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Optimal higher education enrollment and productivity externalities in a two-sector model

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ABSTRACT

We analyze the optimal share of the skilled workforce over the course of development with two sectors using skilled and unskilled labor respectively, and technological spillovers from higher education enrollment. Productivity in each sector depends on the average quality of workers and the size of the workforce. When skill-biased technological change prevails, this structure of externalities coupled with the endogenous ability sorting of workers may well produce a pattern of overenrollment in early and late stages of development and underenrollment in between. Our normative analysis is followed by a positive analysis exploring how policy would differ under alternative political objectives.

1. Introduction

Is the number of college graduates in the population too high or too low? Over the last decades, the number of workers who hold an academic degree has increased tremendously. Nowadays, around 40% of a birth cohort graduate from a theory-based program of tertiary education in OECD countries, ranging from graduation rates around 20% in Chile, Mexico and Turkey to rates exceeding 50% in Iceland, New Zealand, Poland and the United Kingdom (OECD, 2013, Chart A3.2). High and even increasing skill premia in terms of lifetime income for people holding academic degrees in recent decades (Acemoglu, 2002; Mitchell, 2005), even in many developing countries (Ripoll, 2005; Goldberg and Pavcnik, 2007), underpin this trend. On the other hand, there are worries about future shortages of semi-skilled workers like nurses and technicians, raising doubts about whether or not the current share of students in higher education is already detrimental for growth or welfare. From a theoretical perspective, overeducation arises if the present value of the productivity gain for the marginal, least talented, individual, corrected for possible externalities, falls short of the education cost. As this requires to predict the future evolution of the productivity of the marginal individual, overeducation is hard to identify. Indeed, hinting to the average skill premium is not convincing because it will substantially exceed the productivity increase of the marginal individual. The phenomenon of overeducation has been discussed in the empirical literature, though not in a conclusive way (Sicherman, 1991; Büchel, 2003; Chevalier, 2003). They are looking at individuals being employed in an occupation that does not require the actual formal qualification of the worker at some given point in time. However, this observation does not necessarily indicate overeducation. It may easily go along with a substantial positive return to human capital investment in higher education in a lifetime perspective.

This paper addresses the question of which pattern of overenrollment and underenrollment can be expected over the course of development. Our notion of overenrollment (or overeducation) refers to social returns of education falling short of private returns. Unlike the concept of overeducation in the microeconometric literature, pointing to low private returns ex post, education always pays off for the marginal individual in the market equilibrium. However, other individuals in the different sectors of the economy may lose or benefit due to the increase in the enrollment rate at the margin. In principle, there are various possible sources of over- and underenrollment. First, costs and returns may be distorted. For example, the cost of acquiring skills may be subsidized or the returns are partially appropriated by employers

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or, through taxation, by the government. Second, the deviation of private and social returns arises due to technological externalities, which is the main feature of our model.

The arguments from the literature and the stylized facts suggest a move from underenrollment in some intermediate stage of industrialization to overenrollment in advanced economies. Underenrollment at intermediate stages seems a prevalent phenomenon in view of many contributions stressing borrowing constraints (eg Galor and Zeira, 1993; Gary-Bobo and Trannoy, 2008) and estimates suggesting that social returns to education are considerably higher than private returns in less advanced stages of development (Psacharopoulos, 1981, 1994). We try to explain this pattern within a simple structure of production externalities that are stationary in terms of parameters describing the externality, where the growth process is driven by some exogenous skill-biased technological change. When dealing with the issue of whether undereducation or overeducation prevails, our focus lies on externalities of the enrollment decision. We discuss why market forces lead to overinvestment or underinvestment in higher education, justifying government intervention in that sector. Though only a minority of the population takes tertiary education, it is subsidized to a large extent in many countries, where policies toward tuition fees are far from uniform. While tuition fees are either negligible or even absent in many continental European countries, they can take values clearly exceeding average cost at several US universities. In the absence of market failures, standard considerations state that individual decisions to study will not be distorted with a proportional income tax when the subsidy rate of the direct cost coincides with the income tax rate (Trostel, 1993; Nielsen and Sorensen, 1997). This is true as the income tax reduces the returns to education and its opportunity cost by the same factor. Overenrollment can easily turn out in the absence of externalities if an almost proportional income tax is matched with heavy subsidization of tuition. This may reasonably well describe the current policy parameter settings in many European countries, taking account of coexisting progressive income taxes, social insurance contributions and income transfer withdrawal rates.

Our contribution focuses on externalities suggested by endogenous growth theory. Individuals are differentiated according to ability, which translates into differences in the cost of acquiring a university degree. Such a heterogeneity can be attributed to direct costs, like need for additional tuition, opportunity costs, e.g. need to repeat some exams, or even psychic costs, as learning with lower ability will be harder. Although our formulation describes such psychic costs, generalizations would be straightforward. The structure of our model builds on the analyses of educational standards by Costrell (1994) and Betts (1998), using a similar mechanism of sorting by ability. Having asymmetric information on individual productivity as source of market failure, their focus rests on political economy perspectives of the choice of the standard. By contrast, we are concerned with net impacts of technological externalities over the course of development. Moreover, we show that the government generally would like to affect enrollment by additional instruments even if the quality standard of education is optimally set.

We embed the endogenous enrollment decision in a simple model of a production economy with two sectors employing one type of labor – either skilled or unskilled – together with skill-specific technologies. In the basic model, we abstract from neoclassical scarcity effects from diminishing returns as they will typically not be a source of an externality. We also ignore the argument that when it comes to bargaining at the individual level, workers will only get a share of the productivity gain by education or training, thus pointing to underinvestment in human capital (Acemoglu, 1996; Acemoglu and Pischke, 1999).

Two main sources of market failure are considered, (i) an average human capital externality, and (ii) a size externality. Productivity in each sector depends on average human capital of the workers in the spirit of Lucas (1988). When the marginal individual decides to go to college, he disregards that average human capital will go down in each sector. This average human capital externality is clearly a source of overeducation from the point of view of a social planner. Similar overenrollment phenomena would occur if marginal workers face strong incentives when all workers passing an academic exam are paid the same wage (Costrell, 1994), or if in a matching framework investment of firms goes down when average human capital levels in each education group declines (Charlot and Decreuse, 2005). Productivity of a sector also depends on the size of the sector, which may reflect learning by doing or productivity gains through improved division of labor (Arrow, 1962; Lucas, 1988).[3] When enrollment in higher education increases, the skilled sector becomes larger and the unskilled sector becomes smaller. Hence, there is a negative externality on the unskilled sector and a positive externality on the skilled sector.

Over the course of development, the size of the skilled sector tends to grow, for example due to skill-biased technological change. The structure of externalities coupled with the endogenous sorting of workers in the two sectors may give rise to a pattern of overinvestment in education in early and late stages of development and underenrollment in between. Such an outcome can easily occur owing to endogenously changing relative weights of the externalities. While negative size and quality effects on the unskilled sector dominate in early stages, and negative quality effects on the skilled sector are particularly strong in late stages, the positive size externality in the skilled sector may turn out to be the key factor in between.

Next, we go beyond the normative approach by investigating the impacts of alternative political environments. Our analysis is qualified to some extent, as non-welfarist governments will also distort enrollment decisions. If the government aims at maximizing aggregate income ignoring costs of acquiring education, the resulting enrollment rate will be higher than under welfare maximization. Conversely, an egalitarian government will restrict access to higher education so as to avoid an income reduction of the poor. In a majority vote environment, this is also true when the unskilled are the majority, while the opposite may happen in late stages of development.

Using a more general production structure implies additional sources of externalities. A CES production function environment allows for substitutability between skilled and unskilled workers, where spillover effects occur that work through relative prices of the skilled and the unskilled goods. Should the quality of higher education (or a productive academic standard) be endogenized, we show that it makes sense to optimize both quality and the enrollment rate separately so as to maximize the aggregate macroeconomic net return to education. Finally, positive intertemporal spillovers of enrollment can be relevant if the future level of technology depends on the current number of college graduates.

The remainder of the paper is organized as follows. Section 2 introduces the model, and Section 3 deals with its equilibria and comparative statics. Optimal enrollment is discussed in Section 4. The following two sections deal with alternative frameworks and extensions, where Section 5 focuses on the political sphere, and Section 6 considers generalizations of the production technology. The final Section 7 concludes and indicates directions for future research.

2. The model

2.1. Individuals and wages

Each individual lives for one period. Upon learning her ability type, she chooses whether or not to enroll in higher education. All university students graduate and work in the skilled sector, the other individuals work in the unskilled sector. Individuals are heterogeneous in ability a. For simplicity, let ability a be uniformly distributed on [0,1]. The

[3] For empirical evidence on agglomeration economies, stressing a positive correlation between productivity and size of an industry, see Ciconne and Hall (1996), and Combes et al. (2012).