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Social and Individual Costs of Child Labor

by

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Children who are engaged in work rather than attending school fail to accumulate human capital. This has implications at the personal level as well as the economy wide level, since education contributes to labor productivity. We examine the consequences of not sending children to school with regard to economic growth and income inequality and assess the trade-off between child labor and human capital formation. 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 individual welfare. A particular feature of the Tanzania SAM is the explicit consideration of a child labor market, which enables us to analyze child labor issues. In order to get an insight in how child labor affects the economy, we simulate a government program that aims at increasing primary school enrollment, to reduce the amount of child labor by 50%. We find that an increase in human capital formation through the reduction of child labor 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.

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1. Introduction

Child labor is an apparent phenomenon in many developing countries whereas the amount of working children is particularly high in Sub-Saharan Africa. Among SSA countries, Tanzania belongs to the group of countries that exhibit the highest shares of children participating in the labor force. Data from the 2000/01 Labor Force Survey in Tanzania conducted by the National Bureau of Statistics suggest that 1.4 million children from 10 to 14 years of age, representing 40.2% of all children 10 to 14 years old, are at least partly engaged in work rather than attending school.

While there are many reasons that make parents decide to engage their children in work, and many forms that child labor can show, the results of not attending school are fairly equal. The child fails to accumulate human capital which 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.

From the literature it is evident 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.

Facing the importance of human capital formation this paper is concerned with the effects of child labor on economic growth and household welfare. While many econometric studies have investigated the causes of child labor, we examine the consequences of not sending children to school with regard to economic growth and income inequality and assess the trade-off between child labor and human capital formation. A dynamic computable general equilibrium (DCGE) model is used to evaluate the quantitative long-term effects of increased school attendance on overall

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

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 from these results.

2. Child labor and earnings in the Tanzanian economy

Although child labor is prohibited by law it is virtually existent in most sectors of the Tanzanian economy. Out of 16.4 million working people[2] about 8.6% or 1.4 million are children. Although children constitute a relatively large portion of the labor force they contribute only 0.3% to total GDP at factor costs.[3] Therefore, it is reasonable to think about a trade-off between children working and children going to school in order to accumulate human capital. Children who have been working rather than attending school are expected to enter the unskilled labor force—which contributes a mere 1.9% to GDP at factor costs—when they become adults. The largest portions of value added are generated from the more skilled labor force that finished primary but not secondary schooling (15.7%) and the subsistence sector with a share of 26.7%.[4] Incomes earned in the labor force with secondary or higher education amounts to 7.9%. These shares should be interpreted with caution since they do not consider the different number of people within the respective labor categories. When we only look at earned income per capita and express this in percentage shares, then it becomes clear that education is clearly beneficial to earnings. The educated laborers earn 63.9% of all earned income per capita, while children earn only 0.7%. These numbers indicate that in terms of welfare households might indeed face a reduction in income when child earnings are missing, but this share is rather low. In the long term, households will probably be better off, assuming that laborers are paid according to their marginal product, which is typically higher for workers with better education.

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.

[2] Data derived from the Labor Force Survey (LFS) 2000/01.
[3] Data derived from Household Budget Survey (HBS) 2000/01.
[4] We draw here on the categorization of the labor force as done in the 2000 Tanzania SAM (Thurlow and Wobst 2003), which will be explained in more detail below.

Table 1: Sectoral structure of the Tanzanian economy (in %)

	Sectors	Value added	Production	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
	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	Agricultural Manufacturing	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.

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 to incorporate temporal dynamics.[5] 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

[5] 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.

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.

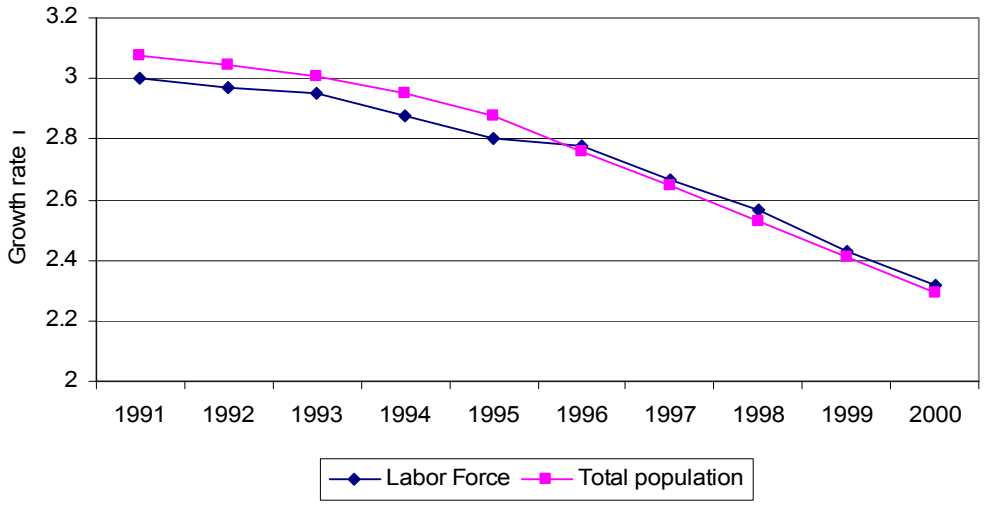
4. Data

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, which enables us to analyze child labor issues. The SAM labor category accounting for child labor contains children from 10 to 14 years old that are working for a wage. Other labor categories include accounts for non-educated labor, labor 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—including children[6]—and capital used in the subsistence sector.

[6] In our simulation we do not consider children working in the subsistence sector, since children will always be obliged to engage in domestic activities, like family farm work, household chores etc. This kind of work cannot be easily controlled for. In addition, the Tanzania SAM does not disaggregate the value that is produced in subsistence production by type of labor, making it difficult to assess the consequences of a reduction of child labor in the subsistence sector. Our focus is therefore on children who are self-employed or work for wage.

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 2000)

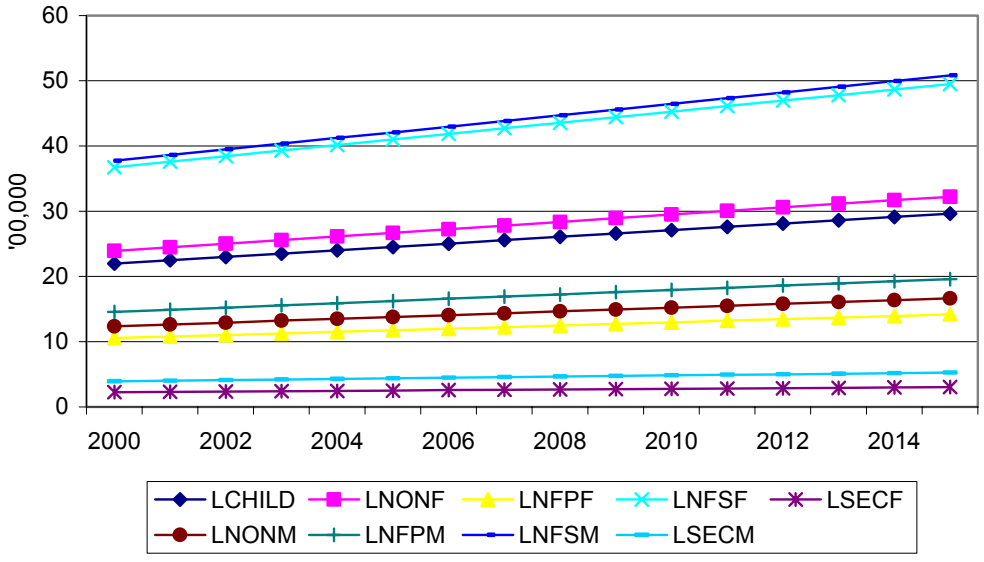
5. Experimental design and results

In order to get an insight in how child labor affects the Tanzanian economy, we simulate a governmental program that aims at increasing primary school enrollment, thus reducing the amount of child labor by 50%. We assume 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 Tanzania, primary schooling is distinguished from secondary schooling and children are released after 7 years of primary schooling to the labor market in case they do not opt for attending secondary school. In our scenarios we compare the economic impact of children attending school as compared to the base scenario that represents the current status

quo of child labor participation in Tanzania. We run 3 different scenarios distinguished by different assumption with regard to the labor force growth and the success of schooling. The scenarios allow us to assess the effect of a schooling program as compared to the current situation in the Tanzanian child labor market. In each scenario 50% of child labor is moved from wage labor to school. In the first scenario, 'RedChild', 50% of the pupils who have been working in the base scenario enter the adult labor market after 7 years of school attendance and amend 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 amended by laborers that have been working as children and thus were not able to attend school, the growth rate of this labor segment must go down. In the 'PrimChild' scenario we capture these interdependencies and slow down the growth of unskilled labor categories. In order to further adjust the model to the Tanzanian reality we take into account that children initially enrolled in Grade 1 of primary school often fail to finish the first degree. To assess the probability with which children move through the Tanzanian school system, we rely on the transition matrix estimated by Arndt and Wobst (2002). The derived values indicate that only 38.5% of the children initially enrolled in Grade 1 finish the whole 7 years of primary education. 5.2% continue with secondary education, which is Form 1 to Form 4 or 6 and only 0.4% of all juveniles enjoy some kind of higher education that follows secondary schooling.

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 constitutes the largest portion of the labor force.

Figure 2: Labor force growth - Base scenario*

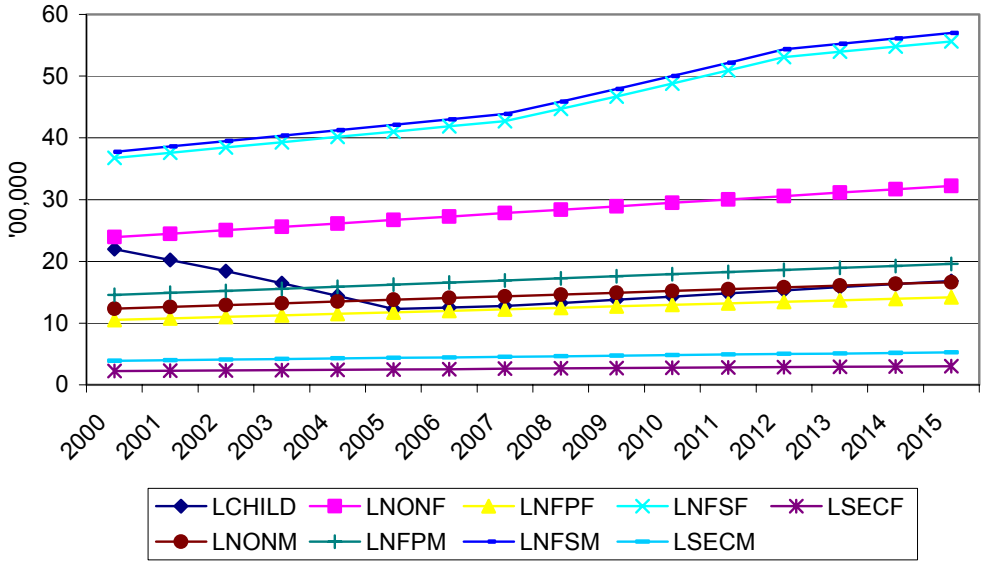


Source: Authors' calculations
*All acronyms are explained in Appendix A1

The share of unskilled female labor (LNONF) is substantially higher than the share of unskilled males (LNONM). Females have usually less opportunities to enjoy formal education then men, although the gender difference is rather low when looking at workers who finished primary school. The figure further reports a very high share of child labor (LCHILD) in the labor force as mentioned above.

Figure 3 reports labor force growth rates after implementing the child labor reduction program. Child labor is reduced by 50% while, after 7 years, the primary educated labor force segments (LNFSF and LNFSM) increase as the children enter the adult labor market. All other labor segments grow constantly as before.

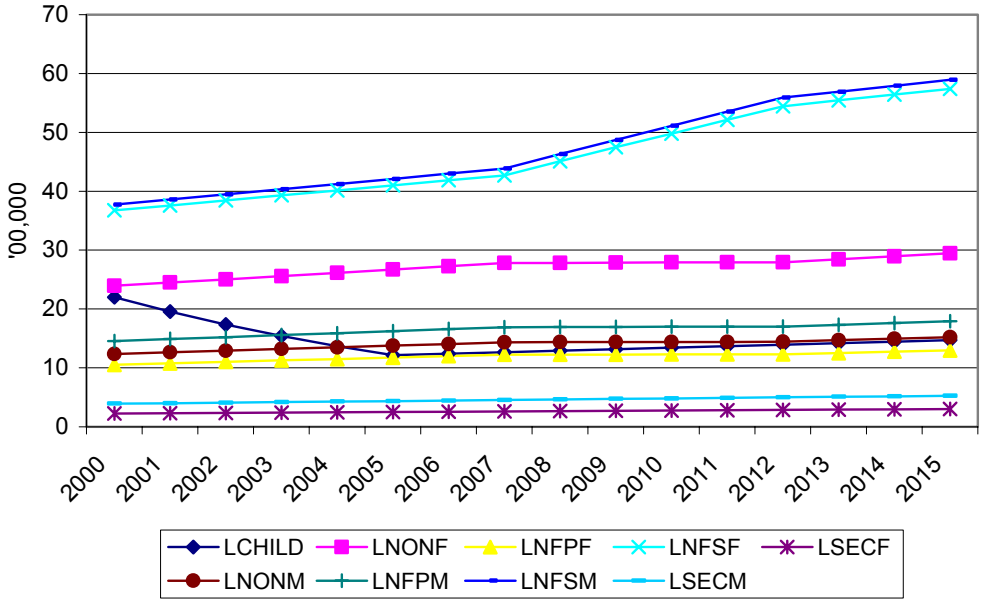
Figure 3: Labor force growth - 'RedChild' scenario*



Source: Authors' calculations
*All acronyms are explained in Appendix A1

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 (LNONF and LNONM), these segments now receive only a smaller portion of new labor and, consequently, their growth stagnates. We observe stagnation rather than mere reduction in these labor force segments since the model also takes dropouts (through retirements, etc.) into account. The same applies to the labor force segments that have not finished primary school, while the secondary educated labor segments is not affected in this scenario (see Figure 4).

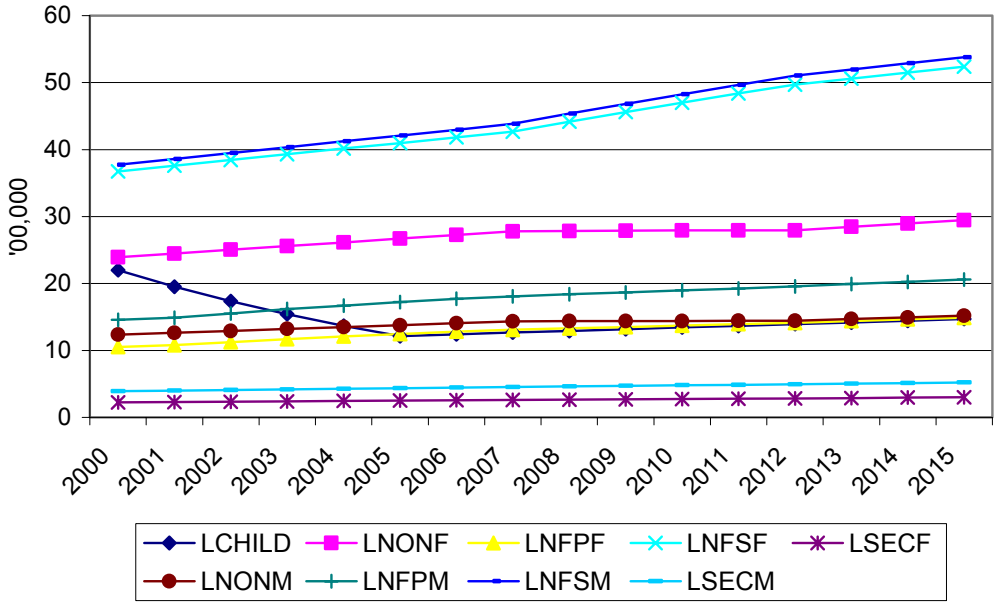
Figure 4: Labor force growth - 'PrimChild' scenario*



Source: Authors' calculations
*All acronyms are explained in Appendix A1

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. Using the probabilities of the education transition matrix estimated by Arndt and Wobst (2002) in the third scenario 'TransChild', the success of the school program from the first two scenarios is dampened. Since only a 38.5% of the newly enrolled children finish primary school the growth of the primary education 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 obvious from Figure 5.

Figure 5: Labor force growth - 'TransChild' scenario*



Source: Authors' calculations
*All acronyms are explained in Appendix A1

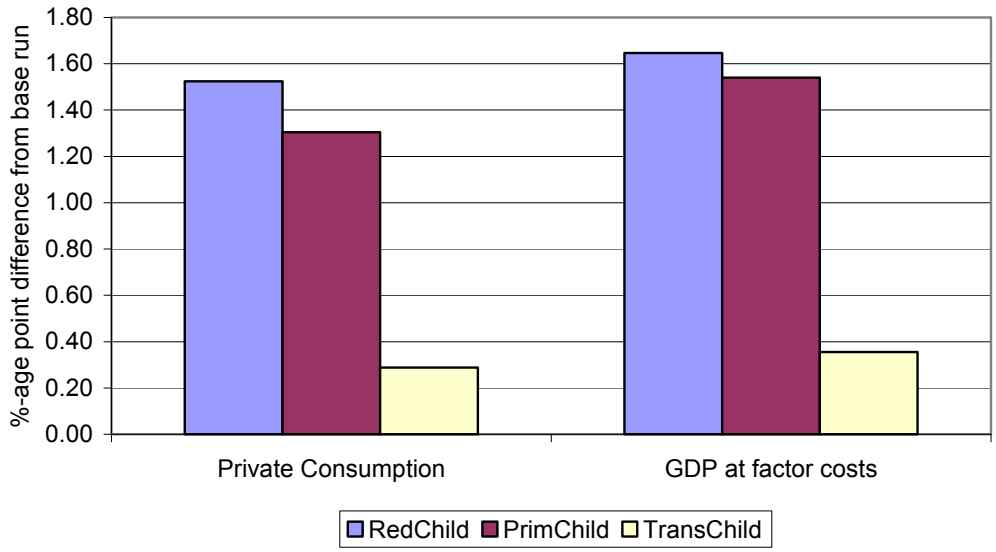
Beside the more descriptive effects of a reduction of working children it is interesting to see what happens to welfare in terms of private consumption and GDP at factor costs.[7] Figure 6 shows the evolvement of total consumption and GDP over time. The first set of bars indicates the percentage point difference of the scenarios from the base run for private consumption for the last period 2015. A reduction of child labor and the increase of the educated labor force affect growth rates of GDP and private consumption thus replicating the empirical results from the studies cited above that human capital formation increases GDP growth. After 15 years, total GDP is 1.5% in the first scenario 'RedChild' and 1.3% and the second scenario 'PrimChild' higher than in the base scenario when child labor is reduced and all additional pupils remain enrolled until they have finished primary schooling. The results from the third scenario, 'TransChild', draw a quite different picture: GDP is only 0.4% higher than in the base scenario. Private consumption has risen by more than 1.5% after 15 years in the first two scenarios, while it is increasing by only 0.3% in the third scenario, 'TransChild'.

The different results obtained by the scenarios should be judged on the basis of the underlying assumptions regarding the evolvement of the different labor segments. The most salient trait of the scenarios is that some labor segments grow at different rates as compared to the base run. But the growth rates in each scenario do not necessarily compensate for each other, thus affecting the overall growth rate of the aggregate labor force. Consequently, the resulting number of workers at the end of period 16 differs between the scenarios. Since in any case we are lacking reliable information of how each labor segment will evolve over time, the results can serve to develop a

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

'confidence interval' of the range of results that can be expected. In this respect, the scenario 'RedChild' provides the upper bound while the scenario 'TransChild' serves as a worst case scenario where the labor force growth is slower as in the other possible simulations and a large portion of children fail to finish primary school. The results of all other simulations will be likely to vary within these boundaries.

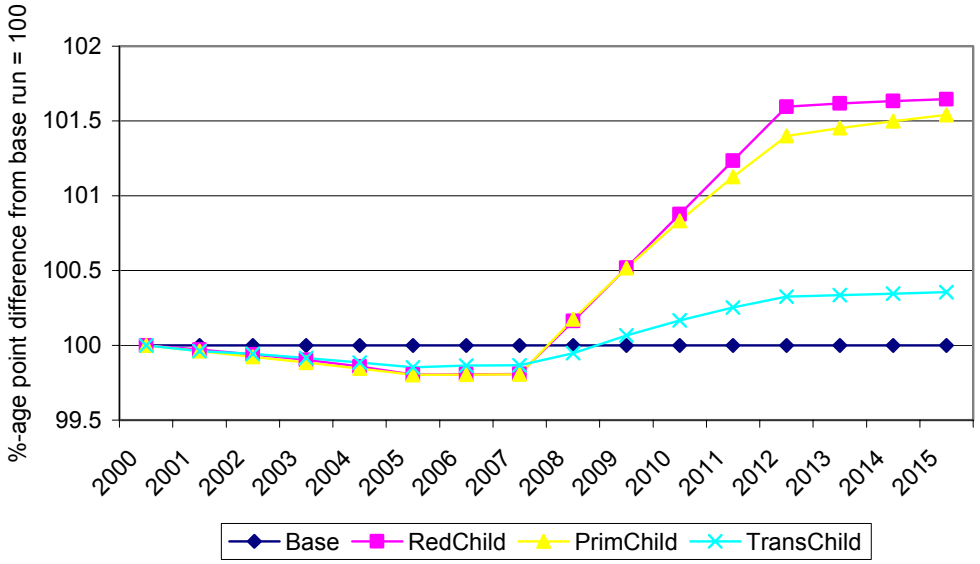
Figure 6: Total GDP and private consumption changes as compared to the base run 2015



Source: Authors' calculations

While Figure 6 reports absolute levels, in Figure 7 we standardize absolute levels of GDP from the base scenario to 100, making it easier to evaluate changes in GDP as compared to the base scenario. The vertical axis refers to percentage changes of GDP for the scenarios in relation to the base run. The figure shows that GDP declines when child labor is reduced by 50% in all scenarios during the first 7 years. But when the 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. But this is also supportive for 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 Tanzanian government, but a rather unlikely planning horizon for most subsistence households in Tanzania.

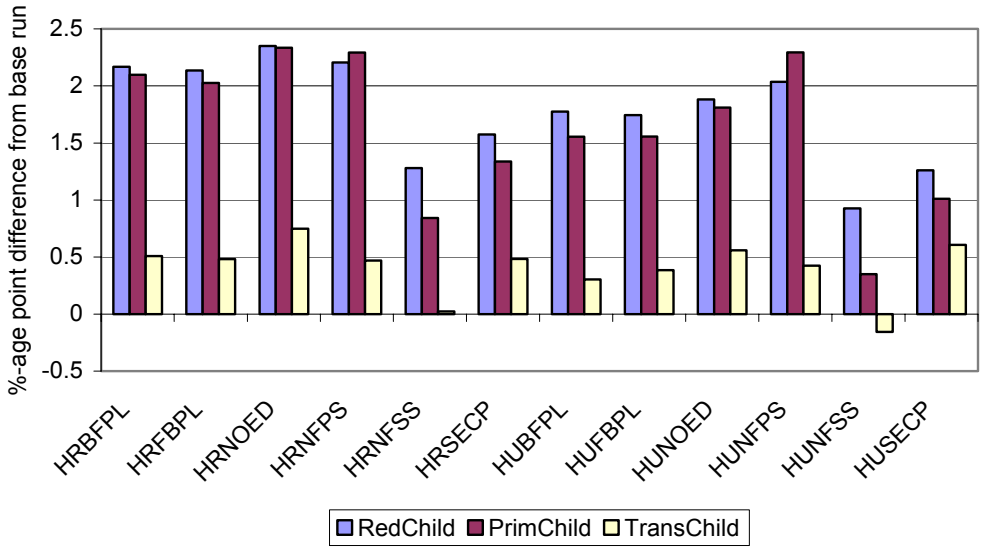
Figure 7: GDP at factor costs growth



Source: Authors' calculations

As GDP grows total incomes evolve positively and all households gain from economic growth and the reduction of child labor. Figure 8 shows the relative changes in incomes for the 12 household categories at the end of the last period for all three simulation scenarios as compared to the base run. For instance, in the scenario 'PrimChild', rural households operating below the poverty line earn a 2.1% higher income in comparison to the base run. In the first and the second scenario, 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 a reduction of child labor. Their incomes increase by an average of 2.2% in the first scenario. If the head-of-household is un-educated or has a primary education, rural households above the basic needs poverty line gain slightly more than poor rural households.

Figure 8: Relative income changes as compared to the base run in 2015*



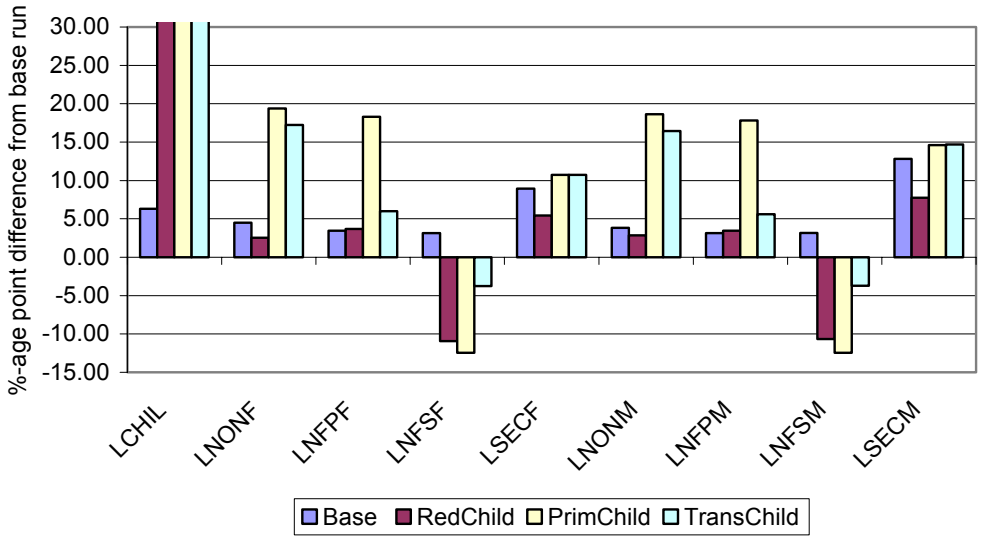
Source: Authors' calculations
*All acronyms are explained in Appendix A2

Even though rural households gain more than urban households in the 'PrimChild' scenario, the results also show that in general, poor and unskilled non-poor households gain more than the more skilled non-poor households. The average income increase of poor households in urban areas amounts to 1.6%, while unskilled households earn 2.0% more in average. Non-poor households in rural and urban areas exhibit less pronounced income changes of about 1.0%. In the third scenario, the picture is quite different since the reduction of child labor has only marginal effects on the evolution of household incomes. Furthermore, the income gap between rural and urban, as well as between skilled and unskilled household categories is narrowing. If their head-of-household has primary education, households even loose slightly 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.

As mentioned above, the reduction of the child labor force and the related increase in human capital formation through improved school attendance has implications for the wage gap between different labor categories. Since the total amount of children available for work has declined, wages paid to children increase. In the aftermath of the implementation of the child labor reduction program more educated labor is supplied to the labor market resulting into a narrowing of the wage gap between different labor categories. The narrowing is most obvious in those labor categories which face a major change in their size, as has occurred in the child labor and the primary educated labor categories. However, wages for secondary educated labor still remain very high and do not change much. Thus the closing of the wage gap mainly applies to low wages for non-educated labor, as well as labor not-finished primary school, and medium wages paid to primary educated labor, which are still much lower than wages paid to secondary educated labor. In the base run the wage structure for each labor category is relatively stable and changes amount to no more than 10 percentage points. In the simulation scenarios wage levels are changing, particularly

for the most affected labor categories child labor and labor not finished secondary school as can be seen from Figure 9. The average wage paid to child labor more than doubles in period 2015 in all scenarios. The increase of child labor wages has to be interpreted on the background, that wages paid to children are very low. Although the wage level increases very sharply, the wages for child labor remain very low. Wages for the rather skilled labor force that has not finished secondary school decline by more than 10% in the first two scenarios, respectively.

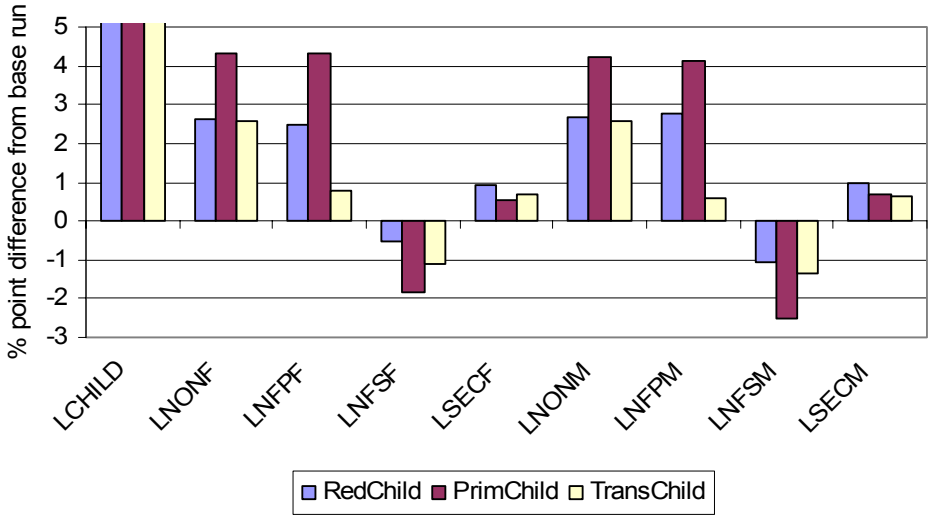
Figure 9: Relative changes of average wage paid to labor categories as compared to base run in 2000*



Source: Authors' calculations
*All acronyms are explained in Appendix A1
Note: Part of the LCHILD bar values are missing due to the cut at the 30% level. The values are: 'RedChild': 110.1%; 'PrimChild': 166.6%; 'TransChild':156.7%.

How do changes in the wage structure for different skill levels in the labor force affect the distribution of incomes? 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 the reduction of child labor and the formation of skilled labor. The income changes presented in Figure 10 have to be on the basis of the initial shares of the respective labor category. Though the income of child labor increases by 17.7% in the first scenario, the share in total labor income itself is rather low (0.9% in the base run, 1.2% in the first, and 1.1% in the second scenario). From this follows, that the factor endowment must be the main reason that made households better off in the simulations.

Figure 10: Changes of factor income shares as compared to the base run in 2015*



Source: Authors' calculations
*All acronyms are explained in Appendix A1
Note: Values of LCHILD bar are missing due to the cut at the 5% level. The values are: 'RedChild': 18.5%; 'PrimChild': 21.6%; 'TransChild':19.5%.

Since factor income shares do not change, income inequality is not affected either, which is reflected in Table 2 that reports Gini-coefficients for each scenario. In the first simulation, inequality decreases only slightly, while the impact on inequality in the second simulation is nil, when the movement of children through the education system is adjusted according to the education transition matrix.

Table 2: Evolvement of income inequality according to Gini*

	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	0.455	4.2

*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 indicates that the reduction of child labor may not change income inequality substantially, but nevertheless has an impact on poverty. The index

[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.

increases by 13.6% if all children enrolled in the course of the schooling program finish primary school. In the third scenario, where most of the children fail to finish primary school, the poverty index decreases by 12.1%, which is slightly smaller than the base run.

Table 3: Evolvement of poverty according to Sen Poverty Index*

	2000	2015	Percentage changes
Base	0.214	0.193	9.8
RepChild	0.214	0.187	13.6
PrimChild	0.214	0.187	13.6
TransChild	0.214	0.188	12.1

*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 clearly indicate that child labor has implications for overall economic growth. When child labor hinders human capital formation, economic growth is reduced. As expected, GDP growth is reduced in the first periods of the simulations, but immediately outperforms the base run growth rates when the 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 'TransChild', none of the households faces a decrease of income. But 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 simulation results, the gains from child labor reduction 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 when implementing a reduction of child labor.

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 Lucas (1988) suggests, 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 better adoption of new technologies or spill-over effects.

The effects of human capital formation are most obvious in rural areas, where more children work for wage and a higher percentage share of primary educated labor

works. But whether such a child labor reduction program works or not depends on how households weigh 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. The probabilities obtained from the education 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. Nevertheless, the conclusion that can be drawn from the results of the three scenarios is that the schooling system has to be enhanced, not only in educational quality but also with regard to dropout rates of pupils. Human capital formation and a reduction of child labor are 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 reduction of child labor might be quite disappointing. Given the results of the third scenario the incentive for households to send their children to school will be dampened, since substantial gains are not obvious in the long run. Then, income losses in the first periods may have a heavier weight than income gains in the future.

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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
Subsistence Labor			5,937,131	36.2
Child labor	LCHILD	Ages 10 to 14	1,403,358	8.6
Female	LNONF	No formal education	1,527,131	9.3
	LNFPF	Not finished primary school	672,474	4.1
	LNFSF	Not finished secondary school	2,344,897	14.3
	LSECF	Secondary or higher education	143,315	0.9
Total adult female			*4,687,817*	*28.6*
Male	LNONM	No formal education	788,193	4.8
	LNFPM	Not finished primary school	928,912	5.7
	LNFSM	Not finished secondary school	2,407,857	14.7
	LSECM	Secondary or higher education	249,685	1.5
Total adult male			*4,374,646*	*26.7*
All labor categories			16,402,952	100.0

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

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

Category	Acronym	Description	Number of People	Share of Total Population
Rural	HRBFPL	Below food poverty line	5,080,859	16.2
	HRFBPL	Between food and basic needs poverty lines	4,605,455	14.7
	HRNOED	Non-poor – head with no education	3,512,349	11.2
	HRNFPS	Non-poor – head not finished primary school	3,499,736	11.2
	HRNFSS	Non-poor – head not finished secondary school	7,842,113	24.9
	HRNSECP	Non-poor – head finished secondary school	661,535	2.1
Total rural			*25,202,047*	*80.3*
Urban	HUFPL	Below food poverty line	674,816	2.2
	HRFBPL	Between food and basic needs poverty lines	712,486	2.3
	HRNOED	Non-poor – head with no education	422,993	1.4
	HRNFPS	Non-poor – head not finished primary school	689,084	2.2
	HRNFSS	Non-poor – head not finished secondary school	2,462,953	7.9
	HRNSECP	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 (NBS, 2002)