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The Impact of Increased School Enrollment on Economic Growth in Tanzania

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Abstract

Failure to accumulate human capital is one of the pressing problems of developing countries. Lacking human capital formation bears consequences on an economy wide level, since education contributes to labor productivity. We examine the impact of increased school enrollment with regard to economic growth and income inequality. A dynamic computable general equilibrium (DCGE) model applying a 2000 SAM for Tanzania is used to evaluate the quantitative long-term effects of increased school attendance on overall economic growth and welfare. In order to get an insight in how a potential skill upgrade would affect the economy, we simulate a government program that aims at increasing primary school enrollment. We find that an increase in human capital formation in the long run leads to higher economic growth rates and increases household incomes in a Pareto sense. The results show that the positive effects of enhanced human capital formation are rather moderate in terms of the distribution of the gains from economic growth and hence income inequality does not change substantially.

Kurzfassung

Eines der drängenden Probleme von Entwicklungsländern ist die geringe Rate der Humankapitalakkumulation. Dies hat jedoch Konsequenzen für die gesamte Wirtschaft eines Landes, da Bildung zur Anhebung der Arbeitsproduktivität beiträgt. In diesem Papier wird die Auswirkung einer Erhöhung der Einschulungsrate im Hinblick auf wirtschaftliches Wachstum und die Verteilung von Einkommen untersucht. Es wird ein dynamisches, allgemeines Gleichgewichtsmodell und eine „Social Accounting Matrix“ (SAM) von Tansania für das Jahr 2000 angewandt, um ein Regierungsprogramm zu simulieren, welches auf eine Erhöhung der Einschulungsrate abzielt. Die Ergebnisse der Simulation zeigen, dass eine erhöhte Bildung von Humankapital durch höhere Einschulungsraten langfristig zu höherem wirtschaftlichem Wachstum und zu einer Pareto effizienten Anhebung der Haushaltseinkommen führt. Die Ergebnisse zeigen jedoch nur geringe Änderungen der Einkommensungleichheit.

"Our goal is to have all children in school by the year 2005, as well as to improve the quality of education in primary schools."
– Benjamin W. Mkapa, President of the Republic of Tanzania –

1 Introduction

One of the most undisputed correlations in economics is the positive relationship between human capital formation and economic development. Theory and the empirical literature suggest that education positively contributes to higher productivity levels in non-agricultural as well as in agricultural sectors (Psacharopoulos 1984, 1989). Lockheed, Jamison and Lau (1980) report in an overview over 18 studies on the correlation between education and productivity that most studies found a positive and significant relationship.[1] In agriculture, a more recent study from Pinckney (1997), which also refers to Tanzania, reports significant results on positive returns to education. Further evidence indicates that educated workers in Eastern Africa show a higher marginal product hence earning higher wages (Knight and Sabot 1990). Apparently skills obtained at school account for most earnings differentials what allows the conclusion that households might be better off in the long term when they send their children to school.

Improving human capital through schooling has also implications for development on national scale. Much theoretic work has been undertaken to model the link between human capital formation and economic development (Romer 1986, 1990, Lucas 1988, 1993, Stokey 1988, 1991), and several empirical studies have demonstrated a positive correlation between human capital stocks and economic growth (Mankiw, Romer, and Weil 1992, Barro and Sala-I-Martin 1991 and 1995). Human capital has since become a common control variable in many regressions concerned with the determinants of economic growth.

Failure to accumulate human capital is one of the pressing problems of developing countries. One of the most important reasons why many developing countries fail to accumulate human capital is the fact that a large number of children are engaged in work rather than in schooling. This bears consequences at individual and societal level: (1) As a young adult, the child who dropped out of school is unlikely to cross a certain income threshold, since incomes for educated and non-educated labor can differ vastly. (2) Through the massive dropout of numerous children, the aggregate rate of human capital accumulation in the national economy declines and hence hampers economic growth and development.

Facing the importance of human capital formation this paper is concerned with the effects of skills upgrading of the labor force on economic growth and household welfare. We start from the assumption that child labor ineffectively binds human resources that might be shifted to more productive utilizations in the long run by moving children away from the labor market into

[1] See also Jamison and Lau (1982) for a general introduction into that issue.

school. We examine the effects of skills upgrading through improved school enrollment with regard to economic growth and income inequality. A dynamic computable general equilibrium (DCGE) model is applied to evaluate the quantitative long-term effects of increased school attendance on economic growth and individual welfare. The following section briefly summarizes some basic features of the Tanzanian economy. Section 3 describes the underlying model, while Section 4 is dedicated to data descriptions. Section 5 introduces to the design of the experiments conducted, followed by Section 6 where the results of the analysis are presented and Section 7 where some conclusions are drawn.

2 Background on Tanzania's Economy

In accordance to the Anglo-Saxon educational system, the Tanzanian school system is divided into primary and secondary school, following a 7-4-2 system. Primary school takes 7 grades to finish, while it takes another 4 grades (Form 1-4) to obtain the Certificate of Secondary Education. Adding 2 grades (Form 5 and 6) more culminates in the Advanced Certificate of Secondary Education. Gross primary school enrollment rates[2] in Tanzania dropped from 92.5% in 1980 to 63.0% in 1998 (World Bank 2002) after mandatory enrollment was abandoned in the course of the liberalization program, imposing a serious deficit in future human capital development. The net secondary school enrollment rate has risen from 3.3% in 1980 to 5.8% in 2000. Primary schools are mostly owned and run by the government. School fees have to be paid in addition to the purchase of school uniforms, which are the responsibility of the parents. In view of the low enrollment rates and the importance of education for development, improvement of the education system belongs to the most important issues on Tanzania's agenda for development.

Table 1: Distribution of Value Added Across Labor, Capital and Land and Labor Force Composition

	Share of value added	Share of labor force
CHILDLAB*	0.3	13.4
NOEDU	2.0	22.1
NOPRIM	4.4	15.3
NOSEC	15.6	55.4
FINSEC	7.8	3.8
Total labor	30.2	
Subsistence	26.7	
Capital	39.2	
Land	3.9	
Total	100.0	100.0

Source: Authors' calculations and LFS 2000/01
*All acronyms are explained in Table A.1 of the Appendix.

Although child labor is prohibited by law it is virtually existent in most sectors of the Tanzanian economy—with an upward time trend. Out of 16.4 million working people[3] about 13.4% or 2.2 million are children[4]. Most of the children work in the poultry and livestock, vegetables and fruits sectors, as well as in the cotton sectors. Although children constitute a

[2] The gross enrollment rates as defined by the World Bank report the ratio of all children currently enrolled to the officially eligible age group.
[3] Data derived from the Labor Force Survey 2000/01 (URT 2002a).
[4] See Table A.1 in the Appendix for further descriptions of the structure of the labor force

relatively large portion of the labor force they contribute only 0.3% to total GDP at factor costs.[5] This suggests a trade-off between children working and children going to school in order to accumulate human capital. In a study on Tanzania, Akabayahi and Psacharopoulos (1999) established this trade-off empirically and found that indeed child labor is negatively correlated with hours spent for studying and learning. The numbers further indicate that in terms of welfare households might indeed face a reduction in income when child earnings are missing, but they also show that this share is rather low. In the long term, households will most likely be better off.

Table 2: Sectoral Structure of the Tanzanian Economy (in %)

	Sectors	Value added	Production value	Total employment	Total exports	Total imports
Agriculture	Maize	10.1	6.3	33.4	0.1	0.7
	Cereals	5.7	4.2	10.7	0.3	1.9
	Major export crops	3.7	3.1	4.1	30.6	0.0
	Other crops	17.5	10.3	22.8	5.1	2.7
	Livestock/ Forestry	11.5	6.9	9.1	7.8	0.2
Non-agriculture	Food processing	6.9	12.0	4.7	1.9	10.7
	Non-agricultural Manufacturing	8.0	8.5	0.6	4.0	52.3
	Mining	1.4	0.9	0.1	2.0	0.6
	Construction	4.8	5.6	0.5	0.0	0.0
	Trade	8.7	6.0	3.4	0.0	0.0
	Hotel	2.9	3.3	0.8	0.0	0.0
	Transportation	5.0	4.1	0.4	41.1	22.6
	Real estate	5.0	14.5	5.5	0.0	0.0
	Public services	6.2	11.9	1.2	1.9	0.7
	Business	2.4	2.2	2.7	5.3	7.6
Totals	Total agriculture	48.6	30.9	80.1	43.8	5.5
	Total non-agriculture	51.4	69.1	19.9	56.2	94.5
	Total	100.0	100.0	100.0	100.0	100.0

Source: Authors' calculations from Tanzania SAM 2000.

With a gross national income of 9.4 billion US$ and a per capita income of 270 US$ in 2000, Tanzania belongs to the poorest countries in the world. The economy is largely driven by agriculture and about 80% of the labor force is employed in agriculture. Despite its importance as the major employer in Tanzania, the agricultural sector generates only 48.6% of value added and produces 43.8% of total exports. Within agriculture, maize is the most produced single crop and the major employer in the economy, as 33.4% of the labor force is involved in maize production. Table 1 provides a more disaggregated overlook of the economic structure by sectors.

[5]Data derived from Household Budget Survey 2000/01 (URT 2002b).

3 Underlying Dynamic Model

In this section, we present the dynamic computable general equilibrium (CGE) model and a summary of the Tanzanian database to which the model is applied. In contrast to conventional static CGE models, the dynamic CGE model approach allows to analyze long-term effects that evolve over time. In many cases, like changes in quantities of labor supplied, the shock imposed in the model has an inherent time lag. Impacts are not immediately obvious but emerge over time. This time dimension can be modeled with a DCGE model, which considers the evolvement of factor stocks.

The dynamic CGE model is based on the "standard" static CGE model developed by Lofgren et al. (2002), which recently has been extended by Hans Lofgren at the International Food Policy Research Institute (IFPRI) to incorporate temporal dynamics.[6] It is constructed to be recursive meaning that it is solved for each period hence generating selected parameter values which are then rendered into the consecutive period where the model is again solved using the new values. To account for its recursive features the model is divided into two sub-sections—the within-period module and the between-period module. The within period module is basically a static CGE model and defines the behavior of public and private agents who choose their optimal level of consumption and production on the basis of relative prices. In the model all agents are myopic which means they do not make their decisions with regard to future expectations but base their decision making only on current economic conditions. In concordance to many other CGE models all agents are price takers indicating perfect competitive markets. The assumption of shortsighted economic agents is justified as there is only little empirical support for the assumption that agents make their decisions on the basis of perfect foresight.

The between-period module of the model defines the size of the labor stock, which is updated from period to period based on an exogenously determined growth rate. In the base run labor stock evolvement is connected to population growth, growing at exactly the same rate. Accumulation of capital is endogenous and depends on the stock of the previous period, investments, and the depreciation rate. Labor and capital stocks are disaggregated by institutions (private households and government) what allows for calculating the shares of labor income of each institution. An additional feature that distinguishes the dynamic from the static CGE model is that it allows for total factor productivity growth. For the relevant period of 2000 to 2015 we assume a 0.5% annual total factor productivity growth for all sectors of the Tanzanian economy. The model is solved for each consecutive period thus creating a dataset for each of the 16 periods, which contains economy wide data on micro and macro levels plus evolvement of stocks that are allowed to change over time.

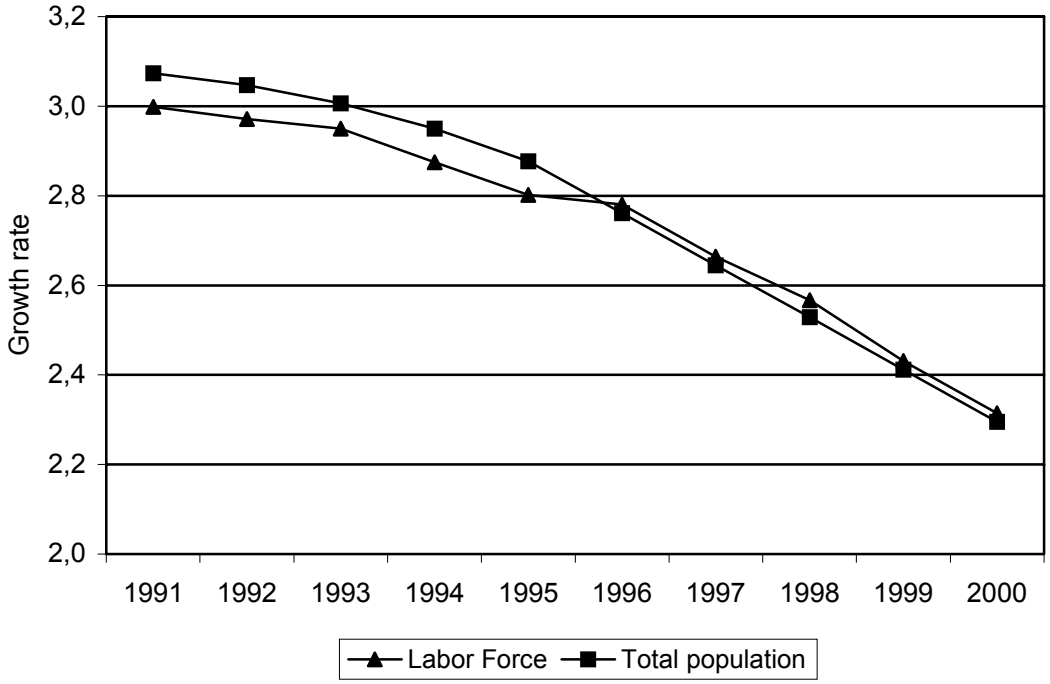
[6] This section is based on an unpublished work-in-progress manuscript by Hans Lofgren at IFPRI that describes the dynamic CGE modeling approach applied here.

4 Data

The main data source for the analysis is a 2000 social accounting matrix (SAM) for Tanzania, which has been documented by Thurlow and Wobst (2003). It includes several accounts for activities, commodities, factors and institutions that represent all payment flows in the Tanzanian economy, including monetized non-monetary transactions such as own-household consumption or gifts. The accounts are disaggregated into lower level units to account for different agents and sectors. The SAM is adapted to poverty analysis since household and labor categories take into account the large number of people living below the basic needs poverty line and the high share of agricultural production in generating value added. The households are disaggregated into 12 categories considering (i) different poverty levels according to Tanzania's Poverty Base Line Study (URT 2000) as well as (ii) rural and urban areas. A particular feature of the Tanzania SAM is that it explicitly considers a child labor market. The SAM labor category accounting for child labor contains children from 10 to 14 years old that are working for wage. Other labor categories include accounts for non-educated labor, labor with some education but not finished primary school, labor finished primary but not finished secondary school, and labor with completed secondary or higher education. These four adult labor markets are further divided by gender. The last account representing a share of the total labor force is a subsistence factor, which is an aggregate of all people working in the subsistence sector and capital used in the subsistence sector.

The dynamic model requires additional data about population growth rates to bring forward the population and labor force, which has been adopted from the World Development Indicators 2002 (World Bank 2002). Since the model is dynamic and allows for the evaluation of future prospects the accordant growth rates have to be based on expectations rather than experience. In this respect it is quite difficult to determine the future growth rates, especially when the time horizon is rather long. As can be seen from Figure 1, although the labor force does not grow exactly in concordance with total population the correlation is quite high—in particular from 1996 onwards. This reasonably justifies the linkage of population growth rates to the respective labor force growth rates in the base run which are therefore set to 2.3% in the first period. The declining trend of population growth is continued in the model and we assume an annual decrease of the population growth rate of 2.5%. This annual reduction generates a population growth rate of 1.7% in 2015, which seems justifiable in the face of an expected high mortality rate through AIDS and a further decline in birth rates over time. Since land is a non-tradeable factor and new land is often substituted for degraded land plots the growth rate for land is set to zero.

Figure 1: Population and Labor Force Growth



Source: World Development Indicators (World Bank 2002)

5 Experimental Design and Results

In order to get an insight into the impact of skills upgrading on the Tanzanian economy, we simulate a governmental program that aims at increasing primary school enrollment. We assume that the program affects the amount of working children and thus child labor is reduced. In our simulation, the enhancement of the school enrollment rate leads to a decrease of the amount of child labor by 50%. All children sent to school are completely removed from the wage labor market. We impose a program-duration of 5 years with an annual reduction of 10 percentage points to achieve a total 50% reduction in the supply of child labor from year 2000 to 2005. In the scenarios we compare the economic impact of an increased output of educated labor as compared to the base scenario that represents the current status quo of the skill structure of the Tanzanian labor market.

Box 1: Policy Simulations

'RedChild' - scenario
- Child labor decreases by 50% over 5 periods assuming increased school enrollment
- After 7 periods, all formerly working children now enrolled finish primary schooling and join the primary educated labor market segment

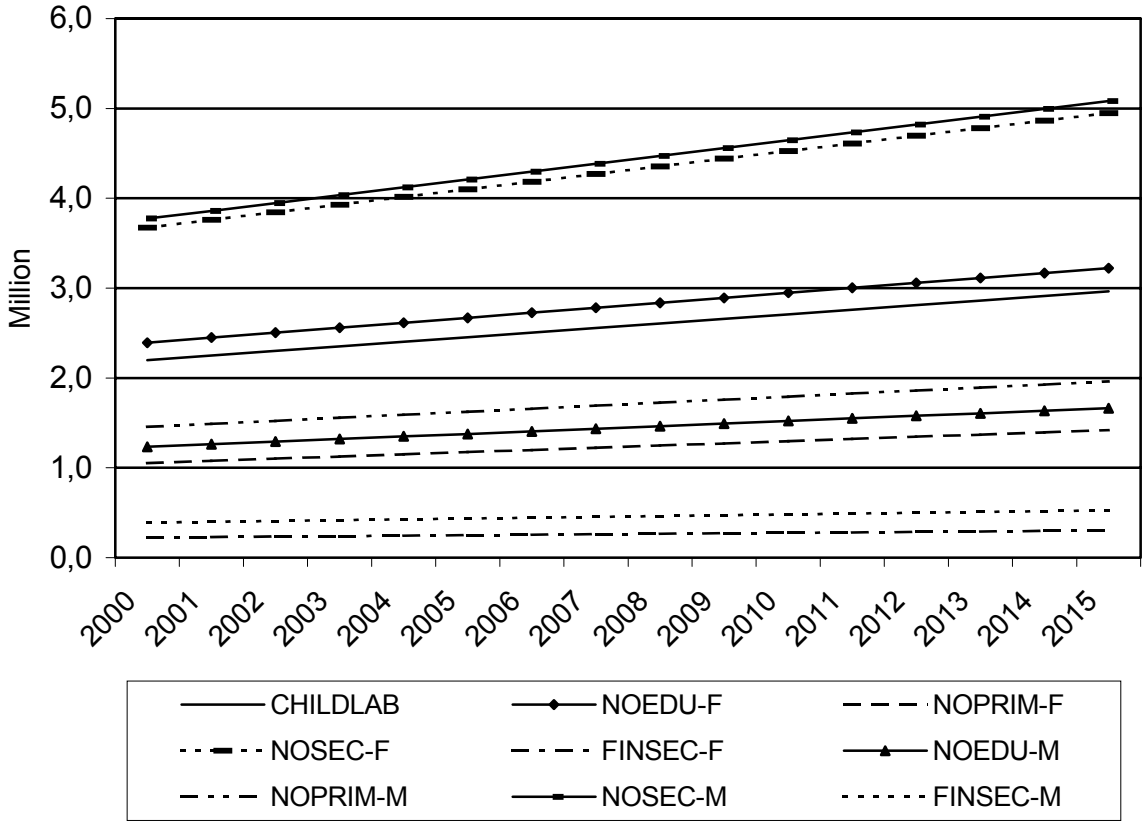
'PrimChild' - scenario
- As 'RedChild'
- Labor force growth rates are interdependent (size of non-educated labor force declines due to higher school enrollment)

'TransChild' - scenario
- As 'PrimChild'
- But, adjusted for drop-out probabilities from educational transition matrix (Arndt and Wobst 2002)
- Pupils dropping out of primary school enter labor force segment 'not-finished-primary-school'

We run 3 different scenarios, described in Box 1, distinguished by different assumptions with regard to labor force growth and the success of schooling. The simulated government program is the same across all 3 scenarios and hence, in each scenario 50% of child labor is moved from wage labor to school. All scenarios extend over 16 periods, for 2000 to 2015. In the first scenario, 'RedChild', the children who have been working in the base scenario are now sent to school in 5 consecutive steps. After 7 years of primary school attendance they enter the adult labor market and complement the portion of the labor force that has finished primary but not finished secondary school. We allocate these children to the respective labor segments according to their gender. In the second scenario, 'PrimChild', we consider that the evolvement of other

labor segments is affected by the reduction of the child labor force. Since non-educated labor is to a great extent supplemented by laborers that have been working as children and thus were not able to attend school, the growth rate of this labor segment must decrease as a result of the increased primary school enrollment. In the 'PrimChild' scenario we take these interdependencies into account and reduce the size of unskilled labor categories according to the number of children that are now educated and have entered the skilled labor force. In order to further adjust the model to the Tanzanian reality, we consider that children initially enrolled in primary school often fail to finish the first degree. To obtain the probabilities with which children move through the Tanzanian school system, we rely on the educational transition matrix estimated by Arndt and Wobst (2002). The values of the transition matrix provide information about how likely an average child is to finish primary school. Only 63.7% of the children initially enrolled in Grade 1 finish the whole 7 years of primary education. In the 'TransChild' scenario, children who drop out are allocated to the labor force segment not-finished-primary-schooling.

Figure 2: Labor Force Growth - Base Scenario*

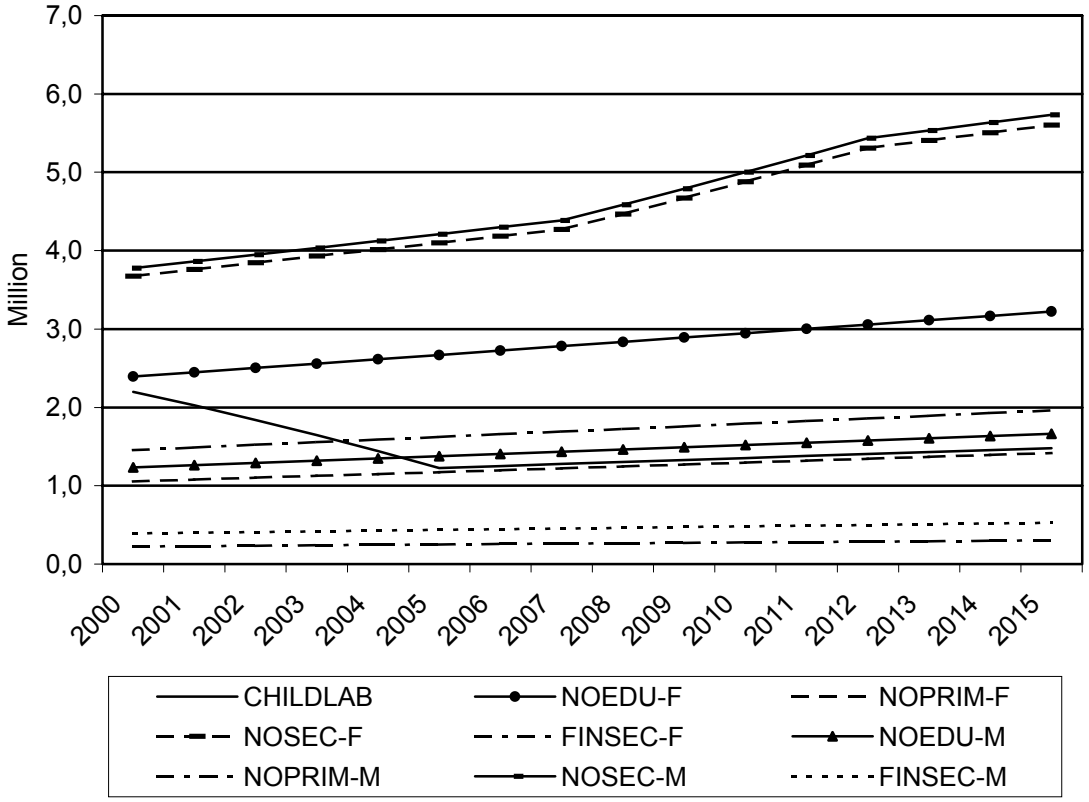


Source: Authors' calculations
*All acronyms are explained in Table A.1 of the Appendix.

Special attention is paid to the development of the labor force composition over time. Figure 2 shows labor force growth rates from year 2000 to 2015 in the base scenario. Labor with primary school education (NOSEC) constitutes with a share of 45.4% the largest portion of the labor force. The share of unskilled female labor (NOEDU-F) lies at 14.6% and is substantially higher than the share of unskilled males (NOEDU-M) with a share of 7.5% of the total labor force. Females have usually less opportunities to enjoy formal education than men, although the gender difference is rather low when looking at workers who finished primary school. With 13.4%, the figure further shows a very high share of child labor (CHILDLAB) in the total labor force.

Figure 3 reports labor force growth rates after implementing the schooling program. Child labor is reduced by 50% while, after 7 years, the primary educated labor force segments (NOSEC-F and NOSEC-M) increase as the additionally educated children enter the adult labor market. All other labor segments grow constantly as before.

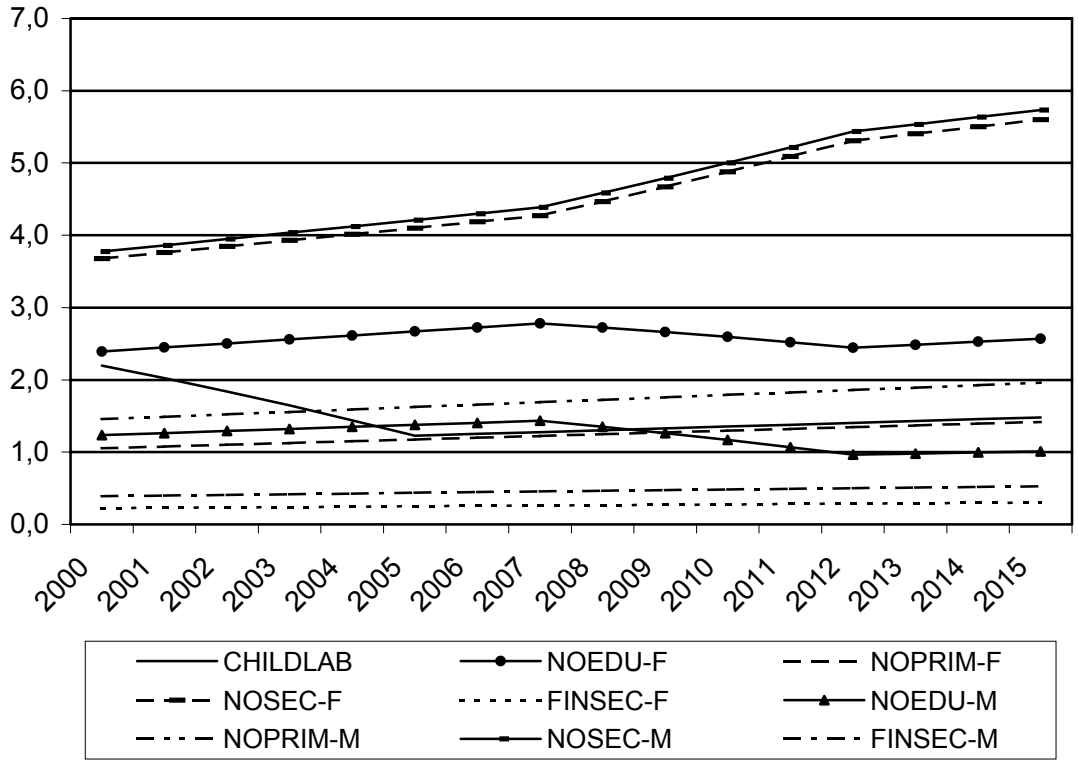
Figure 3: Labor Force Growth - 'RedChild' Scenario*



Source: Authors' calculations
*All acronyms are explained in Table A.1 of the Appendix.

In the second scenario, 'PrimChild', the growth rates of the labor segments are interdependent. Due to the reduction of working children who usually feed into the non-educated labor force segments (NOEDU-F and NOEDU-M), these segments now receive only a smaller portion of new labor and, consequently, not only their growth rates but their sheer size decreases.

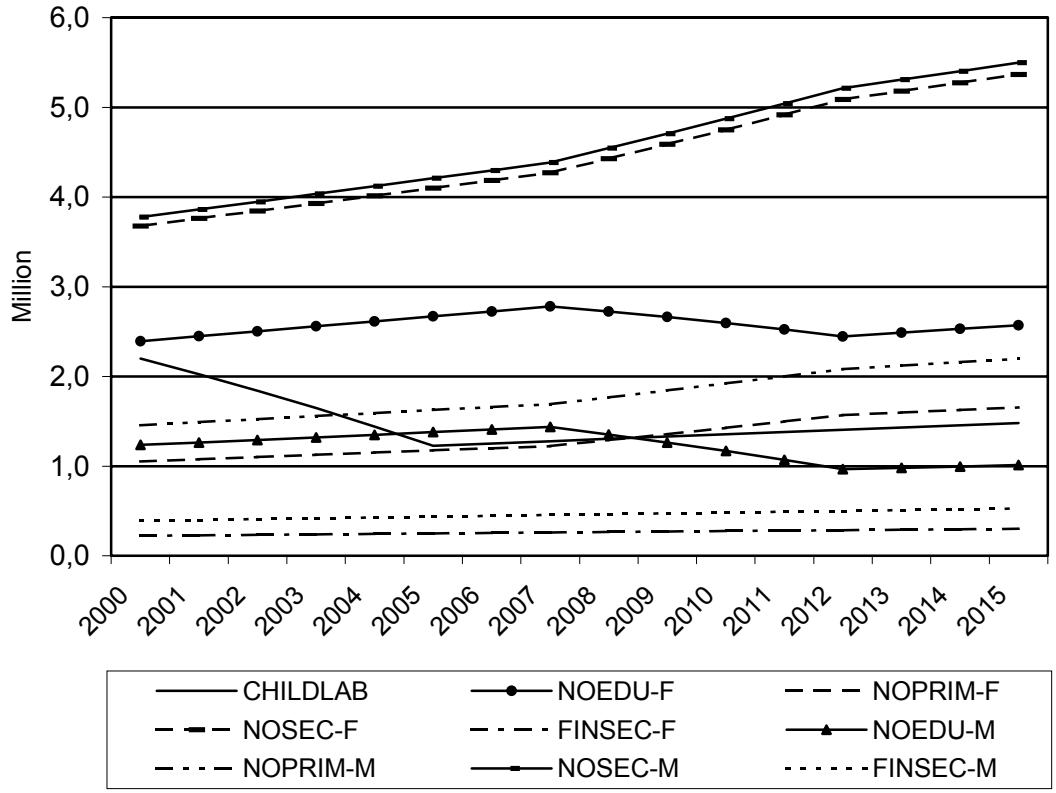
Figure 4: Labor Force Growth - 'PrimChild' Scenario*



Source: Authors' calculations
*All acronyms are explained in Table A.1 of the Appendix.

In addition to the interdependency of the child labor and non-educated labor force segments, the third scenario, 'TransChild', utilizes the probabilities with which pupils are expected to achieve a certain educational degree. Applying the probabilities of the educational transition matrix, the success of the school program from the first two scenarios is dampened. Since only 63.7% of the newly enrolled children finish primary school the growth of the primary educated labor force segments slows down, while the growth of not-finished-primary-school labor force segments increases as compared to the 'PrimChild' scenario, which is shown in Figure 5.

Figure 5: Labor Force Growth - 'TransChild' Scenario*

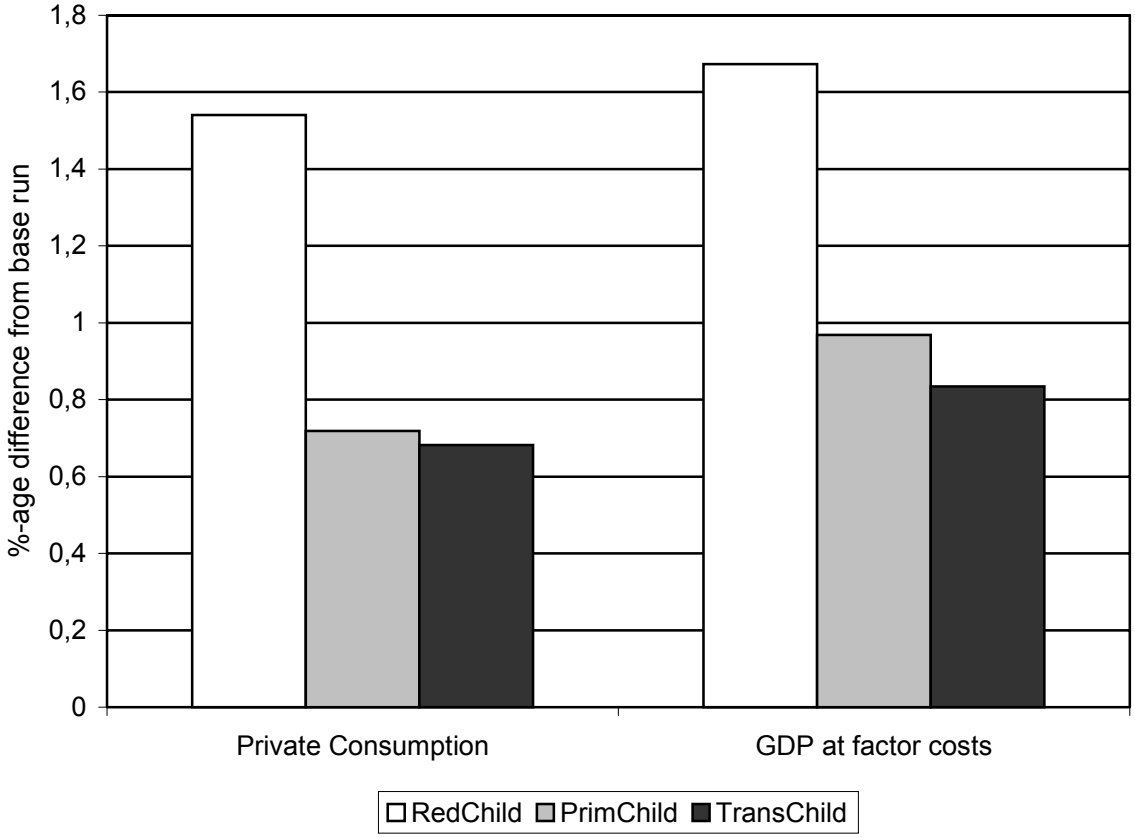


Source: Authors' calculations
*All acronyms are explained in Table A.1 of the Appendix.

Beside the more descriptive effects of a reduction of working children it is interesting to see what happens to welfare in terms of private consumption and GDP at factor costs.[7] Figure 6 shows the evolvement of total consumption and GDP over time. The first set of bars indicates the percentage point difference of the scenarios from the base run for private consumption for the last period 2015. The increase of the educated labor force affects growth rates of GDP and private consumption thus replicating the findings of empirical studies. In the final period, total GDP from the first scenario 'RedChild' is 1.7% higher than in the base scenario. The values obtained from the third scenario, 'TransChild', are smaller than the results of the first two scenarios: GDP is only 0.8% higher than in the base scenario. Private consumption has risen by more than 1.5% after 15 years in the first scenario, while it is increasing by only 0.7% in the second and the third scenario.

[7] In the remainder all occurrences of GDP refer to GDP at factor costs.

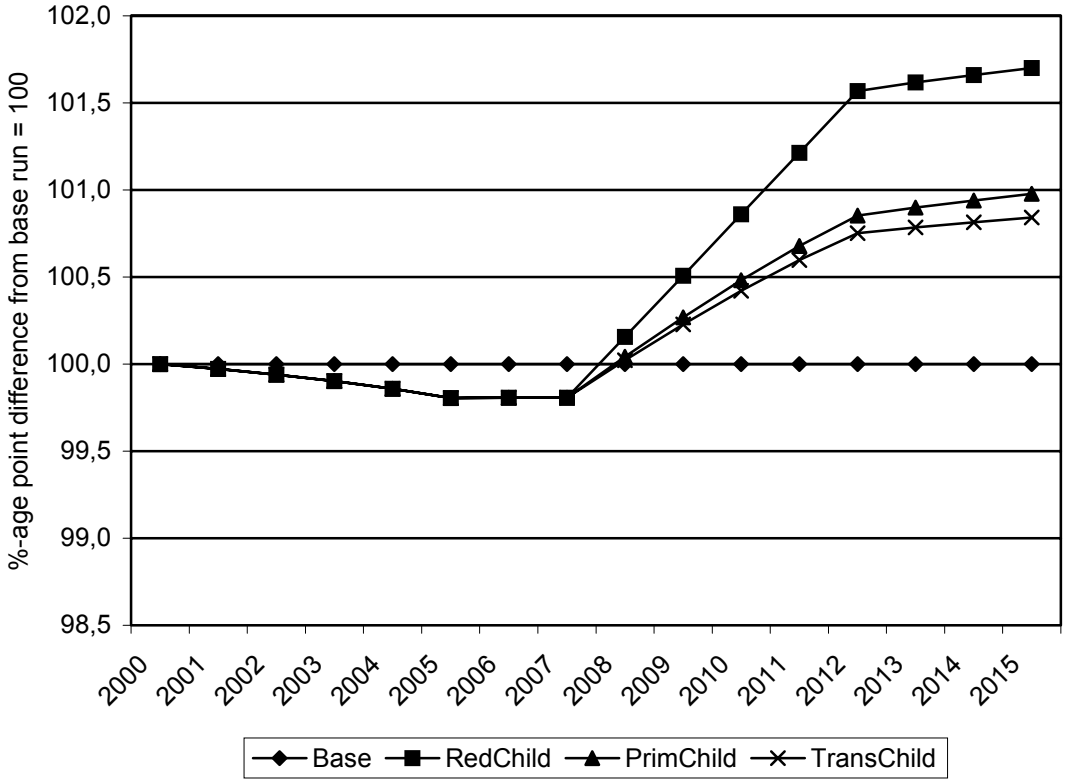
Figure 6: Total GDP and Private Consumption Changes as Compared to the Base Run in 2015



Source: Authors' calculations

While Figure 6 reports absolute levels, in Figure 7 we have standardized absolute levels of GDP from the base scenario to 100, making it easier to evaluate simulated changes in GDP. The vertical axis refers to percentage changes of GDP for the scenarios in relation to the base run. The figure shows that GDP declines during the first periods when child labor is removed from the labor market. But when the educated adolescents enter the labor market, GDP growth in the scenarios outperforms the base run as the increased formation of human capital comes into effect. The higher the share of relatively well-educated workers in the economy, the higher its GDP growth. The findings are also supportive of the assumption that households might face a trade-off between welfare in the short and the long run since GDP first declines and is overcompensated for these early declines only after 8 years—a planning horizon to be considered by the government, but a rather unlikely planning horizon for most subsistence households in Tanzania.

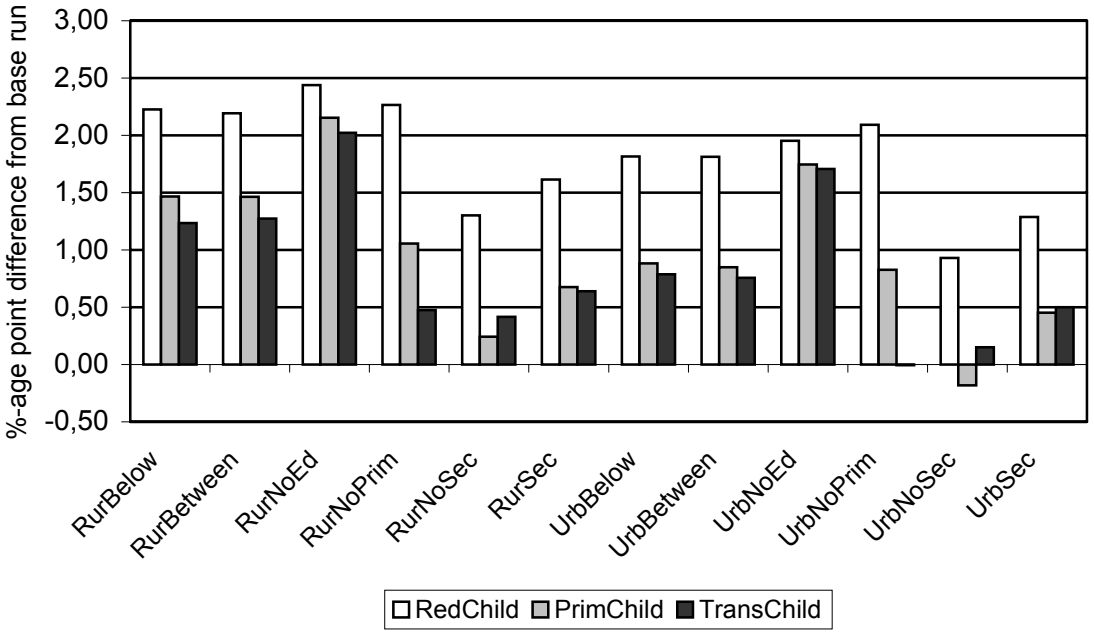
Figure 7: GDP at Factor Costs Growth



Source: Authors' calculations

As GDP grows total incomes evolve positively and all households gain from the upgrading of skills and economic growth. Figure 8 shows the relative changes in incomes for the 12 household categories at the end of the last period for all three simulations. In the scenario 'RedChild', rural households operating below the poverty line earn a 2.2% higher income in comparison to the base run. There is a clear increase in income of households across all categories indicating that the economy reaches a new Pareto optimum, though the distribution of additional income increases is not equal. The findings support the further conclusion that poor and/or unskilled rural households gain most from educational improvements. Their incomes increase by an average of 2.3% in the first scenario. If the head-of-household is un-educated or has dropped out of primary education, rural households above the basic needs poverty line gain slightly more than poor rural households. This general picture is more or less the same across the other scenarios.

Figure 8: Relative Income Changes as Compared to the Base Run in 2015*

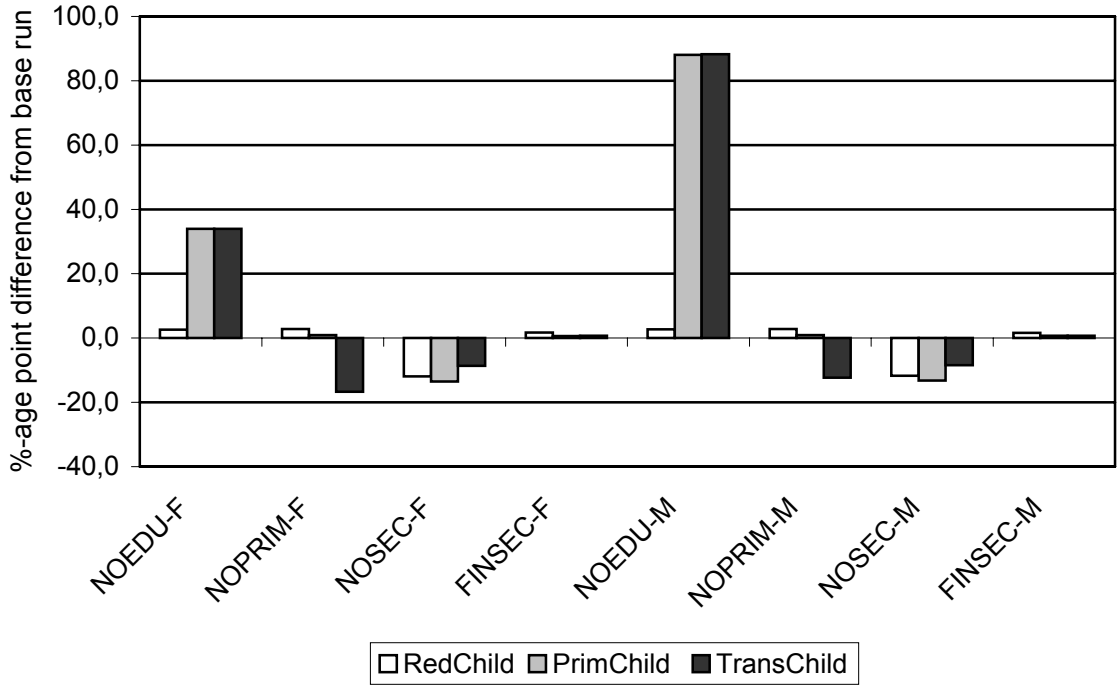


Source: Authors' calculations
*All acronyms are explained in Table A.2 of the Appendix.

Even though rural households gain more than urban households, the results also show that, poor and unskilled non-poor households gain more than the more skilled non-poor households. The average income increase of poor and/or unskilled households in urban areas amounts to 1.2% in the 'RedChild' scenario. Non-poor households in rural and urban areas exhibit less pronounced income changes of about 0.9%. In the third scenario, the picture is quite similar as compared to the 'RedChild' scenario, although the values are much smaller. The schooling program has only marginal effects on the evolution of household incomes in rather skilled urban households and in scenario two, if the head-of-household is primary educated, households even loose from the reduction of child labor. This can be partly explained from the fact that wages adjust to the changed quantities of labor supply in the respective categories. All in all, the income gap between rural and urban, as well as between skilled and unskilled household categories is narrowing.

Since, due to the program, more educated labor is supplied to the labor market, the wage gap narrows between non-educated and educated labor categories. Wages rise in particular for non-educated labor, while wages for female and male primary educated labor decrease due to their larger relative size as compared to the base run. Wages for the primary educated labor force decline by more than 10% in all scenarios. Thus, the closing of the wage gap mainly applies to low wages for non-educated labor and medium wages paid to primary educated labor, which are still much lower than wages paid to secondary educated labor.

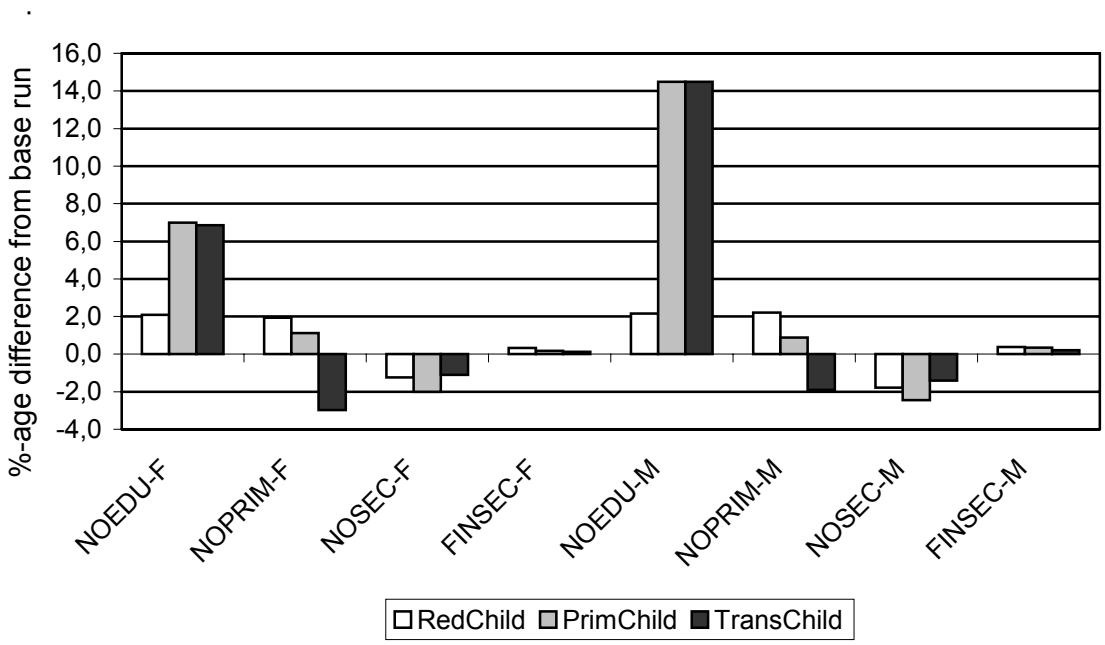
Figure 9: Relative Changes of Average Wage Paid to Labor as Compared to the Base Run in 2015*



Source: Authors' calculations
*All acronyms are explained in Table A.1 of the Appendix.

How do changes in the wage structure for different skill levels in the labor force affect the distribution of incomes across labor categories? First, we look at the evolvement of factor incomes over time and surprisingly there are no major impacts on the distribution of incomes to different factors resulting from increased school enrollment. The income changes presented in Figure 10 have again to be interpreted on the basis of the initial shares of the respective labor category thus deflating the results for non-educated labor.

Figure 10: Changes of Factor Income Shares as Compared to the Base Run in 2015*



Source: Authors' calculations
*All acronyms are explained in Table A.1 of the Appendix.

Since factor income shares do not change substantially, income inequality is not affected either, which is reflected in Table 2 that reports Gini-coefficients for each scenario. Inequality decreases only slightly. Differences between the scenarios and the base run are rather low though it should be noted that inequality declines in the course of economic growth in the base run as well as in the scenarios.

Table 3: Evolvement of Income Inequality According to Gini-Index*

Scenario	2000	2015	Percentage changes
Base	0.475	0.456	4.0
RepChild	0.475	0.455	4.2
PrimChild	0.475	0.454	4.4
TransChild	0.475	0.454	4.4

*Column 2 and 3 report the respective Gini-coefficients, while column 4 indicates to what extent the coefficients changed in the course of time.

Although changes in overall income inequality measured through the Gini-coefficient are very small, changes in poverty can be better expressed through the Sen Poverty Index.[8] Table 3

[8] The Sen Poverty Index has been widely used in measuring changes in poverty, since it accounts simultaneously for inequality among the poor and their relative position as compared to the poverty line. See Sen (1976) for further discussion.

indicates that an increase of the educated labor force may not considerably change income inequality, but nevertheless has an impact on poverty. The index increases by 12.6% in the 'RedChild' scenario. In the second as well as in the third scenario, where a large number of children fail to finish primary school, the poverty index decreases by 11.6%, as compared to 9.8% in the base run.

Table 4: Evolvement of Poverty According to Sen Poverty Index*

	2000	2015	Percentage changes
Base	0.214	0.193	9.8
RepChild	0.214	0.187	12.6
PrimChild	0.214	0.189	11.6
TransChild	0.214	0.189	11.6

*Column 2 and 3 report the Sen Poverty Index, while column 4 indicates to what extent the coefficients changed in the course of time.

6 Conclusions

The simulation results indicate that schooling and skills upgrading has implications for overall economic growth. When child labor hinders human capital formation, economic growth is reduced. As expected, due to the removal of child labor from the labor market GDP growth is reduced in the first periods, but immediately outperforms the base run growth rates when human capital formation comes into effect. Beside the effects of a schooling program on economic growth, we focused on the distribution of the gains resulting from human capital formation. Although the increase of GDP might appear rather moderate, the gains are obvious, since the distribution of household income increases are Pareto efficient: except for one household category in the scenario 'PrimChild', none of the households faces a decrease of income. Our findings also show that factor shares do not substantially change. Hence, the impact on income inequality is rather low. This might be partly due to the fact that the Gini-coefficient does not reflect proportional changes in the rank (with respect to income) of a particular household category. As is obvious from the simulations, the gains are not equally distributed across all household categories. The incomes earned by poor rural households might outperform incomes of poor urban households, thus causing an interchange between the relative ranks of the respective household categories. However, the Sen Poverty Index shows that although inequality is not affected by human capital formation, poverty changes in a way that the index values decreases.

But even when inequality does not change in the simulations, the extension of the time path in the scenarios might show an improvement towards more equality. The results show that economic growth itself leads to a reduction in inequality. Furthermore, as for instance Romer (1986) or Lucas (1988) suggest, inherent to the formation of human capital are the long-term prospects for economic growth. As the endogenous growth theories emphasize human capital can lead to maintained long-run growth, through spillover effects or the improved adoption of new technologies.

The effects of human capital formation are most obvious in rural areas, where more child labor can be found and a higher percentage share of primary educated labor works. Whether such a schooling program works or not depends on how households assess the trade-off between slight income losses in the short run and high income gains in the long run. The decision on this clearly depends on the economic situation in which the household operates. When income from child labor is crucial to maintain the minimum food requirements, households will not have the opportunity to decide whether to send their children to school or not.

The results from the three scenarios are quite different, and which one of them is closer to reality is not easy to decide. Nevertheless, the results obtained from the 'TransChild' scenario

are probably closest to reality, since this scenario incorporates school drop-out rates observed in the Tanzanian school system. But the probabilities obtained from the educational transition matrix might be affected when more children go to school. With an increase of children enrolled in school the probability of attaining at least a degree in primary education might increase. Moreover, it is likely that although many children are sent to school in the simulations, a large number of children will continue to work, while neglecting their homework and thus fall back in their overall school performance. Furthermore, the AIDS pandemic is also likely to have a negative effect on the future evolvement of school enrollment rates (see Arndt and Wobst 2002, Beegle 2002). However, the conclusion that can be drawn from the results of the three scenarios is that the schooling system has to be improved, not only in educational quality but also with regard to dropout rates of pupils. Human capital formation is successful only in case the schooling system is efficient enough to guarantee at least a degree in primary school. If children attending school do not earn a degree that will help them to increase their value in the labor market, the effects of a schooling program might be quite disappointing. Given the long time horizon the incentive for households to send their children to school might be dampened, since substantial gains are not immediately obvious. For very poor households, sure income losses in the first periods may have a heavier weight than uncertain income gains in the future.

An increase of the overall level of education implies also non-economic benefits, as reported in Wolfe and Haveman (2001). For instance, positive correlations have been found between schooling and health, whereas spillover effects are regularly observed, i.e. children and spouses of educated people are usually in a better health condition than in uneducated families. Educated people have the capability to attain information on their own and can easily disperse information to others, thus encouraging activities like saving or introducing new technologies. Disposal of cognitive skills contributes to greater political awareness, hence encouraging voting behavior in democracies. Since many of these by-products from education might contribute to economic development, the moderate gains reported in this study could be regarded in this respect as the lower bound of benefits that an increase of primary schooling brings about. In view of these effects, the results from the 'TransChild" scenario might therefore provide a lower bound under which the gains of the schooling program are unlikely to fall.

The fact that the modeled schooling program comes at no costs for the government is problematic when it comes to the real implementation of such a program. It is possible that schooling programs will not be conducted at all, when they are too costly and gains are too uncertain. It is also possible that increased expenditures on education will decrease investment in other sectors, due to the reallocation of available budgets what might have negative effects on the respective sector which are not accounted for in this model.

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Appendix

Table A.1: Labor Force by Labor Category (2000/01)

Category	Acronym	Description	Number of Workers	Share of total workers
Child labor	CHILDLAB	Ages 10 to 14	2,199,466	13.4
Female	NOEDU-F	No formal education	2,393,453	14.6
	NOPRIM-F	Not finished primary school	1,053,960	6.4
	NOSEC-F	Not finished secondary school	3,675,128	22.4
	FINSEC-F	Secondary or higher education	224,616	1.4
Total adult female			*7,347,157*	*44.8*
Male	NOEDU-M	No formal education	1,235,325	7.5
	NOPRIM-M	Not finished primary school	1,455,872	8.9
	NOSEC-M	Not finished secondary school	3,773,804	23.0
	FINSEC-M	Secondary or higher education	391,328	2.4
Total adult male			*6,856,330*	*41.8*
All labor categories			16,402,952	

Source: Authors' calculations using the Labor Force Survey 2000/01 (URT 2002a)

Table A.2: Household Population by Household Category (2000/01)

Category	Acronym	Description	Number of People	Share of Total Population
Rural	RurBelow	Below food poverty line	5,080,859	16.2
	RurBetween	Between food and basic needs poverty lines	4,605,455	14.7
	RurNoEd	Non-poor – head with no education	3,512,349	11.2
	RurNoPrim	Non-poor – head not finished primary school	3,499,736	11.2
	RurNoSec	Non-poor – head not finished secondary school	7,842,113	24.9
	RurSec	Non-poor – head finished secondary school	661,535	2.1
Total rural			*25,202,047*	*80.3*
Urban	UrbBelow	Below food poverty line	674,816	2.2
	UrbBetween	Between food and basic needs poverty lines	712,486	2.3
	UrbNoEd	Non-poor – head with no education	422,993	1.4
	UrbNoPrim	Non-poor – head not finished primary school	689,084	2.2
	UrbNoSec	Non-poor – head not finished secondary school	2,462,953	7.9
	UrbSec	Non-poor – head finished secondary school	1,146,635	3.7
Total Urban			*6,108,967*	*19.7*
All households (total population)			31,311,014	100.0

Source: Authors' calculations using the Household Budget Survey 2000/01 (URT 2002b)

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