Does mobility of educated workers undermine decentralized education policies?

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The paper studies a multi-jurisdictional framework in which, from a federal perspective, educational subsidies turn out to be efficiency enhancing. However, in the presence of mobile high-skilled labor, local jurisdictions might try to free-ride on other regions’ education policies and abstain from subsidizing education. Social mobility is introduced as an additional dimension of labor mobility. Using this framework, it is shown that local governments abide by the optimal decision rule for subsidizing human capital investments. Hence, decentralized education policies remain to be efficient, although high-skilled workers are perfectly mobile. Only if one allows for high- and low-skilled mobility, local incentives to promote education vanish.

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1 Motivation

In the course of economic integration, mobility of the labor force has increased considerably due to a rapid decline in transaction costs. Administrative or legal barriers have been reduced in highly integrated regions such as the European Union, while language or cultural obstacles to migration are of minor importance in federal states. Moreover, the mobility of labor increases with the skill level as specialized skills of highly educated workers may be locally less demanded and, hence, require searching a geographically larger labor market. In view of the high mobility especially of skilled labor, benefits resulting from local investments in education do not necessarily accrue to the region of origin. Therefore, public incentives to promote mobility enhancing education might be limited. Rather, it seems to be tempting to attract skilled labor from abroad using a favorable tax system and free-ride on other regions’ education policies. Hence, high-skilled mobility can be problematic for decentralized fiscal policies.

The present study analyzes this free-rider problem at the level of local jurisdictions in a setup that allows for social mobility across skill types. Individual underinvestment in education provides a rationale for educational subsidies from a federal point of view. Local governments, however, might refrain from subsidizing education in the presence of high-skilled migration. Since the size of the educated workforce available in the respective jurisdiction is no longer determined by domestic educational investments but by migration flows, local governments might lose the incentive to correct private underinvestment. This suggests that decentralized education policies are inefficient, and educational subsidies have to be provided at the federal or supra-national level. Yet, local governments do engage in education policies and subsidize especially early education substantially. The present analysis provides an explanation for this phenomenon and shows that local governments do not free-ride on other regions’ education policies, even though high-skilled workers are assumed to be perfectly mobile.

Most previous studies stress an efficiency enhancing aspect of migration that implies a reduced need for public policy. Surprisingly, the recent literature on the brain drain has emphasized this point in various studies. The welfare improving impact of migration in new approaches to the brain drain rests on the observation that an exogenous increase in the migration probability of high-skilled labor fosters private educational investments as in Stark et al. (1998). Starting from a situation of educational underinvestment that is induced by externalities, increasing the probability to emigrate raises private incentives to accumulate human capital and, hence, promotes welfare. Since educational underinvestment provides a rationale for public intervention, migration can even function as a substitute for subsidies in education (Stark and Wang, 2002).

1The possibility of an efficiency enhancing brain drain on the basis of a probabilistic approach to migration has been discussed in models with underinvestment due to production externalities (Stark (2004); Mountford (1997)) as well as intergenerational transmission of knowledge (Beine et al. (2001); Vidal (1998)).
Similar to new approaches to the brain drain, migration can enhance efficiency in a setup in which private underinvestment results from uncertainty. Wildasin (2000) considers a framework in which high-skilled workers possess industry-specific human capital. This implies that qualified labor is intersectorally immobile and, therefore, exposed to earning risks. If education is privately financed and wage risks are uninsurable, globalisation that raises the geographical mobility of high-skilled labor provides full insurance of the involved income risks. As a consequence, investments in human capital increase to an efficient level.

At the same time, migration can restore efficiency in a setup where educational subsidies are used to overcome a hold-up problem of time-inconsistent taxation. Andersson and Konrad (2003a,b) argue that alternatively allowing for mobility of labor reintroduces the elasticity of the tax base and serves as a commitment device for low tax rates. Against this background, they determine the welfare effects of globalisation when education is risky.

The studies cited above suggest that an increase in labor mobility should be accompanied by a decline in public investments due to a reduced need for fiscal policies. The present research does not intend to cast doubt on this efficiency enhancing effect of migration. Yet, it is presumed that mobility of high-skilled workers will most likely not entirely restore efficiency. If migration fails to exactly offset the inefficiencies, private underinvestment persists. This calls for public policies to correct the underlying market failure. However, from the point of view of a small jurisdiction facing migration of highly educated workers, the size of the high-skilled workforce available depends on migration flows alone and not on previous local investments in education. Therefore, the possibility to free-ride on other regions’ educational investments arises, and decentralized policies in the presence of labor mobility might not be efficient anymore. As Sinn (1997) puts it, fiscal competition reduces the incentives of governments to correct market failures.

The above-mentioned study by Wildasin (2000) additionally considers the case of public investment in human capital. It is shown that if education is financed publicly, tax competition for high-skilled workers results in public underinvestment. Hence, decentralized education policies turn out to be inefficient. Similarly, Justman and Thisse (1997, 2000) develop a model in which the number of school places and, consequently, the supply of skilled workers is entirely determined by public instead of private investments. Their analysis demonstrates that mobility of high-skilled labor induces underprovision of public education if regions interact strategically. To restore local incentives for public provision of education, a system of interjurisdictional transfers based on migration flows

\[\text{Wildasin (2000) analyzes the effect of high-skilled labor mobility for the case of private as well as public investments in education.}\]

\[\text{In a comparable approach, Poutvaara (2000, 2001) model wage-tax financed educational transfers to students as an insurance against regions-specific shocks. Against this background, the trade-off between the efficiency enhancing effect of mobility and the possible erosion of local tax policies due to tax competition is assessed.}\]
is suggested.

The cited studies on education policies in the presence of migration conclude that government activity in this area will decline if mobility rises, either due to a reduced need for fiscal intervention or due to diminished incentives to correct market failures. Hence, they fail to explain why education is still subsidized substantially even at the local level. The focus of the present study lies on the incentives of local jurisdictions to correct underinvestment in education, while positive efficiency enhancing effects of migration at the private level are ignored. This research contributes to the literature as it develops a dynamic framework capable of integrating social mobility as an additional dimension of labor mobility. Consequently, lacking governmental support of education cannot be compensated by immigration as it additionally affects the number of immobile low-skilled workers in a respective region. As a result, local governments stick to the optimal decision rule for subsidizing education despite of the mobility of educated workers, and decentralized decision making remains to be efficient.

Only if one allows for high- and low-skilled mobility, local incentives to correct the underinvestment problem vanish as education policies neither affect the size of the domestic high- nor of the low-skilled workforce. This implies that private underinvestment in education persists. To correct the market failure and establish the social optimum in a decentralized setting in which both types of workers are perfectly mobile across regions, a federal matching grant can be used. However, such a federal matching grant effectively assigns the education policy to the federal or supranational level.

The paper is organized as follows: In Section 2, the basic model setup is described with a special emphasis on the educational process and the migration dynamics. Section 3 and 4 derive the optimal fiscal policies a unitary state government chooses and discuss what policy instruments are needed to decentralize the welfare optimum. Firstly, the case of perfect mobility of the educated workforce is considered, and then migration of high- as well as low-skilled labor is allowed for. The last section concludes.
2 The Model

Consider a federal economy with a large number of small local jurisdictions $i = 1, ..., m$. Each of these jurisdictions represents a local tax authority that can raise lump-sum taxes to finance educational subsidies, given the fiscal policy decided by the central government. Initially, and before any migration takes place, the population of region $i$ consists of a fixed number of high-skilled ($N^H_{0,i}$) and low-skilled households ($N^L_{0,i}$). Moreover, the federation is populated by successive generations. Every household or parent has one offspring and invests an amount $e^i_n$ in the education of this child, where $n = H, L$ indicates the respective type of the parent. This educational investment determines the child’s probability of becoming high-skilled. Thus, while the overall size of the population is fixed over time with $\bar{N} = \sum_{i=1}^{m} (N^H_{t,i} + N^L_{t,i}) \forall t \geq 0$, the evolution of types depends on the regional investments in education.

The timing of events is as follows: The central government moves first, deciding on the sequence of fiscal policies that maximizes the welfare of the aggregate federal population. It is assumed that the federal government has access to a commitment technology that fully binds it to the announced tax policy. The local governments move next, behaving like small open economies when choosing the sequence of regional tax rates, followed by private agents, who take all tax rates as given.

The basic model setup follows Boadway et al. (2003), who analyze fiscal equalization in a static model with two types of mobile labor. Their work is extended to a dynamic framework with successive generations and an endogenous human capital formation process to study the consequences of labor mobility for optimal education policies. The production of human capital is based on a setup suggested by Cremer and Pestieau (2006). In their model, the educational success is determined by an endogenously derived probability of becoming high-skilled. In the present research, this is interpreted as social mobility which reflects the fact that children of both low- and high-skilled parents face a positive probability to become high-skilled themselves.

2.1 Regional Production

In every period $t \geq 1$, firms produce a single aggregate good that can be used for consumption and investments in education. Labor is the only input factor with high-skilled ($N^H_{t,i}$) and low-skilled households ($N^L_{t,i}$) being perfect substitutes. Households supply $z^n$ efficiency units of labor inelastically, with $n = H, L$ denoting the respective skill group, and it is assumed that high-skilled labor is more productive ($z^H > z^L$). Aggregate effective labor supply can be written as $Z_{t,i} = z^H N^H_{t,i} + z^L N^L_{t,i}$.
Firms in every region have access to the production function \( F(Z_{t,i}) \) with \( F'(Z_{t,i}) > 0 > F''(Z_{t,i}) \). As an example one can think of the following production technology

\[
F(Z_{t,i}) = (Z_{t,i})^\alpha
\]  

(1)

where \( 0 < \alpha < 1 \) denotes the production elasticity of labor. Labor markets are competitive, therefore the wage rate equals the marginal product of labor.

As the production function exhibits decreasing returns to scale, local rents arise. The rent income of region \( i \) is given by \( R(Z_{t,i}) = F(Z_{t,i}) - Z_{t,i}F'(Z_{t,i}) \) with \( R'(Z_{t,i}) = -Z_{t,i}F''(Z_{t,i}) > 0 \). It is assumed that these rents accrue to the regional government.\(^4\)

### 2.2 Central and Local Governments

Both the central and the regional governments are benevolent in the sense that they maximize the sum of their residents’ utility, discounted over all periods. In other words, governments care about the aggregate welfare of each parent generation living in the respective region. The central government has access to a federal lump-sum tax \( \theta_{n,t,i} \), which can be differentiated both across regions and across skill-types. Furthermore, it can choose a skill-specific matching grant \( \theta_{n^t,et,i} \) paid to regions for every unit invested locally in education. The budget constraint of the federal government can be written as

\[
\sum_i \sum_n N_{t,i}^n \left( \theta_{n,t,i}^n - \theta_{n^t,et,i}^n e_{n^t,t,i} \right) = 0.
\]  

(2)

The set of available tax instruments at the local level of government is restricted to a skill-specific head tax on residents \( (\tau_{n,t,i}^n) \) and a skill-specific educational subsidy or tax \( (\tau_{n^t,et,i}^n) \). The budget of a representative jurisdiction \( i \) additionally includes the regional rent and the federal matching grant,

\[
\sum_n N_{t,i}^n \left( \tau_{n,t,i}^n - [\tau_{n^t,et,i}^n - \theta_{n^t,et,i}^n] e_{n^t,t,i} \right) + R(Z_{t,i}) = 0.
\]  

(3)

\(^{4}\text{This can be justified by the implicit assumption that either the local jurisdiction is the owner of the fixed factor who generates the rents, or that it has access to a rent tax to fully appropriate the pure profit.}\)
2.3 Household Behavior

Following Cremer and Pestieau (2006),\(^5\) successive generations of two types of labor, namely low-skilled \((N_{Lt})\) and high-skilled \((N_{Ht})\), are assumed.\(^6\) Each of these workers has one offspring and is, hence, also referred to as a parent. Parents invest an amount \(e^n_i\) in the education of their children and thereby determine the probability of their child to become high-skilled, \(h(e^n_i)\) with \(h^n_0 > 0\) and \(h^n_{ee} \geq 0\). While young, children undergo education, but only enter the model explicitly when old, that is, once they have completed their education and start working as either high- or low-skilled. Note that individuals do not decide on their own education, but only on the amount invested in their children. Thus, the model rather depicts basic or early education as compared to college or university education.

The probability to become high-skilled and, thus, high-productive is derived endogenously as a function of the different educational investments of the respective type of parent: The probability to become high-skilled is \(h(e^H_i)\) if parents are high-skilled, and \(h(e^L_i)\) if they are low-skilled. Since children of high- and low-skilled parents both face a positive probability of becoming high-skilled, the model allows for social mobility across skill types.

However, in the absence of any fiscal policy, children of high-skilled parents face a higher probability of becoming high-skilled themselves. This is due to the fact that high-skilled parents are more productive and earn a higher wage income. Consequently, they spend more resources on education than low-skilled parents do. As the amount invested by parents is determined by the net earnings realized by the respective type, social mobility is contingent on the productivity and eventually on the educational background of parents. Therefore, the model additionally captures intergenerational earnings persistence which can, however, be reduced using educational subsidies.

The proposed framework replicates basic findings of the recent literature that stress the importance of early investments in shaping the cognitive ability of children that in turn determines their future educational success as well as their income prospects. Restuccia and Urrutia (2004) calibrate a model in which innate ability, acquired ability, based on parental investments in early education, and college education determine the probability of successful college graduation. They show that parental investments in education, especially early education, account for nearly one-half of the observed inter-generational earnings persistence. This evidence suggests that social mobility can be increased substantially by the provision of educational subsidies on private investments in early education. Additionally, Carneiro and Heckman (2002) stress the importance of long-run factors to explain the positive correlation between college enrolment and

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\(^5\) Cremer and Pestieau (2006) consider an immobile workforce and study optimal education policies when private investment, which can be supplemented by public investment, is not observable.

\(^6\) The region index \(i\) is suppressed for the moment.
family income. They argue that children from high-income families have better access to resources that provide them with higher quality of education early in life leading to superior cognitive ability in the long-run.

Assuming large numbers, the size of the aggregate high-skilled labor force in period \( t \) can be derived on the basis of parent’s educational investment in period \( t-1 \),

\[
N_t^H = N_{t-1}^H \cdot h(e_{t-1}^H) + N_{t-1}^L \cdot h(e_{t-1}^L). \tag{4}
\]

Analogously, the number of low-skilled workers can be deduced,

\[
N_t^L = N_{t-1}^H \cdot (1 - h(e_{t-1}^H)) + N_{t-1}^L \cdot (1 - h(e_{t-1}^L)). \tag{5}
\]

After the educational process determined the respective type, the child enters the working period as either high- or low-skilled, supplying \( z_n \) efficiency units of labor inelastically to firms in the region of residence. The resulting labor income is spend on consumption, tax payments as well as net investment in the education of children. The household’s budget constraint can be expressed as

\[
z^n F'(Z_t) - \tau_n t - \theta_n t = c_n^t + (1 - \tau_{net}) e_n^t, \tag{6}
\]

where \( c_n^t \) denotes consumption and \( e_n^t \) investment in education of children. Note that a consumption tax is not allowed for at neither level of government. As far as type-specific consumption taxes are concerned, no further insights can be expected as both the consumption tax as well as the educational subsidy decrease the opportunity cost of investments in education and are, consequently, perfect substitutes. Moreover, a consumption tax is typically not differentiated across skill-types and, therefore, displays an inferior tax instrument as it cannot mimic type-specific education policies.\(^7\)

Parents are altruistic in the sense that they experience a joy of giving when supporting their children’s education (warm glow altruism). Preferences of different skill types are identical and additively separable between consumption and educational investments. They can be expressed by the strictly concave utility function

\[
U(c_n^t, e_n^t) = u(c_n^t) + v(e_n^t). \tag{7}
\]

Households of each type maximize utility subject to their budget constraint, taking both federal and regional tax rates as given. In the optimum, the marginal rate of substitution between consumption and investment in education equals the private cost

\(^7\)Yet, a consumption tax will turn out to be sufficient ex post. This is due to the fact that the assumed utilitarian welfare function entails redistribution among types. In the resulting type-symmetric equilibrium, a universal consumption tax and a type-specific educational subsidy are perfect substitutes.
of education,\(^8\)

\[
\frac{u_{ct}^n}{u_{ct}^n} = (1 - \tau_{ct}^n). \tag{8}
\]

While equations (4) and (5) underline the crucial impact of private investments in education on the composition of the future workforce, parents solely optimize their own utility disregarding the positive effect for future generations. Put differently, they fail to internalize their child’s benefits resulting from these educational investments. As will be shown, this intergenerational externality leads to inefficient levels of investment in education that can be corrected using an educational subsidy.

2.4 Migration

Two different scenarios of migration are considered: mobility of the high-skilled workforce and mobility of both the high- and the low-skilled workforce. For simplicity, the analysis abstracts from any migration costs such as language barriers, moving costs or attachment to the home country.\(^9\) Migration takes place at the beginning of every period \(t \geq 1\), before households decide on consumption and educational spending. Hence, migration flows determine the current working population of a respective region \(i\) in every period \(t\).

A potential migrant is indifferent between migrating or staying as soon as utility is equalized across regions. Thus, a migration equilibrium between any region \(i \neq j\) and an arbitrarily chosen reference region \(j\) is characterized by identical utility levels,

\[
u(c_{t,i}^n) + \nu(e_{t,i}^n) = u(c_{t,j}^n) + \nu(e_{t,j}^n). \tag{9}
\]

Equation (9) implicitly defines the quantity of mobile labor allocated in a particular region after a migration equilibrium has been reached.

3 Optimal Education Policies with High-Skilled Migration

Introducing mobility of households affects the constraints for fiscal policies both at the federal and at the local level. While in a closed economy the number of low- and high-

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\(^8\)In the absence of any tax or subsidy, the private cost of education in terms of consumption equals one. This reflects the underlying assumption that output can be transformed into consumption and education at no further resource cost.

\(^9\)As will be discussed below, this assumption influences the equilibrium attained. However, it has no impact on the results concerning the efficiency of regional education policies.
skilled workers available in a particular region is fully determined by investments in education, this is no longer true if one considers migration. Rather, migration incentives are crucial for the allocation across regions. Yet, the size of the mobile population group in the federal state as a whole is still contingent on regional investments in education and is, hence, restricted. The federal government takes this into account, while the government of a small open region views the supply of the mobile factor as infinitely elastic. Consequently, jurisdictions might substitute efficiency enhancing education subsidies by fiscal policies that aim at attracting migrants. It is important to point out that as long as solely mobility of the high-skilled is allowed for, a local jurisdiction perceives the number of the immobile low-skilled workforce as dependent on local human capital formation. With mobility of high- and low-skilled, however, migration flows alone determine the allocation of types across regions. The proceeding section derives the unitary state optimum as a benchmark case and then analyzes whether regional free-riding indeed occurs and federal education policies are needed to correct the intergenerational inefficiency.

3.1 The Central Planning Solution

Consider a unitary state government that is benevolent in the sense that it maximizes a utilitarian welfare function, summed up over all generations and discounted by the social rate of time preference, $0 < \beta < 1$. This unitary state government optimizes social welfare by choosing the allocations $\{c_{t,i,n}, e_{t,i,n}, N_{t,i,n}\}$,

$$\max \sum_{t=1}^{\infty} \beta^t \left\{ \sum_i \sum_n N_{t,i,n} \left[ u(e_{t,i,n}) + v(e_{t,i,n}) \right] + \lambda_t \sum_i \left[ F(Z_{t,i}) - \sum_n N_{t,i,n} (e_{t,i,n} + e_{t,i,n}) \right] + \mu_{t,i} \left[ N_{t+1,i} - \sum_n N_{t,i,n} \left[ 1 - h(e_{t,i,n}) \right] \right] + \mu_t \left[ \bar{N} - \sum_i \sum_n N_{t,i,n} \right] + \sum_{i \neq j} \varphi_{t,i}^H \left[u(c_{t,j}^H) + v(e_{t,j}^H) - u(c_{t,i}^H) - v(e_{t,i}^H)\right] \right\},$$

where the variables $\lambda_t, \mu_{t,i}, \mu_t$ and $\varphi_{t,i}^H$ denote the Lagrange-multipliers on the respective optimization constraints. The population $N_{t,i,n}$ is treated as an artificial control variable, since the human capital formation constraint as well as the migration equilibrium are added as constraints to the optimization problem. Alternatively, one can use the two
constraints to determine the respective population group as an endogenous variable, depending on the different tax rates and allocations. Note that the household’s first-order condition has been used to eliminate $\tau_{el,i}^n$ from the central planner’s optimization problem.

The first constraint integrates the household’s as well as the regional and the federal budget constraints into an economy-wide resource constraint.\textsuperscript{10} The second constraint reflects the fact that the size of a region’s immobile low-skilled population in period $t+1$ is contingent on local educational investments in period $t$. The remaining constraints illustrate that the exogenously given aggregate labor force $\bar{N}_t$ consists of high- and low-skilled labor allocated in one of the regions and that the mobility of high-skilled workers requires that the migration constraint is met. Since the size of the low-skilled workforce is determined by the human capital formation constraint, the population restriction characterizes the aggregate size of the high-skilled workforce. The migration constraint then identifies the allocation of theses educated workers across regions, demanding the utility level in region $i$ to equal the utility attainable in an arbitrarily chosen reference region $j$. The first-order conditions of the social planning problem are stated in Appendix A.1.

**Optimal Policy Rule**

To determine the optimal educational policy rule, derive the social marginal rate of substitution between consumption and investments in education by combining the first-order conditions on $c_{el,i}^n$ and $e_{el,i}^n$,

$$\frac{v_{el,i}^n}{u_{el,i}^n} = 1 - \frac{\mu_{el,i}^L}{\lambda_{el,i}^L} h_{el,i}^n.$$  \hspace{1cm} (11)

In the welfare optimum, the social marginal rate of substitution has to equal the private cost of education minus the term $\frac{\mu_{el,i}^L}{\lambda_{el,i}^L} h_{el,i}^n$ that captures an external effect of education. This external effect of education consists of the welfare impact of a declining number of low-skilled in $t + 1$ ($\mu_{el,i}^L$), weighted by the marginal productivity of educational investments ($h_{el,i}^n > 0$) and discounted by the opportunity cost, the marginal utility of consumption ($\lambda_{el,i}^L > 0$). If the contribution to aggregate welfare of a high-skilled worker exceeds the benefit of her being low-skilled, the external effect of education is positive. This implies that investments in education should take place until the marginal rate of substitution exceeds the private costs of education of one by additionally accounting for the social benefit of human capital formation.

\textsuperscript{10} Since the federal government can redistribute between regions, the resource constraint need not hold for every region independently.
Since in a decentralized market equilibrium this optimal marginal rate of substitution has to equal the private marginal rate of substitution (equation (8)), the optimal policy rule to determine the educational subsidy or tax for the respective type $n$ can be deduced,

$$1 - \frac{\mu^L_{t,i}}{\lambda_t} h_{et,i} = \frac{u_{et,i}}{u_{et,i}^n} = (1 - \tau^n_{et,i}) \iff \tau^n_{et,i} = \frac{\mu^L_{t,i}}{\lambda_t} h_{et,i}.$$  \hspace{1cm} (12)

**Proposition 1**  
The optimal educational policy rule of a benevolent unitary state government aims at internalizing the external effect of education.

In the absence of any education policy, households adjust their marginal rate of substitution to the marginal private cost of educational investment of one (equation (8)). Hence, they do not take into account the external effect of education, and private investment will be inefficient. The educational subsidy or tax is a means of internalizing this external effect and of establishing the welfare optimum. As long as the external effect of education is positive ($\mu^L_{t,i} > 0$), it is optimal to subsidize educational investments.

**First-Best Equilibrium**

To deduce the first-best equilibrium, consider a situation in which the migration equilibrium constraint is not binding ($\varphi^H_{t,i} = 0$). In this case the intraregional equilibrium is type-independent with $c^n_{t,i} = c_{t,i}$ and $e^n_{t,i} = e_{t,i}$ as can be inferred comparing the relevant first-order conditions. Since preferences are the same, it follows that utility levels across types will be equalized.$^{11}$ Notice that consumption is independent of the place of residence ($c_{t,i} = c_t$), while this need not be the case for educational investments: As long as the Lagrange-multiplier on the human capital formation constraint, $\mu^L_{t,i}$, is not identical across regions, the level of spending on education will differ as well. Alternatively, one can use the first-order conditions to express $\mu^L_{t,i}$ as a function of consumption as well as regional investments in education. Consequently, any interregional difference in $\mu^L_{t,i}$ is accompanied by different levels of educational expenditures in the respective regions.

Identical consumption and investment levels between types in a single region entail that the optimal subsidy or tax on education is independent of the respective type, $\tau^n_{et,i} = \tau_{et,i}$. This implies that in the optimum parents from either type spend an equal amount of resources on consumption and educational investments. Since productivity differs, identical spending patterns can only be achieved if the aggregate head tax on high-skilled exceeds the one on low-skilled workers.

$^{11}$This is due to the fact that the unitary state government aims at maximizing a utilitarian welfare function.
Still, it is not clear a priori whether education should be subsidized or taxed. To determine the sign of the educational subsidy, one needs to evaluate the shadow price $\mu_{t,i}$ that captures the social benefit of turning a child in period $t-1$ into a high-skilled instead of a low-skilled worker. Equating the first-order condition with respect to $N_{t,i}^H$ and $N_{t,i}^L$ yields

$$
\beta^{-1}\mu_{t-1,i} = U_{t,i}^H(\cdot) - U_{t,i}^L(\cdot) + \mu_{t,i}^L \left[ h(e_{t,i}^H) - h(e_{t,i}^L) \right] \\
+ \lambda_t \left[ (z^H F'(Z_{t,i}) - c_{t,i}^H - e_{t,i}^H) - (z^L F'(Z_{t,i}) - c_{t,i}^L - e_{t,i}^L) \right].
$$

(13)

This social benefit of education consists of the differences in each type’s contribution to social welfare, that is the differences with respect to the utility levels achieved, the net fiscal revenue raised, as well as the impact on future human capital formation.

According to the optimal policy rule, it is efficient to subsidize education as long as the contribution to social welfare of an additional high-skilled exceeds the contribution of a low-skilled worker ($\mu_{t,i}^L > 0$). Given the symmetric equilibrium outcomes derived above, the net social benefit of education reduces to the difference in productivity between the two types,

$$
\beta^{-1}\mu_{t-1,i} = \lambda_t \left( z^H - z^L \right) F'(Z_{t,i}) > 0.
$$

(14)

The positive social benefit of human capital formation is due to the fact that high-skilled workers are more productive and, hence, contribute more in terms of tax payments than low-skilled do. Since individual households do not take this positive external effect into account, they underinvest in education. This explains why the optimal educational subsidy is strictly positive with

$$
\tau_{st,i} = \frac{\mu_{t,i}^L}{\lambda_t} h_{st,i} > 0.
$$

(15)

Proposition 2 To correct private underinvestment in education, a unitary state government subsidizes educational investments.

The analysis reveals that the social benefit of turning a child into a high- instead of a low-skilled individual is strictly positive.12

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12Note that this result hinges on the assumption that the types are perfect substitutes in production with $z^H > z^L$. With complements, the net social benefit of education would be positive for low levels of human capital intensity, implying the optimality of a subsidy ($\mu_{t,i}^L > 0$). However, raising the fraction of high-skilled workers would decrease the net social benefit and eventually a tax on private educational investments would become efficient ($\mu_{t,i}^L < 0$). Yet, the optimal decision rule for subsidizing education is independent of assumptions concerning the production technology.
For the subsequent analysis it is important to note that equation (14) can be used to express the marginal productivity of labor as a function of the Lagrange-multipliers \( \lambda_t \) and \( \mu_{L-1,i} \). Interregional differences in the aggregate effective labor supply, therefore, involve differences in the Lagrange-multiplier \( \mu_{L-1,i} \), which in turn is determined by the level of local educational spending.

An efficient allocation of labor across regions requires that the contribution to social welfare of an additional high-skilled immigrant is the same for all regions. To determine the optimality condition for the allocation of mobile high-skilled workers, equate the first-order condition with respect to \( N^H_{t,i} \) across regions,

\[
U^H_{t,i}() + \lambda_t \left( z^H F'(Z_{t,i}) - c^H_{t,i} - e^H_{t,i} \right) - \mu^L_{t,i} \left[ 1 - h(e^H_{t,i}) \right] = \mu_t
\]

\[
U^H_{t,j}() + \lambda_t \left( z^H F'(Z_{t,j}) - c^H_{t,j} - e^H_{t,j} \right) - \mu^L_{t,j} \left[ 1 - h(e^H_{t,j}) \right] = \mu_t = U^H_{t,j}() + \lambda_t \left( z^H F'(Z_{t,j}) - c^H_{t,j} - e^H_{t,j} \right) - \mu^L_{t,j} \left[ 1 - h(e^H_{t,j}) \right]. \tag{16}
\]

The left-hand side of equation (16) can be interpreted as the net social benefit of migration that consists of the contribution of a high-skilled immigrant in terms of the additional utility and the net tax payments region \( i \) receives, minus the social cost, which arises if the immigrant’s child becomes low- instead of high-skilled (\( \mu_{L-1,i} \)), weighted by the probability to become low-skilled (\( 1 - h(e^H_{t,i}) \)). The optimal allocation of high-skilled between regions \( i \) and \( j \) is attained when the net migration inefficiency, that is the difference in the net social benefit between regions, vanishes.

As previously pointed out, with a non-binding migration constraint consumption is not only type-independent but additionally identical across regions, \( c^a_{t,i} = c_t \). Moreover, recall that interregional differences in the aggregate effective labor supply \( Z_{t,i} \) are associated with differences in the Lagrange-multiplier \( \mu_{L-1,i} \) which, in turn, results from unequal educational spending levels across regions. Consequently, the optimal allocation of labor only depends on current and previous local investments in education. Focussing on the steady-state where \( e_{t,i} = e_i \), one can reveal that the social benefit of migration will only be equalized across regions whenever educational spending levels are identical as well. This entails that the aggregate effective labor supply will also be independent of the respective region. An optimal interregional allocation of labor, therefore, involves an equalization of productivities across regions, that is a situation in which production efficiency holds.\(^{13}\) It is important to note that the steady state assumption is not as restrictive as it might seem on first sight. Given the optimal policy derived above, the steady state will be attained immediately as perfectly mobile households will relocate in the first-period, before decisions on consumption and educational investments have been made. This entails an equalization of the aggregate effective labor supply across regions.

\(^{13}\)While the optimal educational policy rule can be derived for the entire time path, efficient redistribution can only be determined in the steady state. Notice, however, that this restriction can be avoided applying the popular symmetry assumption: If all regions are symmetric with respect to the initial effective labor supply, the local equilibrium paths will coincide and interregional redistribution becomes redundant.
in the first period, after which the equilibrium paths in all regions coincide.

Hence, the solution to the optimization problem is entirely symmetric with $c_{t,i}^n = c$ and $e_{t,i}^n = e$. Moreover, it follows immediately from the educational policy rule that the optimal subsidy is type- and region-independent with $\tau_{t,i}^n = \tau_e$. To derive the optimal interregional redistribution policy, use the steady-state equilibrium values in equation (16),

$$\theta_i^H + \tau_{t,i}^H = \theta_j^H + \tau_{j}^H. \quad (17)$$

In the welfare optimum, the central planner imposes federal lump-sum taxes such that the aggregate head tax of the high-skilled is independent of the region of residence. Given that mobile households face the same marginal rate of substitution between consumption and investments, that is the same educational subsidy, they will evaluate locations solely in terms of the attainable net income. Since aggregate head taxes are independent of the region of residence, migration corresponds to productivity differences across regions and leads to an equalization of the aggregate effective labor supply $Z_i = Z$. Given the resulting symmetric equilibrium, the migration constraint is fulfilled as well. Accordingly, the solution that was derived ignoring the migration constraint coincides with the optimum of the fully constrained problem.

The central planning solution reveals that it is optimal to subsidize education to overcome the underinvestment problem at the private level. The following section focuses on the optimal fiscal policy a small open region opts for. A local government disregards the fact that the overall size of the high-skilled population in the federal economy is contingent on private investments in education. Hence, it might choose not to subsidize education, but try to attract high-skilled workers from other regions. Such free-riding of regional governments induces an educational underinvestment problem at the federal level that might be corrected using an educational matching grant.

### 3.2 Local Education Policies with High-Skilled Migration

Next, the optimal fiscal policy chosen by a local government is derived, and necessary policy instruments at the federal state level are deduced to decentralize the unitary state optimum. Recall that the first-best solution requires (1) consumption and educational spending to be equalized across types, (2) educational investments to be subsidized to prevent private underinvestment and (3) production efficiency to be achieved.

From the point of view of a small open region, perfect mobility of educated workers entails that the high-skilled workforce is in infinitely elastic supply. Thus, a regional

\[14\text{In contrast, the equilibrium will no longer be symmetric in the presence of migration costs as an interregional equalization of utility would violate the migration equilibrium.}\]
government will not take into account the fact that the overall number of high-skilled available in the federal state is restricted, but only consider the migration constraint. The amount of low-skilled workers in any region $i$, however, is still contingent on local human capital formation. Therefore, a regional jurisdiction respects the local human capital formation constraint, it’s own as well as the household’s budget constraint, and the migration equilibrium constraint. The utility level attainable for mobile high-skilled workers in case of emigration is exogenous with $u(c_H^H) + v(e_H^H)$, where $c_H^H$ and $e_H^H$ denote the amount of consumption and educational investments realized outside of a small open region $i$. Furthermore, the regional government takes the federal head tax and the matching grant as given, since the central government is assumed to be the Stackelberg leader who moves first. Once more, the household’s first-order condition is used to eliminate $\tau_{et}^n$ from the optimization problem.

The local government maximizes the social welfare of it’s resident population, choosing $\{c^n_i, e^n_i, N^n_i\}$,

$$\max_{\{c^n_i, e^n_i, N^n_i\}} \sum_{t=0}^{\infty} \beta^t \left\{ \sum_{n} N^n_t [u(c^n_i) + v(e^n_i)] 
+ \lambda^t \left[ F(Z_t) - \sum_{n} N^n_t (c^n_i + (1 - \theta^n_{et}) e^n_i + \theta^n_{et}) \right] 
+ \mu^L_t \left[ N^L_{t+1} - \sum_{n} N^n_t [1 - h(e^n_i)] \right] 
+ \phi^H_t \left[ u(c_H^H) + v(e_H^H) - u(c_H^H) - v(e_H^H) \right] \right\}. \quad (18)$$

Again, $\{\lambda^t, \mu^L_t, \phi^H_t\}$ denotes the set of Lagrange-multipliers. The first-order conditions are left to Appendix A.2.

**Local Policy Rule**

Using the first-order conditions of the planning problem, one can derive the regionally optimal marginal rate of substitution between consumption and educational investments from the point of view of a small local jurisdiction,

$$\frac{\nu^n_{et}}{u^n_{et}} = (1 - \theta^n_{et}) - \frac{\mu^L_t}{\lambda^t} n_{et}^n. \quad (19)$$
Equating the regionally optimal and the private marginal rate of substitution immediately reveals the optimal educational subsidy or tax a local government chooses,

\[(1 - \theta^n_{et}) - \frac{\mu^L}{\lambda_t} h^n_{et} = \frac{\nu^n_{et}}{u^n_{et}} = (1 - \tau^n_{et}) \quad \Leftrightarrow \quad \tau^n_{et} = \frac{\mu^L}{\lambda_t} h^n_{et} + \theta^n_{et}. \tag{20}\]

Taking the federal grant as given, the local jurisdiction increases the educational subsidy to meet the above optimality condition. Obviously, the federal matching grant \((\theta^n_{et})\) complements regional education policies \((\mu^L_t h^n_{et})\). This is true irrespective of whether the federal grant is paid directly to local governments or as a federal subsidy to households.\(^{15}\)

Yet, the federal grant becomes redundant as an instrument to correct underinvestment, since the region chooses the educational subsidy according to the optimal policy rule:

If the central government refrains from providing a matching grant \((\theta^n_{et} = 0)\), the local government sticks to the optimal educational policy rule that supports the first-best, even though high-skilled workers are perfectly mobile. Since local jurisdictions move after the central government, correcting private underinvestment in education can be delegated to the regions.

**Proposition 3** Local jurisdictions abide by the optimal decision rule for subsidizing education. Thus, decentralized education policies are efficient, although high-skilled workers are perfectly mobile.

This surprising result of efficient decentralized policy making is due to the fact that regional investments in education determine the size of the future immobile low-skilled workforce, irrespective of any assumption concerning the mobility of the high-skilled. Thus, regional governments continue to respect the human capital formation constraint as well as the associated impact of education on future generations. Since parents do not take the intergenerational externality into account, local jurisdictions intend to correct this market failure and subsidize education, even though high-skilled workers are perfectly mobile. Hence, perfect mobility of high-skilled labor does not destroy local government’s incentives to correct educational underinvestment. Rather, introducing social mobility forces local governments to adhere to the optimal decision rule for education policies. Yet, the size and sign of \(\tau^n_{et}\) might deviate from the optimal subsidy a unitary state government imposes: while regions stick to the optimal policy rule, it is not clear whether the implemented subsidy replicates first-best optimum, as the regional welfare optimum might entail different levels of consumption and educational investments than the unitary state outcome.

\(^{15}\)One can easily verify that both approaches result in the exact same optimization problem.
Notice that the efficiency of decentralized education policies is not dependent on assumptions concerning the production technology or the migration dynamics. While these assumptions affect the equilibrium obtained, this is true for the unitary state as well as the decentralization case. For example, if migration costs are introduced, the solution will no longer be symmetric across countries as an interregional equalization of utility would violate the migration equilibrium. This applies for the unitary state optimization as it does at the local level. Yet, the efficiency of decentralized education policies remains unaffected, as local jurisdictions abide by the optimal decision rule for subsidizing education irrespective of the realized equilibrium. The same reasoning holds true if one varies the social welfare function. One can easily reveal that the optimal policy rule is unaffected if one uses fixed weights rather than the size of the population groups. Even if jurisdictions adopt a parietian welfare objective and only take into account the welfare of their immobile, low-skilled residents, the educational policy rule remains the same. While this might, again, entail different realized equilibria, the efficiency of decentralized education policy persists.

**Local Equilibrium**

In the following, conditions replicating the welfare maximum of the unitary state scenario are analyzed. To pursue this, assume that regions are confronted with a federal decentralization policy that ensures that the migration constraint is not binding in the local optimum ($\varphi_i^H = 0$). In this case, optimal levels of consumption as well as educational investments in any region $i$ are type-independent with $c_i^H = c_i$ and $e_i^H = e_i$ as can be revealed from the first-order conditions on consumption and educational investments. Consequently, utility levels are equalized in the optimum, and the local educational subsidy is identical for the different types, $\tau_{nt}^H = \tau_{et}$. Note that this requires that any matching grant possibly provided by the federal government is type-independent. In the remaining analysis, the set of tax instruments available at the federal level will accordingly be restricted to the use of region-specific matching grants that cannot differentiate between types.

Following the above procedure, one can make use of the household’s budget constraint to determine the optimal redistribution policy at the local level: Since productivity across types differs, but consumption as well as educational investments are equalized in the regional optimum, the aggregate head tax on high-skilled households has to exceed the one on low-skilled. Obviously, federal and local head taxes are perfect substitutes to establish intraregional redistribution. As long as the central government levies type-independent head taxes ($\theta_i^H = \theta_i^L$), local jurisdictions will appropriate the whole income difference between the two types ($\tau_i^H > \tau_i^L$). Such a federal tax policy leaves local redistribution unaffected. In order to focus on decentralization policies that are essential to replicate the first-best in the remainder of this section, the set of available federal tax
instruments is restricted to type-independent taxes, that is both head taxes as well as the educational grant can only be differentiated across regions, but not across types.

To evaluate under which conditions the local subsidy or tax on education coincides with the educational subsidy that supports the first-best optimum (equation (15)), one has to determine the value of the shadow price $\mu_L^t$ associated with the probability of being low-skilled. This can be derived equating the first-order conditions on high- as well as low-skilled workers, and evaluating in equilibrium,

$$\beta^{-1} \mu_{L-1}^t = \lambda_t \left[ (z^H - z^L) F'(Z_t) - (\theta^H_t - \theta^L_t) \right].$$

(21)

If the central government uses type-independent head taxes ($\theta^H_t = \theta^L_t$), the net social benefit of migration reduces to the difference in productivities between the two types. Consequently, the social benefit of turning a child into a high- instead of a low-skilled worker is strictly positive, although high-skilled labor is perfectly mobile across regions. This is due to the fact that high-skilled workers are assumed to be more productive than low-skilled workers and contribute more to social welfare in terms of higher tax payments. It follows that the social benefit of education from the point of view of a local government coincides with the social benefit of education as perceived by a federal government (equation (14)): Private underinvestment in education involves a welfare cost in terms of an increased number of less-productive low-skilled workers that is correctly accounted for at the local level. This explains why a small region facing mobility of high-skilled labor continues to subsidize education and intends to correct private underinvestment.

In the first-best resulting from the unitary state optimization, consumption and educational investments have to be equalized not only intraregionally, but also across regions. This ensures that differences in the net social benefit of migration across regions vanish, and labor is allocated efficiently. Yet, a single jurisdiction only aims at redistributing income between types, not between regions. To avoid the migration inefficiency, a central government, therefore, has to ensure that decentralization results in an interregionally symmetric equilibrium. Since intraregional redistribution can be delegated to the regions, it suffices if the federal tax authority induces mobile high-skilled households to choose the optimal consumption and educational spending levels. This requires that the high-skilled are confronted with the optimal, region-independent marginal rate of substitution and face the same net income independent of their place of residence.

To derive the optimal decentralization policy, recall that the local government already subsidizes education according to the optimal policy rule and, additionally, passes on the federal matching grant to the households. This implies that the central government can complement the local educational policy by a region-specific educational matching grant $\theta_{et,i}$ such that the subsidy paid at the local level equals the optimal, region-independent
first-best value,
\[ \tau_{et,i} = \frac{\mu_{L,t,i}}{\lambda_{t,i}} h_{et,i} + \theta_{et,i} = \frac{\mu_{L,t}}{\lambda_t} h_{et}. \] (22)

This guarantees that all households in the federal economy are confronted with the same shadow price of educational investments. Notice that irrespective of the fact that the federal level provides an educational matching grant, local education policies remain to be efficient: While the local level correctly accounts for the underinvestment problem, the matching grant is used to avoid migration inefficiencies and establish the first-best. Still, even in the absence of a higher-level tax authority, regional governments abide by the optimal policy rule.

The central government can now establish the interregionally symmetric equilibrium imposing federal head taxes such that the aggregate lump-sum tax on high-skilled labor is identical for all regions.\(^\text{16}\) This policy induces migration in the first period, resulting in an equalization of the aggregate effective labor supply \(Z_{t,i}\) between regions in the steady state. This guarantees that consumption and educational expenditures are equalized across regions. As a consequence the migration constraint is not binding, which was the prerequisite for efficient regional redistribution policies.

**Proposition 4** The central government can decentralize the first-best providing a region-specific educational matching grant and imposing identical aggregate head taxes in all regions. This establishes an interregionally symmetric equilibrium and induces local governments to redistribute income from mobile high- to immobile low-skilled labor to achieve a symmetric intraregional equilibrium.

### 4 Optimal Education Policies with High- and Low-Skilled Migration

The preceding analysis reveals that local jurisdictions abide by the optimal decision rule for subsidizing education even in the presence of perfect mobility of high-skilled labor. However, the result hinges on the assumption that low-skilled households are immobile. As the size of a region’s low-skilled workforce is determined by local investments in education, regional governments respect the human capital formation constraint and efficiently correct private underinvestment in education. In the following, this assumption is relaxed and mobility of both the high- and the low-skilled population is considered.

\(^{16}\)To ensure that intra-regional redistribution is not violated, federal head taxes have to be type-independent.
Again, the unitary state optimum is derived as a benchmark case, followed by a discussion of decentralized policies of local jurisdictions.

Note that in the case of low-skilled mobility, the allocation of both types of workers across regions is entirely determined by migration flows. Thus, the low-skilled workforce available in any region \( i \), \( N_{i, t}^L \), is no longer contingent on previous local educational investments. Only the aggregate federal endowment with low-skilled tomorrow depends on parental investments in education today. In contrast to the case of high-skilled mobility, the Lagrange-multiplier on the human capital formation constraint \( (\mu_L^t) \) is, therefore, independent of the respective region \( i \).

Following the above procedure, one can reveal that the unitary state government chooses the same decision rule for subsidizing education, irrespective of whether one or all types of labor are mobile across regions. Furthermore, the first-best optimum in the presence of high- and low-skilled migration coincides with the solution derived above for the case of high-skilled mobility. This is plausible, since the migration equilibrium constraints are not binding in the optimum. Hence, introducing mobility of high- and low-skilled labor does neither change the welfare maximum nor the optimal educational subsidy chosen by a unitary state government.

4.1 Local Education Policies with High-Skilled and Low-Skilled Migration

Perfect mobility of both types of workers changes the optimization constraints local governments face substantially. Since from the point of view of a small open region the mobile factor is in perfectly elastic supply, a regional government perceives the size of the respective type of worker as only dependent on migration incentives. Thus, it disregards the fact that the evolution of the different population groups is contingent on regional investments in education and no longer respects the human capital formation constraint. Hence, a local government chooses the allocations \( \{c^n_t, e^n_t, N^n_t\} \) to solve the following problem,

\[
\begin{align*}
\max \sum_{t=0}^{\infty} \beta^t \left\{ \sum_n N^n_t \left[ u(c^n_t) + v(e^n_t) \right] \\
+ \lambda_t \left[ F(Z_t) - \sum_n N^n_t \left( c^n_t + (1 - \theta^n_t) e^n_t + \theta^n_t \right) \right] \\
+ \phi^n_t \left[ u(c^n_t) + v(e^n_t) - u(c^n_t) - v(e^n_t) \right] \right\}
\end{align*}
\]

(23)

where \( \lambda_t \) and \( \phi^n_t \) denote the Lagrange-multipliers. The utility level attainable for mobile workers outside region \( i \) is given by \( u(\bar{c}^n_t) + v(\bar{c}^n_t) \). The first-order conditions are presented...
in Appendix A.3.

**The Local Policy Rule**

Again, one can combine the first-order conditions with respect to consumption and investments to derive region $i$’s marginal rate of substitution between consumption and educational investments,

$$\frac{v^n}{w^n} = (1 - \theta^n_{et}).$$

Equating the regionally optimal and the private marginal rate of substitution immediately reveals the educational subsidy chosen by a local government,

$$(1 - \theta^n_{et}) = \frac{v^n}{w^n} = (1 - \tau^n_{et}) \iff \tau^n_{et} = \theta^n_{et}. \quad (25)$$

The optimal regional policy in the presence of high- and low-skilled mobility is not to subsidize education at all. Since the federal matching grant is conditional on local investments in education, local governments have to pass $\theta^n_{et}$ on to households, but refrain from subsidizing education themselves:17 In the absence of any federal grant ($\theta^n_{et} = 0$), a local jurisdiction does not subsidize education ($\tau^n_{et} = 0$).

The inefficiency of local education policies can be explained by the fact that from the point of view of a small open region, the available size of both the high- and the low-skilled workforce is entirely determined by migration flows. Previous investments in education have no impact on the composition of the local workforce. Hence, educational underinvestment is not accounted for at the regional level. This entails an inefficient evolution of the composition of the federal population as private underinvestment persists.

Since local governments disregard this inefficiency, the central government has to correct the intergenerational externality. Since the regional government has to pass the optimal federal grant on to its residents, the federal matching grant is an efficient policy tool to decentralize the first-best optimum. Still, since the federal grant replaces local education policies, the first-best optimum can effectively only be established by assigning competencies in the field of education policy to the federal level.

**Proposition 5** If high- and low-skilled workers are mobile across regions, decentralized

17Again, this finding is robust, irrespective of whether the grant is paid to regional governments or directly to households.
education policies are inefficient as incentives of local jurisdictions to subsidize education vanish completely. To correct educational underinvestment, education policies have to be assigned effectively to the federal or supranational level.

Similarly to the case of high-skilled mobility only, the result concerning the inefficiency of decentralized education policies carries over to a scenario in which migration costs are present. Only if mobile households face a certain probability to emigrate, part of the workforce remains immobile and is, thus, affected by local education policies with a positive probability. Consequently, local governments continue to respect the human capital formation constraint and choose an efficient education policy.

Intra- and interregional Redistribution

In the following, the optimal local redistribution policy that supports the first-best optimum is deduced. To this end, it is again assumed that regions face a federal policy ensuring that the migration constraint is not binding in the local optimum \( (\varphi^H_t = 0) \). According to the first-order conditions on consumption and educational investments, this entails that optimal levels of expenditure in any region \( i \) are identical, irrespective of the type of household, \( c^H_t = c_t \) and \( e^H_t = e_t \). Recall that intraregional symmetry in consumption and education guarantees that utility levels between types are identical in the optimum, and utilitarian welfare is maximized.

With a type-independent federal grant, intraregional equalization of consumption and educational investments requires that the net income of the different types is equalized. Consequently, the aggregate head taxes on the high-skilled have to exceed the taxes on the low-skilled type. The head taxes chosen by the local government will, however, be type-independent. To see this, equate the first-order conditions with respect to the population groups,

\[
U^H_t(\cdot) + \lambda_t \tau^H_t = 0 = U^L_t(\cdot) + \lambda_t \tau^L_t
\]  

(26)

The left- and right-hand side of equation (26) can be interpreted as the net social benefit of an additional high- and low-skilled worker from the point of view of a small open region: In the case of high- and low-skilled mobility, immigration no longer involves any educational benefits, but only contributions in terms of additional utility and tax payments of the respective type of migrant. If the central government ensures that the migration constraint is not binding, consumption and education are identical for both types. This implies identical utility levels and explains why local governments have no interest in redistributing income between the different types: High- and low-skilled
workers are perfectly homogenous from the point of view of a local, welfare maximizing government. Since the gain in utility from immigration of a high- or low-skilled worker is the same, the local government does not intend to alter migration incentives for different types. Rather, the optimal policy at the local level is to distribute profits evenly among the two types, $\tau_t^H = \tau_t$.

Given type-independent local head taxes, the central government has to achieve the symmetric intraregional equilibrium and, moreover, ensure that the net social benefit of migration is identical across regions. Since the federal government already imposes the optimal matching grant, entailing that the marginal rate of substitution between consumption and educational investments is independent of the place of residence, the first-best level of consumption and educational investments can easily be established imposing type-specific region-independent federal head taxes. Resulting migration flows in period $t = 1$ again establish a steady state in which production efficiency holds and spending levels are equalized both across types and regions.

**Proposition 6** If both high- and low-skilled workers are perfectly mobile, local jurisdictions distribute profits evenly among their residents. This implies that competencies for both education policy as well as redistribution have to be assigned to the federal level.

The analysis reveals that federal policies can replicate the first-best optimum in which production efficiency holds. This, however, requires the central government to provide the optimal educational grant and - given type-independent local lump-sum taxation - impose a type-specific head tax to redistribute income. At the same time, federal lump-sum taxation has to be used in a way to ensure that the aggregate head tax on mobile labor is identical across regions.

5 Conclusion

In the view of increased mobility of high-skilled labor, local governments face the option to free-ride on other regions’ education policies instead of correcting educational underinvestment themselves. Still, one can observe that education is financed substantially by local governments. The present research provides an explanation for this phenomenon that is based on the effect of social mobility across different skill-types. The notion social mobility reflects the fact that parental investments in education today determine their children’s probability to become high-skilled tomorrow. The model thereby extends previous studies to a dynamic setup, endogenizing the evolution of the size of the different

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18In the absence of a local educational subsidy, the only purpose of local fiscal policy is to distribute profits. Therefore, local lump-sum taxes are negative.
skill-types over time. Moreover, an intergenerational externality is introduced that leads to a situation of underinvestment in education and, hence, provides a justification for a corrective educational subsidy from a federal perspective. Against this background, the efficiency of decentralized decision making in the presence of perfect, high-skilled mobility is discussed.

It is shown that small regions abide by the optimal decision rule for subsidizing education, although high-skilled workers are perfectly mobile across regions. This is surprising, since private underinvestment in human capital can, from the point of view of a small region, be fully compensated by high-skilled immigration from neighboring jurisdictions. However, in a dynamic setup with social mobility underinvestment in education not only affects the size of the high-skilled workforce, but additionally determines the number of immobile low-skilled workers in the respective region. Consequently, inefficiencies with respect to human capital formation still have local consequences, implying that the incentive to correct educational underinvestment prevails although high-skilled labor is assumed to be perfectly mobile. Thus, decentralized education policies remain to be efficient. Social mobility, therefore, provides an explanation of why local governments continue to subsidize education, even though high-skilled workers can migrate.

However, the efficiency of decentralized education policies does not persist in a scenario in which both types of labor are mobile. In such a setup, local governments lose any incentive to subsidize education since both the size of the high- and low-skilled workforce are solely determined by migration flows. From the point of view of a small region, previous local investments in education are entirely irrelevant for the composition of today’s workforce. This explains why decentralized education policies turn out to be inefficient. To prevent underinvestment in this case, education policies have to be assigned to the federal or supranational level.

Though two polar cases - perfect high-skilled mobility and perfect high- as well as low-skilled mobility - are considered in the present analysis, the results carry over to more realistic migration scenarios including costs of moving. Moreover, one can conjecture that mobility of high-skilled labor is empirically more relevant as education directly reduces migration costs such as language barriers. In contrast, at least for some less-qualified workers barriers to migration are prohibitively high. Hence, part of the low-skilled will most likely be immobile. As long as only a fraction of the low-skilled workforce continues to be immobile, local educational investments matter and indicate that decentralized education policies remain to be efficient. The results, therefore, imply that local governments facing mobility of labor do not necessarily lose their scope to correct market failures, at least not with respect to underinvestment in education.
The first-order conditions for the central planning problem are as follows,

\[
\frac{\partial}{\partial c_{ct,i}} : u_{ct,i}^L = \lambda_t \tag{A.1.1}
\]

\[
\frac{\partial}{\partial c_{ct,i}} : (N_{t,i}^H - \varphi_{t,i}^H) u_{ct,i}^H = \lambda_t N_{t,i}^H \tag{A.1.2}
\]

\[
\frac{\partial}{\partial e_{ct,i}} : v_{ct,i}^L = \lambda_t - \mu_{t,i}^L h_{ct,i} \tag{A.1.3}
\]

\[
\frac{\partial}{\partial e_{ct,i}} : (N_{t,i}^H - \varphi_{t,i}^H) v_{ct,i}^H = \lambda_t N_{t,i}^H - \mu_{t,i}^L N_{t,i}^H h_{ct,i} \tag{A.1.4}
\]

\[
\frac{\partial}{\partial N_{ct,i}^L} : U_{ct,i}^L + \lambda_t \left[ Z_t F'(Z_{t,i}) - c_{t,i}^L - e_{t,i}^L \right] - \mu_{t,i}^L \left[ 1 - h(e_{t,i}^L) \right] = \mu_t \tag{A.1.5}
\]

\[
\frac{\partial}{\partial N_{ct,i}^H} : U_{ct,i}^H + \lambda_t \left[ Z_t F'(Z_{t,i}) - c_{t,i}^H - e_{t,i}^H \right] - \mu_{t,i}^L \left[ 1 - h(e_{t,i}^H) \right] = \mu_t. \tag{A.1.6}
\]

To gain symmetric first-order conditions, define the multiplier on the migration constraint for the arbitrarily chosen reference region \(j\) as \(\varphi_{t,j}^H = -\varphi_{t,i}^H\).

The first-order conditions for the local optimization problem are

\[
\frac{\partial}{\partial c_{ct,i}} : u_{ct}^L = \lambda_t \tag{A.2.7}
\]

\[
\frac{\partial}{\partial c_{ct,i}} : (N_t^H - \varphi_t^H) u_{ct}^H = \lambda_t N_t^H \tag{A.2.8}
\]

\[
\frac{\partial}{\partial e_{ct,i}} : v_{ct}^L = \lambda_t \left( 1 - \theta_{ct,i}^L \right) - \mu_{t,i}^L h_{ct}^L \tag{A.2.9}
\]

\[
\frac{\partial}{\partial e_{ct,i}} : (N_t^H - \varphi_t^H) v_{ct}^H = \lambda_t N_t^H \left( 1 - \theta_{ct,i}^H \right) - \mu_{t,i}^L N_t^H h_{ct}^H \tag{A.2.10}
\]

\[
\frac{\partial}{\partial N_{ct}^L} : U_t^L + \lambda_t \left( Z_t F'(Z_t) - c_t^L - (1 - \theta_{ct}^L) e_t^L - \theta_t^L \right) = \mu_t \left[ 1 - h(e_t^L) \right] - \beta^{-1} \mu_{t-1}^L \tag{A.2.11}
\]

\[
\frac{\partial}{\partial N_{ct}^H} : U_t^H + \lambda_t \left( Z_t F'(Z_t) - c_t^H - (1 - \theta_{ct}^H) e_t^H - \theta_t^H \right) = \mu_t \left[ 1 - h(e_t^H) \right] \tag{A.2.12}
\]
A.3 Regional Optimization: Migration of High- as well as Low-Skilled Workers

The first-order conditions of the regional optimization, when high- and low-skilled workers are mobile, are

\[ \frac{\partial}{\partial c_t} : (N_t^n - \varphi_t^n) u^n_t = \lambda_t N_t^n \]  
(A.3.13)

\[ \frac{\partial}{\partial e_t} : (N_t^n - \varphi_t^n) v^n_t = \lambda_t N_t^n (1 - \theta_t^n) \]  
(A.3.14)

\[ \frac{\partial}{\partial N_t^n} : U_t^n + \lambda_t \left( z^H F'(Z_t) - c_t^H - (1 - \theta_t^H) e_t^H - \theta_t^H \right) = 0 \]  
(A.3.15)
References


