

3.2.4 Government intervention and economic dynamics

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This project focuses on the impact of government interventions on growth. The first two parts deal with the effects of different ways to finance processes leading to human capital formation. The first part concentrates on the economic implications of financing schemes for higher education. The considered financing schemes differ with regard to their risk pooling capacities and they affect the incentives of individuals to invest in higher education. The goal of this part is twofold. First, it studies the effects of various financing schemes on the investment decisions in the education sector. And second, it explores the effects of more reliable screening mechanisms with regard to individual talent on human capital formation and its implications for income inequality and welfare. The second part is devoted to the design of an optimal growth policy, assuming labor market imperfections and inequalities where different regions are allowed for. A third part deals with the stabilization role of economic policy. If agents are heterogenous and markets imperfect, there may exist endogenous fluctuations that can be reduced or amplified according to the taxation policy. Finally a fourth part studies the role of economic policy in the very long run, when population size, pollution and land can be ultimate obstacles to growth.

A: Financing Schemes in Higher Education

Topic

Growing empirical evidence shows that higher education is an important element in national economic performance and in the distribution of personal incomes Becker & Nigel (1979), Restuccia & Urrutia (2004). But higher education is also costly and its financing is sensitive politically. In addition, the world-wide collision between expanding higher education and fiscal pressures has created a tendency for shifting larger parts of the costs towards the students. Yet, as most students cannot afford to pay for higher education, well-designed financing schemes are needed. In order to qualify for further considerations any such financing scheme should meet two objectives: firstly, it must offer adequate finance to all qualified individuals. And secondly, it should strengthen the overall accumulation of human capital for reasons of national economic performance. In short, the challenge is to finance higher education in ways that promote growth and welfare and, if possible, avoid an increase in the inequality of income distribution.

Financing schemes currently used in European countries involve a variety of loan contracts. Apart from government sponsored loans, the education system might, at least in part, rely on private finance. One example is finance through bank-intermediated loan contracts. The terms of repayment for these loans are not conditional on the students' future incomes and, therefore, do not involve any risk sharing component. Other examples include specialized private financial institutions offering customized financing schemes with income-dependent repayment. The terms of repayment depend on the prospects for the student's future income. Therefore, given competition in the market, the lending institution tries to identify these prospects as accurately as possible through records, tests, interviews, etc.

The goal of the project is a dynamic equilibrium analysis of financing schemes for higher education. A model will be studied that operates alternately under one out of a variety of financing schemes. Three examples for such financing schemes are

- (a) Scheme 1 (benchmark case): No customized financing is available. Individuals borrow at the ongoing market interest rate to finance their education.
- (b) Scheme 2 (government intermediated loans): Individuals obtain loans from the government. The repayments are *income-contingent* with terms being identical for all individuals.
- (c) Scheme 3 (private customized funding): Individuals obtain loans with income-contingent repayment. The terms of the loan contract reflect the future income prospects of the individual.

The return to investment in education is not deterministic but exhibits some randomness which is related to each agent's innate ability. Investment in education takes place when the individuals are young. At this time his/her ability is yet unknown but some (imperfect) information about the agent's talent is revealed through a signal (test outcome). This signal will be used as a screening device for assessing the individual's ability/talent. Such screening processes are routinely used in secondary and higher education, but also in the health sector and elsewhere, in order to identify individual characteristics which cannot be directly observed. The project studies the economic implications of each financing scheme, such as investment in formation of human capital and income inequality.

Recently, many countries in Europe have begun to reform their systems of higher education. In this process, it is expected that the screening mechanism governing admission to higher education will be improved. In addition, financial institutions offering customized education loans undertake efforts to upgrade their screening techniques in order to maintain a competitive edge in the market. As a consequence of better screening, more reliable information about the individuals' abilities becomes available and can be used for the allocation of scarce resources in the education sector (see Stiglitz (1975) for a discussion of the concept of screening information). Clearly, this type of information affects the private investments in higher education and skill acquisition and, thereby, it affects the accumulation process of human capital. For each of the financing schemes outlined above the project investigates how better information affects human capital accumulation, income inequality, and economic welfare in equilibrium.

State of the Art and Own Prior Work

Moving from public funding towards private funding of higher education generally induces a trade-off in terms of economic welfare which results from interacting efficiency effects and equity effects. Friedman (1955, 1962) was the first to raise this issue and to suggest income-contingent financing of students' investments in higher education. Friedman argues that the use of income-contingent loans for the finance of higher education is recommendable because it allows individuals to sell 'shares' in their random future income streams in order to finance their educational investments. These shares will be bought by investors who can 'diversify' their holdings through buying shares from many different agents with independent⁹ income risks. The diversification process drives down the expected return on the shares to the market rate of interest. This mechanism ensures that individuals can finance their educational investments on favorable terms, thereby avoiding an economy-wide underinvestment in education.

Friedman's suggestion is not explicit about the precise way in which the repayment should be linked to individual income. In particular, it is not clear whether all students should be offered the same terms of repayment or whether these terms might take into account certain individual characteristics which are correlated to an agent's future earning prospects. This aspect has been addressed in some more recent papers. Various forms of integrating income-sensitive elements into financing schemes for higher education have been discussed in Barr & Crawford (1998) and in Greenway & Haynes (2003). The design of student loan programs, repayment and debt defaults, as well as some international experience has been discussed by Woodhall (1988) and Lleras (2004). Albrecht & Zidermann (1993) provide evidence on loans collectibility and on the cost of such programs. The role of borrowing constraints for private investment in education has been studied by Glomm & Ravikumar (1992), Cameron & Tabler (2000), Card (2001), Keane & Wolpin (2001), Carneiro & Heckman (2002), and others.

Also, the effect of information and its qualitative implications have been studied in various economic models. Some studies have examined the value of information Blackwell (1953) in general equilibrium

⁹More precisely, Friedman (1955) is talking about individual incomes that are subject to risks which can be completely eliminated by pooling. This property is not always equivalent to assuming that individual income risks are independent.

frameworks [e.g., Hirshleifer (1971), Orosel (1996), Schlee (2001), Eckwert & Zilcha (2001, 2003, 2004)]. However this project is the first attempt to study the impact of information on human capital formation and income distribution in an endogenous growth model under different financing scenarios for higher education.

Expected Line of Progress

The main objective of the research is a better understanding of the interactions between various financing schemes in higher education and the performance of the economy. With regard to economic performance the focus is on the process of human capital formation and its implications for economic growth, distribution of incomes, and economic welfare. The aim of the project is to produce useful policy recommendations in support of the ongoing process worldwide to reform financing systems of higher education.

To the extent that reforms involve a shift towards privately financed investment in education, screening information about individual abilities will become an important element in the design of loan contracts and for individual investment decisions as well. The implications of changes in information systems are critically relevant for the incentives created by the various financing schemes. They are also relevant for the efficiency properties of the human capital formation process as higher aggregate investment in education does not necessarily result in a higher stock of aggregate human capital. For each financing scheme, we hope to identify conditions under which better information enhances the efficiency of the process of human capital accumulation.

Depending on the adopted financing scheme, in equilibrium only part of the individual future income risks will be hedged. The coexistence of insured risks and uninsured risks in combination with the fact that both risk categories are interrelated via the individual signals adds significantly to the complexity of a welfare analysis. New analytical tools are needed in order to cope with the problem of interrelated risk categories. Within the project such tools will be developed and we are confident that these techniques will be useful in other areas of economics as well.

B: Human capital, labor market imperfections and growth

State of the Art and Own Prior Work

With the publication of the paper by Lucas (1988) the role of human capital has become increasingly popular in building models of economic growth. The paper by Lucas, which is based on the one by Uzawa (1965), asserts that the accumulation of human capital is the major source of ongoing growth. Empirical research analyzing the role of human capital indeed seems to find supportive evidence for this view (see e.g. Krueger and Lindahl, 2001). It should also be pointed out that Levine and Renelt (1992) have demonstrated that human capital, measured by the secondary enrollment rate, is a robust variable in growth regressions. Because of that, building endogenous growth models with human capital as the engine of sustained growth is certainly justified.

As concerns the formation of human capital, one can find two approaches in the economics literature. On the one hand, there are approaches where human capital formation is only financed by the private sector and, on the other hand, there exist studies where only the public sector spends resources for the formation of human capital. In addition, there also exist contributions where human capital formation is the result of both public and private expenditures. For example, Glomm and Ravikumar (1992) and Blankenau and Simpson (2004) assume that human capital accumulation results from both private and public services. Glomm and Ravikumar present an OLG model with heterogenous agents where human capital accumulation is the result of formal schooling. They demonstrate that public education leads to a faster decline of income inequality whereas private education may lead to higher per-capita incomes. Blankenau and Simpson present an endogenous growth model with both private and public inputs in the process of human capital accumulation. They demonstrate that the response of growth to public education depends on the tax structure, on the level of government spending and on parameters of the production function.

On the other side, Ni and Wang (1994) and Beauchemin (2001) present models where human capital is the result of public spending alone. Ni and Wang also assume homogenous agents and present an OLG model where human capital is the result of public education which is financed by an income tax. Using calibration exercises they derive that the optimal income tax rate is in the range of six to ten percent. Beauchemin presents a political-economic OLG model of growth and

human capital accumulation where human capital accumulation is the result of public education. The paper demonstrates that a sufficiently rapid population growth may generate economic stagnation. In Greiner (2007) a growth model with public education and public debt is presented and analyzed. There, the question of how public debt and deficits affect human capital formation and economic growth is analyzed.

Expected Line of Progress

In this project the role of the government as concerns human capital formation, economic growth and welfare in economies is to be studied where different regions are considered. In addition, unemployment due to labor market imperfections is taken into account. It is this aspect that has been neglected in the preceding project but that is of high relevance for EU countries such as France, Germany and Italy, for example. Starting point of the analysis is the model by Greiner (2006), where effects of fiscal policy as concerns economic growth and welfare is studied. The present project, however, allows for unemployment that is due to imperfections in the labor market. The wage setting process is modeled as in Raurich et al. (2006) where unions set the wage such that the wage sum is maximized. There, the wage rate unions demand is a function of parameters and of the reference wage that depends on the average past labor income. In addition, labor market rigidities can be modeled by parameters that affect the wage adjustment rate.

The model consists of two households where one household supplies skilled labor, due to human capital formation, whereas the other household supplies low-skilled labor but benefits from human capital accumulation through spill-over effects. Households inelastically supply labor on the first and on the second labor market, respectively, and they both save a certain fraction of their income which is subject to the income tax. Both types of households may become unemployed but, if so, they receive unemployment benefits, thus providing income security for households.

The government pays unemployment benefits and pays transfers to the household supplying simple labor, besides financing human capital accumulation. In order to finance its spending, the government levies a distortionary income tax rate. The firm demands two types of labor: skilled labor on the first labor market that is supplied by household one and simple or low-skilled labor on the second labor market, supplied by household two, which receives a lower wage rate. The firm maximizes profits so that the marginal products of labor equal the wage rates, respectively, implying that there are no restrictions for the firm as concerns hiring and firing.

The approach is extended by allowing for different regions, on the one hand, and by explicitly differentiating between skilled and unskilled labor in the production function for each region. While human capital, i.e. skilled labor, is mobile, unskilled labor and capital are fixed in a first step. The approach by Burda and Wyplosz (1992) may serve as a starting point for this model. In the latter model, which is basically a static one, it is assumed that two regions, East and West, differ as concerns their endowment with human capital. The paper, then, analyzes the optimal allocation of human capital and compares it to the outcome of the market economy.

The goal of this project consists in analyzing how fiscal policies as well as labor market rigidities affect growth, welfare and distribution. Further, effects of regional policies as concerns growth and migration in different regions is to be studied. As concerns governmental policies, in particular the effects of unemployment benefits and of social transfers are to be analyzed. In addition, the growth and welfare maximizing distortionary income tax rate is to be derived and effects of allocating public resources in the educational sector are of relevance. Thus, we intend to derive policy recommendations that can foster economic growth and welfare in market economies. In addition, effects of fiscal policy as concerns stability of the economy are studied since it is well known that the government can be decisive for stability in this class of models (see e.g. Greiner, 2008). Hence, the question of whether a balanced growth path exists at all and whether it is stable is to be addressed. If the model turns out to be stable it is interesting to know whether it is locally determinate or indeterminate.

C: The role of taxation on fluctuations and growth

In this part of the project, the stabilizing and redistributive role of fiscal policy are studied in economies with infinitely-lived heterogeneous agents. The fiscal and dynamic implications of heterogeneity are

crucial issues that have been only partially addressed in the economics literature (Sarte, 1997, Sorger, 2002). On the one hand, consumers' heterogeneity naturally entails a variety of saving behaviors and the emergence of classes of borrowers and lenders, especially in the presence of heterogeneous discount factors (Becker, 1980). On the other hand, taking into account heterogeneity is a way to explain the persistence of wealth and income inequalities, and their impact on the capital accumulation process and the aggregate production. Eventually, consumers' heterogeneity can be viewed as a potential source of fluctuations. All these different aspects constitute powerful arguments to motivate a deeper analysis of the role of fiscal policies in economies with heterogeneous agents, and their effects on fluctuations, growth and inequalities.

Consumers' heterogeneity can be a source of endogenous fluctuations in economies with borrowing constraints, as it is stressed, for instance, by Becker and Foias (1987) and Sorger (1994) among the others. A fiscal policy incorrectly designed could promote persistent fluctuations. Therefore, it seems relevant to investigate the (de)stabilizing role of fiscal policies that differentiate capital and labor incomes within a population which is endogenously segmented in two classes of capitalists and workers, and supplies elastically labor supply. Progressive tax rules will surely play a crucial role in reducing or creating macroeconomic volatility.

A fiscal policy affecting capital income does not have the same impact on the capital accumulation path than a taxation focusing mainly on labor. This is particularly true in economies with heterogeneous consumers, where the variety of saving behaviors matters to determine the growth. Fixing the appropriate tax rates and designing the degrees of progressivity in both types of taxation could turn out to be crucial in order to implement the best achievable growth path, depending on the heterogeneous households' preferences. All these elements can be conveniently studied in a framework where growth is endogenously driven by productive externalities of public spending (Barro (1990)). This type of analysis should also be extended to the case where public spending affects consumers' welfare.

The redistributive role of a fiscal policy has always been important for its implementation. For example, a well-shaped fiscal policy can, on the one side, promote the reduction of social inequalities but, on the other side, slow down growth, by constraining the underlying mechanism of capital accumulation. To study this issue, the link between inequalities and growth should be theoretically specified (see, for instance, Garcia-Penalosa and Turnovsky (2006)). Then, one should understand how a non-linear differentiated taxation could affect the interplay between these phenomena, by lowering the inequality level without worsening growth, or enhancing growth without promoting the pauperization of a part of the population.

D: Population and economic policy in the long run

In a very long-run perspective, population size is an important variable for economic policy. The first part of this project pointed out the role of human capital on growth: quality of population matters for growth. In the very long run, the size of population can be a limit to growth. For example, if there exist non-renewable resources or fixed factors (land), there may be limits to population growth, and it becomes necessary to arbitrate between population size and well-being. Growth of output and population can also be viewed as harmful for ecological environment and health. So it is thinkable that land and environment are ultimate limits to economic expansion.

This issue is not new, since it was already debated following the recommendations of the club of Rome in the 70's. It seems useful to revisit this issue for two reasons. On the one hand, the evolution of the world has often contradicted alarmist vision of the Club of Rome, and its emphasis on the limits of growth. Concerning population, most of developing countries have experienced their demographic transition, in many cases without any anti-nationalist policy. On the other hand, recent works in economic theory on the border with demography allow taking into account the role of population in an economic framework. Population is viewed as an endogenous variable that interacts with the economy and environment.

A theoretical analysis will be developed, using the following assumptions. First, fertility behaviors are viewed as endogenous, in accordance with all the literature developed following Becker and Lewis (1973). Secondly, environmental degradation is linked to production. As production depends itself on the size of population and on the amount of capital, it depends on both the size and the wealth of the economy. Finally, environmental degradation worsens the well-being of individuals, and their life expectancy.

Using this theoretical framework, two issues will be addressed. The first one is concerned with the definition of a social welfare criterion in a framework of endogenous population. If the definition of social welfare functions gave birth to a lot of works from John Stuart Mill and Jeremy Bentham, these works mostly considered population as an exogenous variable. The definition of such a criterion when population size is endogenous is difficult, as it becomes possible to arbitrate between the number of agents and the welfare of each of them. On the question of efficiency with endogenous fertility, Golosov, Jones and Tertilt (2007) provide a very complete analysis. On the problem of a social welfare criterion, Razin and Sadka (1995) give some interesting ideas that could be developed.

A social welfare criterion being available, the second question is the decentralization of the social optimum through appropriate economic policies. Within the framework that is studied, there are several externalities which may imply for the economic equilibrium to be under-optimal. Environment is a first externality, which can lead to under-optimal behaviors concerning fertility and capital accumulation. The impact of environment on health is a second externality which may need government intervention. A set of incentive policies could be defined, in order decentralize the social optimum.

Dissertation Projects

1. Information systems and economic welfare in equilibrium
2. Information in models of human capital accumulation
3. Interactions between information systems and financial market systems
4. Generalization of information concepts and application to problems of human capital formation and income inequality
5. Distribution and Endogenous Growth with Skill Heterogeneities
6. Fiscal Policy and Economic Growth with Heterogenous Agents and Labor Market Imperfections
7. The Dynamics of Endogenous Growth Models with Human Capital and Heterogenous Labor
8. Distribution and Welfare with Heterogenous Agents and Public Education
9. Regional policies and economic growth
10. Population dynamics, migration and economic growth

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