Which education policies can prevent the collapse of the middle-income group?

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A R T I C L E   I N F O

A B S T R A C T

This study addresses the issue of widening income inequality and evaluates elementary and higher education policies. Unless education policy increases the level of elementary education more rapidly than that of higher education, it will become more difficult to prevent the collapse of the middle-income group because of the increasing price of education. This collapse of the middle-income group would subsequently decrease the levels of income for all individuals. Whereas education policy affects the levels of both elementary and higher education, elementary education policy should precede higher education policy as long as the direct effect of policy outweigh the indirect effect.

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1. Introduction

By considering some features of education, this paper addresses the issue of widening income inequality in Japan. Elementary and junior high school education is compulsory in Japan. Nearly all children in a particular region tend to attend the same public school.[1] Although public expenditure on education in Japan is relatively low, at least when compared with other developed economies, the Japanese government is endeavoring to cut its expenditure on elementary education because of the considerable increases in expenditure on the elderly and government debt. Because of the increases in expenditure on supplementary private education and university education, the burden on household budgets has been increasing. The increasing cost of education naturally puts the children of rich parents at an advantage when applying to well-known universities. Further, the number of university students who need scholarships has been increasing.[2]

Thus, it is worthwhile to investigate the effects of elementary and higher education policies on income inequality and economic welfare when the cost of education increases. In the study, we consider the elementary and higher education sectors.[3] Initially, there are three income groups, namely poor, middle-income, and rich groups. We posit that individuals in the poor group, unlike the middle-income and rich groups, cannot initially access higher education. The initially higher education level of the rich group is also higher than that of the middle-income group. We make two major assumptions. First, we consider the level of education positively depends on the human capital level of teachers and the ratio of teachers to students with the diminishing returns of teachers. It implies an increase in the average level of higher education

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[1] In 2011, public elementary school students accounted for 98.6% of all elementary school students. The corresponding figure for junior high school students was 93.2%.

[2] In Japan, almost all junior high school graduates progress to high schools. About half of high school graduates progress to university, of whom about three-quarters enroll at private universities. However, the rate of advancement to universities is now beginning to decline.

[3] We consider university education including graduate schools as higher education.

increases the price of education. Second, we allow for zero expenditure on higher education. This assumption does not necessarily imply a convex educational expenditure with respect to the higher education level of parents, while the convex expenditure is crucial to widening income inequality.

In our model, increasing demand for higher education increases the price of education because of the diminishing returns of teachers. An increase in the level of elementary education increases the basic income level, but decreases the price of education because higher education progresses well with a high level of elementary education. When the average level of higher education increases more rapidly than the level of elementary education, the price of education increases more rapidly than the basic income level and education expenditure becomes convex with respect to the higher education level. Since a large demand by rich individuals increases the price of education, middle-income individuals are eventually unable to keep pace with the increase in the price of education. As the collapse of the middle-income group increases the share of the poor group in the population, the income levels of all individuals will decline because of a decline in the level of elementary education.[4]

Because of the connection between elementary and higher education, education policy affects the levels of both elementary and higher education. However, even if education policy succeeds in temporarily increasing the levels of education, unless the level of elementary education increases more rapidly than the level of higher education, the steady-state levels of both elementary and higher education would decline because of the collapse of the middle-income group.

To begin with, we posit the following. First, this study relates to a literature that explores the effect of education systems on income inequality and growth (see pioneering works, Glomm and Ravikumar, 1992; Bénabou, 1996, 2000, 2002). We explicitly consider both the elementary and higher education sectors along with the price of education. In our model, the race between the levels of elementary and higher education plays a crucial role in the dynamics of the income distribution. Only if the level of elementary education increases at a faster rate than that of higher education can education policy effectively prevent the collapse of the middle-income group and assist poor individuals to escape poverty with a positive feedback mechanism between the levels of elementary and higher education. Further, this would be beneficial, even for the rich group, because public elementary education plays the role of a public good.[5]

Next, this study explores the role of public elementary education when the cost of higher education increases. Galor and Moav (2006) showed that elementary education for the masses would be important for an industrializing economy because of capital-skill complementarity and diminishing returns in education (see also Maoz and Moav, 2004; Koutentakis, 2012). We show that even when many individuals receive higher education, public elementary education plays a crucial role in preventing the collapse of the middle-income group.[6]

The remainder of the paper is organized as follows. Section 2 explains our model. Section 3 examines the dynamics of the levels of elementary and higher education. Section 4 evaluates education policy. Section 5 provides some concluding remarks.

2. Model

We assume individuals live for two periods. In the first period, all individuals receive equal elementary education. They can receive higher education if their parents can afford it. In the second period, individuals with no higher education work as unskilled laborers, whereas individuals who received a higher education work as skilled laborers. We consider three income groups in which the rich, middle-income, and poor groups are represented as r, m, and p, respectively. We assume that $e_{r,-1}^h > e_{m,-1}^h > 0$ and $e_{p,-1}^h = 0$, where $e_{i,-1}^h$ ($i = r, m, p$) is the initial higher education level of the ith individual. The ratios of rich, middle-income, and poor individuals to the population in period t are, respectively, represented as λ_{rt}, λ_{mt}, and $1 - \lambda_{rt} - \lambda_{mt}$. The population of each generation is represented as N.

2.1. Education sectors

We first describe the elementary education sector. Every child receives elementary education. The government employs teachers to supply elementary education. We assume those individuals with the highest education level are teachers. Thus, teachers are both rich individuals and skilled laborers. We assume the production function for elementary education is of the following type:

$$e_t^e S_t^e = (A^e q_{rt-1} L_t^e)^\gamma (S_t^e)^{1-\gamma}, \tag{1}$$

where $0 < A^e$ and $0 < \gamma < 1$. Here, e_t^e is the elementary education level, S_t^e is the number of students in elementary education ($S_t^e = N$), q_{rt-1} is the level of human capital of rich individuals formed in period $t-1$, and L_t^e is the number of elementary education teachers.

When the human capital of a teacher is high, and the number of teachers is large, education progresses well. Students also contribute to educational outcomes because of the collaboration between students and teachers.[7] Eq. (1) is rewritten as:

$$e_t^e = (A^e q_{rt-1} x_t^e)^\gamma, \tag{2}$$

where $x_t^e \equiv L_t^e / N$. Here, x_t^e is the ratio of teachers to students at the elementary education level.

Thus, in the supply of elementary education, there are the diminishing returns of the human capital level of teachers and the ratio of teachers to students. The government funds elementary education by paying wages to teachers from the income tax collected:

$$\lambda_{rt} N \tau I_{rt} + \lambda_{mt} N \tau I_{mt} + (1 - \lambda_{rt} - \lambda_{mt}) N \tau I_{pt} = w_{st} q_{rt-1} L_t^e, \tag{3}$$

where we assume that $0 < \tau < 1$. Here, I_{it} ($i = r, m, p$) is the income level of the ith individual, τ is the income tax rate, and w_{st} is the wage rate of skilled laborers.

Eqs. (2) and (3) imply that an increase in the tax revenue can increase the level of elementary education through an increase in the ratio of teachers to students.

Next, we consider the institution of higher education. The production function for higher education is as follows:

$$e_{at}^h S_t^h = (A^h q_{rt-1} L_t^h)^\alpha (e_{et} S_t^h)^{1-\alpha}, \tag{4}$$

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[4] The level of education includes the quality and quantity of education. The result that all middle-income individuals merge with the poor group would be an extreme prediction of the future Japanese income distribution. While the result depends on the presumption of a single educational institution, we can consider the modification of our model. See Section 4.

[5] Nakajima and Nakamura (2009, 2012) and Nakamura (2013) also examined widening income inequality. However, neither of their studies examined education policy and the feedback mechanism between elementary and higher education.

[6] In our model, a high level of elementary education implies a high intergenerational earning mobility. See Maoz and Moav (1999).

[7] See Rothschild and White (1995). Tamura (2001) also considered teacher quality and class size to examine the conditions for convergence. In our model, the assumption that teachers are rich individuals is not crucial on the result because we also consider the number of teachers in the supply of education.