounts to be proportional to income, i.e. a linearly increasing repayment schedule. Something we find as an optimal policy in our simulation for the most part of the income distribution.

[3] One strand of literature has looked at first- versus second-best investment rules of human capital under risk with ex-ante homogenous agents. Da Costa and Maestri (2007) show that human capital should always be encouraged in the second-best optimum. Anderberg (2009) emphasizes that the risk properties of human capital are crucial for the question whether and how education should be distorted relative to a first-best rule. Focusing on linear policy instruments, Anderberg and Andersson (2003) as well as Jacobs et al. (2012) obtain similar results. An early treatment how taxes affect the risk properties of human capital investment is Eaton and Rosen (1980). Grochulski and Piskorski (2010) focus on the implications of unobservable human capital investment for capital taxation in an ex-ante homogeneous agent setting with uncertainty. Kapicka (2006) introduces non-observable endogenous human capital into a dynamic, non-stochastic Mirrlees model where taxes can only be conditioned on current income. He shows that marginal tax rates are lowered due to the education margin.

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