Government High Education Policy in a Dual Economy: Developing versus Developed Country

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Government High Education Policy in a Dual Economy: Developing versus Developed Country

By Michel Strawczynski*

Abstract

By simulating social planner's optimal redistributive policy, this paper analyzes government's high education policy in a dual economy composed by skilled workers that invest in education and unskilled workers that do not. In a developed economy, characterized by an equilibrium with low educational costs, the government subsidizes high education and maximizes output, allowing for substantial tax revenues that are re-distributed through transfers to the unskilled. In contrast, a developing economy is submerged in a bad equilibrium, avoiding subsidizing high education at the expense of increasing output; by acting this way, the government succeeds on performing substantial re-distribution, obtaining higher social utility that is inclusive of unskilled workers. When the developing economy is trapped in a bad equilibrium, I show that its situation can be improved by receiving a designated high-education subsidy from an international institution.

Keywords: Education, Dual Economy, Developing Country
JEL Classifications: H21

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1. Introduction

Many countries are characterized by a dual economy (Lewis, 1954). According to this characterization, the economy is composed by two layers. One layer is given by skilled workers, who invest in high education (at its different forms) and earn high wages, allowing them to live in a high standard of living. The second layer is composed by unskilled workers, who do not invest in education, and have low income due to a low hourly wage, determined by excess supply in the unskilled labor market equilibrium. For these workers, a crucial source of income is the transfers provided by the government through its re-distribution policy.

In this paper I analyze desired government high education policy in a model in which individuals work and consume, after deciding whether to invest in high education. By ruling the skilled education policy, the government strongly influences the extent of the dual economy, especially in a developing country. I show that in a developing country, where the high education externality is less effective, this feature generates a dilemma: on the one hand, facilitating cheap education costs to workers implies a higher skilled wage and a higher output, which in turn implies higher tax revenues and higher re-distributional transfers to the unskilled; but on the other hand, my simulations show that under a fairly basic characterization, the implied optimal non-linear income average tax

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1 The concept of a dual economy was introduced by Lewis (1954). A well-known paper on the reasons for persistence of such structure in modern economies, is presented by Banerjee and Newman (1998). Volrath (2009) further analyzed endogenous forces that explain dual economy persistence.

2 As explained by Piketty (2017) there is a class with high income that holds inherited firms/wealth that does not necessarily invest in high education. However, firms owned by them are usually governed by individuals with high education.

3 Lewis (1954) says: "A ‘capitalist’ sector develops by drawing labour from a non-capitalist ‘subsistence’ sector. The existence of ‘surplus labour’ in the subsistence sector ensures that during an extended period wages in the capitalist sector remain constant because the supply of labour to the capitalist sector exceeds demand. The surplus of output over wages is captured by the capitalists as profits. Within the capitalist sector, growth occurs as the share of profits in national income rises and profits are directed to profitable investments.” Theoretically, one could say that the phenomenon called “the great resignation” under the impact of COVID-19 may signalize a possible new direction. However, it looks that unskilled wages will continue to be similar, since in many countries we can see a huge supply of low-wage workers that provide delivery tasks – that substitute previous traditional supply.
rate is lower, implying scarce resources to re-distribute. I show that in equilibrium, the elasticity of education demand is heavily influenced by government's policy regarding subsidies to high education, which in turn affects individual's cost. In a developed country, the gap between skilled and unskilled educational costs is low, and consequently a government policy of educational subsidies and regulation succeeds on reducing educational costs, being effective for increasing investment in high education. In the developing country, the gap in education's cost between the skilled and the unskilled is significant, and government policy does not succeed on closing it. Consequently, in a developing economy the cost of high education is high, and the government is constrained to choose an educational policy that is not aimed at maximizing output – with the purpose of providing transfers to low-income individuals and maximizing social welfare.

The paper is organized as follows: in the next section I show a model of a dual economy where the skilled invest in education and the unskilled is trapped under a low wage. I then introduce a classical optimal non-linear income tax model with marginal taxes imposed on skilled workers, in order to finance transfers to the unskilled. In section 3, I run simulations in order to understand the optimal policy of an inequality averse social planner. In section 4 I further analyze government high-education policy for the case in which a means-tested transfer mechanism is not available, and the government is forced to use universal transfers, as usually applied in many societies through child allowances. In this sub-section I will also characterize the optimal policy of a Rawlsian social planner, who is the planner that internalizes at a maximum extent the desire to

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4 Taxation in developing countries imply often a paradigm that is hidden from our eyes. For example, with the V.A.T., Bachas, Gadenne and Jensen (2021) show that in these countries progressivity is crucially affected by the share of the informal sector in the economy. It is important to stress that in our case and in a dual economy – for both developed and developing economies - the main tax characterization shall be performed by taxing the skilled and re-distributing toward the unskilled.
help the individual with the lowest income under a dual economy. In section 5 I summarize and conclude.

2. The Analytical Framework

Individuals decide about their investment in education in a first stage, and then they perform maximization to choose between consumption and leisure, given government's taxation and transfer policy.

2.1 Investment in Education

Following Galor and Zeira (2002), the existence of a dual economy is driven by the high cost of accessing high education, which is prohibitive for the unskilled. Moreover, if these individuals are willing to access credit for this purpose, the lack of collateral affects their ability for liberating themselves from the poverty trap. Thus, the economy remains dual: a skilled economy, with educated people; and an unskilled economy with low-wage individuals that do not invest in education. These individuals depend upon government's transfer policy, which in my model is financed by an income tax on the skilled. The additional tool that is available to the government is the cost of education, which is heavily affected by government policy in two fields: its direct intervention in the skilled education system and its involvement in regulation.

To explain this feature let us assume that investment in high education requires a minimal level \( X^* \); above this level, there is a return on education at the labor market in the form of wage \( w \), which is obtained by individual \( i \) according to his/her learning capacity \( n \) and his/her investment in high education \( X \):

\[
    w_i = n_i \ X_i, \quad X_i > X^*
\]

The return to education depends both on the investment in education, \( X \), and its return, \( n \). As in Galor and Zeira (1993), there is - in addition - a gap among individuals, that is
related to the accessibility to financial sources. For this purpose, I use the cost of education function, \( h \), given in the following equation:

\[
(2) \quad h(X_i) = \frac{X_i^{1+\lambda_i}}{1+\lambda_i}
\]

Where \( \lambda_i \) represents the cost of education, which will be explained in equation 5. Solving the optimum, it can be shown that the investment in high education is:

\[
(3) X_i = n_i^{\frac{1}{\lambda_i}}
\]

Which implies:

\[
(3)' \quad n_i = X_i^{\lambda_i}
\]

i.e., at the optimum the return to education is affected by optimal investment, \( X \), which is affected by the cost parameter, \( \lambda \). The wage is:

\[
(4) \quad w_i = n_i^{\frac{1+\lambda_i}{\lambda_i}}, \quad X_i > X^*
\]

Note that the higher is \( \lambda \), the more rigid is the demand for education for a given learning capacity. Equation 4 implies that the higher is the cost parameter \( \lambda \), the lower is the wage. Thus, if the government is interested on large investment in high education, it must assure a situation of a low \( \lambda \), which will ensure investment in high education among the skilled.

Having said that, note that the government influences the cost of education in a partial manner, as characterized in equation 5:

\[
(5) \quad \lambda = \lambda^1(s) + \lambda^2 + \lambda^3(R)+\lambda^4
\]

Where \( \lambda^1 \) represents the direct cost of education (matriculation), and consequently is a function of \( s \) (government's subsidy to high education); \( \lambda^2 \) represents the alternative cost of working; \( \lambda^3 \) is government's regulatory burden imposed on high education, symbolized by \( R \); and \( \lambda^4 \) represents the financial cost of loans provided by banks for financing high education. Thus, \( \lambda \) (and in particular, its government-influenced part)
will have a crucial impact, since it determines the education's elasticity of the demand for education by individuals that invest above the minimal education threshold - $X^*$. In Figure 1 I use sub-indexes 1, 2 and 3 to identify three different types of skilled workers' education demand ($\lambda_1 > \lambda_2 > \lambda_3$) with the same learning capacity (n), that is obtained by equalizing the expected return to the marginal cost:

**Figure 1: Investment in Education**

Using sub-index U for representing the unskilled and sub-index S for representing the skilled, we know from previous literature (Galor and Zeira, 2002) that:

\[(5)' \quad \lambda_U^2 > \lambda_S^2 ; \quad \lambda_U^4 > \lambda_S^4 \]

Thus, it is easy to show that for any given values of $\lambda_U^{1,5}, \lambda_S^{3,5}$, which are common to both the skilled and unskilled, we obtain that:

\[(6) \quad \lambda_U > \lambda_S \]

For plausible values of the parameters that appear in equation 5, this model implies that the unskilled is trapped in poverty. In a dual economy in the context of a developing country $\lambda_U$ is extremely high, because lack of collateral (inexistence of developed financial market) and because of the huge alternative cost of not working, which is
particularly high for the unskilled (since it requires avoiding subsistence jobs during the period of study in a situation of scarce government aid). In addition, \( n_{Uj} \), which represents the return to education for the unskilled (where individuals are symbolized by \( j \)) is low. This is due to reasons that are related to past allocations in the family.\(^5\)

These features drive the following equation, which is summarized in Figure 2:

\[
(7) \quad n_{Uj} = X^{\lambda u} \text{ occurs for } X_{Uj} < X^* \text{ for all } j = U
\]

![Figure 2 – Unskilled Poverty Trap](image)

i.e., the desired investment in high education by all unskilled is lower than the one needed in order to receive the skilled wage. Consequently, the unskilled does not invest in high education.

Concerning all skilled individuals (symbolized by \( k \)), I assume that for the different levels of \( n \) the following inequality is met for all \( k \):

\[
(8) \quad n_{Sk} = X^{\lambda s} \text{ occurs for } X_{Sk} > X^*
\]

In summary, all skilled workers perform investment in high education, obtaining high wages that are proportional to the chosen \( X \); while the unskilled is constrained by

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\(^5\) Heckman and Landers (2021) show that this channel is fed by many channels, including the lack of education in past generations, neighboring effects and other factors.
his/her impossibility to invest in education, causing a homogeneous low wage for all unskilled workers (U), given in equation 7. Note that this solution applies for all j.

According to my model the government will choose s and R, which constitute two different policy variables that affect the cost of education. For this purpose, the government will implement a set of decisions that include both economic variables (the price of education, and in particular whether it will be subsidized) and regulatory decisions (whether the system is easily accessible to everyone or there are restrictions like a requirement of success at a psychometric exam). In Tables A.1 and A.2 I use empirically plausible parameters that show that educational costs for the unskilled are prohibitive in a developing economy, creating a situation that makes difficult pursuing government action aimed at correcting this basic situation. In a developed economy the basic situation allows for implementing a relatively low educational cost.

**Characterizing the cost of education**

A novel part of my model is that I specify parameters for characterizing the cost of education, both at the micro-level (skilled and unskilled) and at the macro-level – through both education subsidy and the regulation enforcement.

As shown in equation 5, the cost of education is composed by four components: the matriculation cost (that is related to the level of government subsidy), the individual's alternative cost, the regulation cost and the financial cost.

Concerning the alternative and financial costs, which are clearly higher for the unskilled, I calibrate the values as explained in Strawczynski (2014). The matriculation and regulation costs are estimated at 50 and 20 percent for the unskilled and skilled, respectively (Appendix A). The initial equilibrium requires a different characterization of developed economy case (Table A.1) and developing one (Table A.2). The problem
of the developing economy is that the basic costs of the unskilled are particularly high because of a lack of developed financial market and because of the high alternative cost of poor's education.

**Individual's Maximization of consumption and Leisure**

I will use in the simulations a utility of consumption $U$ that allows for income effects\(^6\), and a leisure utility $V$ that reflects an empirically plausible labor elasticity:

$$(9) \quad u_i = U(c_i) + V(l_i) = \ln (c_i) - \frac{l_i^{1+k_i}}{1+k_i}.$$  

Where $k$ can be used to calculate the labor supply elasticity, $\eta_i$. It can be shown that:

$$(10) \quad \eta_i = \frac{1}{k_i}.$$  

In section 3 I calibrate the values of the parameters to fit widely accepted empirical findings in the optimal income tax literature.

I characterize now the second stage, allowing for a simultaneous maximization by individuals and government, while each side takes the other one as given.

**2.2 Government Intervention**

I assume that the government finances education costs and re-distribution transfers imposing an optimal non-linear income tax. Following the literature on optimal income taxation I assume a utility function that is both additive and separable in leisure and consumption\(^7\):

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\(^6\) Diamond (1998) shows an example in which assuming away income effects facilitate the calculation of optimal marginal tax rates; however, since Dahan and Strawczynski (2000) have shown that the exclusion of income effects can be influential in the results.

\(^7\) Almost all papers that appeared in the optimal non-linear income tax literature were based on separable utility between consumption and leisure. See Mirrlees (1971), Atkinson (1973), Stern (1976) and Tuomala (1984).
where C is consumption, 1-L is leisure and U and V are respectively the utility of consumption and the utility of leisure.\(^8\) While individuals enjoy both consumption and leisure, in my simulations the social planner will take decisions according to the following social welfare function\(^9\):

\[ W(c) = \int_{w}^{\infty} \frac{U(c)}{1-\theta} \]

Where \(w\) is the unskilled wage; the novel part of my problem formulation will be based on posing wages as a function of investment in education, X; i.e., the government knows that wages are dependent on educational decisions, which in turn are affected by its cost – that is influenced by government’s high-education policy. This implies adding to the solution of Dahan and Strawczynski (2012) a new term that appears at the end of the RHS:

\[ \frac{\tau}{1-\tau} = \frac{\varepsilon[w(X)]}{w(X)} \left[ \int_{w(X)}^{\infty} \frac{g(x)}{f'(w(X))} \right] \left[ \left( 1 - F(w(X)) \right) \right] \left[ \frac{\lambda}{\ln(n)} \right] \]

The details of this solution are explained in Appendix A.

As explained in equation 5, the social planner affects \(\lambda\) by choosing \(R\) and \(s\). By choosing a low \(R\) and a high \(s\), the government would make education more accessible to the skilled\(^10\); but at the same time, it would imply low average optimal income tax, deriving in lower tax revenue for financing re-distribution transfers. This is so because this parameter determines the rigidity of education demand \(\lambda\), which is crucial for wages determination, and as we see in the last term of the RHS, also for optimal income tax.

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\(^8\) The self-selection constraint requires that both pre-taxes income and consumption rise with skill (see Myles, 1995, p.140, and Stiglitz, 1987).

\(^9\) Strawczynski (2020) shows that this social planner corresponds to a "conservative type", as defined by Saez (2002).

\(^10\) While for instance it would be so also for the unskilled, in practice it is not relevant because the unskilled does not invest in high education.
rates.\textsuperscript{11} The average tax rate, in turn, is crucial for financing transfers to the unskilled. Since the latter are a substantial source of unskilled income, I analyze social planner's action to weight the different forces at place.

Note also that the existence of a dual economy makes the parameters for the transfer policy easily identifiable. Using plausible values for investment in education, I obtain that the lowest income of the skilled is higher than the highest income of the unskilled. Thus, re-distribution is done by setting a tax threshold, below it individuals do not pay an income tax and receive a transfer. This feature will hold for both the developed and developing economy.

**Government's Budget Constraint**

The government collects income taxes to be used for redistribution, higher education subsidies and public goods. The following is the constraint:

\[
\sum_{j}^{N} T(I_{Sj}) = \varepsilon * M + s + G
\]

Where \(\varepsilon\) is the means-tested transfer provided to the \(M\) unskilled workers (in section 4 I will use a universal transfer). \(G\) is the public good provision. As a working assumption I assume that half of the tax revenues are used for re-distribution.

3. Optimal policy in a dual economy: Developed and Developing economy cases

In order to check the optimal policy, I will simulate the decisions of social planners with different degrees of inequality aversion. Before showing the results, we can conjecture on two extreme cases: the utilitarian (\(\theta = 0\)) and the Rawlsian (\(\theta \text{ tends to infinity}\)) cases. Concerning the utilitarian case, it is quite clear that this policy-maker will choose a low \(\lambda_{S}\), since that will allow maximization of output and

\textsuperscript{11} Jacobs (2005) obtains an inverse elasticity rule for linear taxation under endogenous human capital.
maximum social welfare. This is so because this type of social planner does not care about re-distribution, and consequently from his/her point of view a dual economy of the type that I have presented here does not affect his educational policy choice. On the other extreme, a Rawlsian social planner would do the opposite: he/she will choose a high $\lambda_S$, since choosing this policy will assure the possibility of imposing an optimal high average income tax, providing resources for re-distribution in the framework of the dual economy. This characterization hints that the interesting cases are in the middle, for different values of inequality aversion; according to values shown in the literature, we will assume that $\theta$ ranges from 2 to 6. For completeness, in section 4 I will solve the Rawlsian case.

All simulations are based on standard assumptions, as used in other papers of optimal non-linear taxes; with respect to the parameter $k$ in the leisure utility function $V$, I will assume that the compensated labor elasticity starts at 0.1 for the lowest income individual and increases gradually until 0.5, following empirical findings by Gruber and Saez (2002).\(^\text{12}\)

### 3.1 The Distribution of earnings ability

Concerning the income distribution of earnings ability, I will assume a Pareto distribution\(^\text{13}\) in the skilled economy (following Feenberg and Poterba, 1993) and a lognormal one in the unskilled economy (see Aitchison and Brown, 1957). Thus, I am adopting the lognormal-Pareto distribution which has been recently mentioned as a benchmark in many studies (see references in Regev and Strawczynski, 2020):

\[
(15) \text{For the unskilled, } f(n_U) = \text{lognormal}(\bar{n}_U, \sigma^2) ; \text{For the skilled, } f(n_S) = \frac{e^{n_S^\varepsilon}}{n_S^{1+\varepsilon}}
\]

\(^{12}\) Kopczuk (2005) and Slemrod (1998) discuss other outlets for high labor supply elasticities of the skilled.

\(^{13}\) I assume that the Pareto parameter equals 1.5.
Note that for the unskilled the basic wage per hour is low because of the inexistence of investment in education. We use the ratio of skilled to non-skilled professions in Israel in order to calibrate the lognormal and Pareto means of the unskilled and skilled hourly wage distributions, respectively.

3.2 Government's Budget Constraint

Using the optimal income marginal tax rates I can calculate the average tax rate, by applying the density function for each income level; note that this rate is crucial for financing transfers to the unskilled. In the benchmark scenario, transfers are based on a mean-tested system, and consequently they are targeted on the unskilled. This system is implementable since income of the two groups (skilled and unskilled) is clearly differentiated. To assure a realistic scenario, I calibrate the basic ratio of skilled to unskilled wage at 5 (see Autor and Dorn, 2014).

3.3 Government's High Education Subsidy

Concerning the subsidy for high education, government expenditures in higher education are shown in Appendix B, based on data collected by the OECD. It is clear from Figure B.1 that developed economies substantially subsidize higher education. Note that countries that spend lower amounts in high education are characterized by lower GDP per-capita (Greece, Brazil, Hungary and Turkey).

3.4 Differentiating between a developed and developing economy

By using stylized facts about governments’ investment in high education as shown in Appendix B, I will assume that this externality is particularly evident in a developed economy; this kind of economy is ready to finance a substantial subsidy (s) for reducing the private cost of education, to reflect a positive externality. Simulations will assume
that this subsidy produces an externality symbolized by A(s). Accordingly, I re-write equation 4:

\[ (4)' \quad w_i = A(s) n_i^{1+\lambda_i}, \quad X_i > X^* \]

Where A is a function of the subsidy s; this term will be higher in economies where the externality of high education is highly effective. When running my simulations, and in accordance with stylized empirical facts of a dual economy in a developing country, I assume that in this economy A(s)=1.\(^{14}\) Note that this characterization is consistent with the first stage of economic growth in a developing economy, as described by Galor and Tsiddon (1997).

I will perform simulations for both a developed and a developing economy.

### 3.5 Simulation results

The way I will solve the model is: given the optimal investment in education as shown in equation 8, I will use equation 11 to calculate the optimal non-linear tax schedule, which will determine the average tax rate in the economy. This revenue finances transfers to the unskilled, since they are below the threshold income that implies a positive tax rate. Transfers are delivered to the unskilled, whose income is below the threshold income.

#### 3.5.1 Education costs, output and inequality

In Table 1 we see the impact of choosing different values of \(\lambda_S\) for both output maximization and inequality under the developing country benchmark.

\(^{14}\) For the developed economy I will assume that A(s)=2.
These results show that a low $\lambda_S$ is associated with a very high output and high inequality. As it increases, output is lowered because of a lower profitability of investing in education, which reduces output. Moreover, this scenario implies high inequality among skilled individuals, as we can see from the column that reports the wage variance. With a low $\lambda_S$ the variance is 16,600 percent higher than in a no-education economy, while when $\lambda_S = 20$ the variance is 130 percent higher than in a no-education economy. By choosing a high $\lambda_S$ the economy is characterized by lower output and lower inequality.

### Table 1 – Output and Variance under different education costs scenario
(percentage points relatively to the no education economy)

<table>
<thead>
<tr>
<th>Variable</th>
<th>$\lambda_S = 1$</th>
<th>$\lambda_S = 2$</th>
<th>$\lambda_S = 3$</th>
<th>$\lambda_S = 20$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Output</strong></td>
<td>1,000</td>
<td>267</td>
<td>154</td>
<td>36</td>
</tr>
<tr>
<td><strong>Wage Variance</strong></td>
<td>16,600</td>
<td>1640</td>
<td>722</td>
<td>130</td>
</tr>
</tbody>
</table>

#### 3.5.2 Optimal Marginal tax schedule

Let me characterize now the optimal non-linear income tax rates under the different scenarios. For this purpose, I show in Figures 3a and 3b the case of a relatively low-income inequality aversion ($\theta = 2$). The main difference between the developed and developing economies is the need for redistribution in the dual economy: this need is much higher in the developing economy than in the developed one. The reason is that the unskilled in a developing country is 3 times poorer than the one in a developed one. When output is maximized ($\lambda_S = 1$), optimal taxes have a narrow range with a marginal
tax close to 46 percent. In cases where $\lambda_S$ is high, the demand for education is rigid and consequently marginal tax rates are higher; note that the main forces driving marginal taxes up are the re-distribution effect (third term in the right-hand side of equation 13) and the income distribution effect (the fourth term in equation 13). By looking at the last term in the RHS, note also that the higher is $\lambda_S$, the higher is the top marginal tax rate. By comparing figure 3a to 3b, we can conclude that a high $\lambda_S$ implies a more rigid demand for education, allowing for higher (marginal taxes are about 4 percentage points higher when $\lambda_S = 20$) and steeper marginal tax rates.

**Figure 3a – Optimal income tax rates for $\lambda_S = 1$**

**Figure 3b – Optimal income tax rates for $\lambda_S = 20$**

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15 As shown by Dahan and Strawczynski (2000) it is possible to have optimal inverted u-shape or increasing marginal tax rates. In the present paper I use a Pareto distribution, which reduces the case for optimal declining marginal tax rates at the top.
3.5.3 Optimal educational policy

I turn now to analyze optimal educational policy in the dual economy.

In Table 2a I characterize the optimal educational policy of a developed economy.

In the scenario with low inequality aversion, I obtain a similar allocation to the utilitarian case: the social optimum is characterized by a low cost of education, which allows a high output (see Table 1). While the average tax rate in the preferred option is relatively low, the low inequality aversion allows for an income distribution that is unequal: as shown in Table 1, the variance is the highest among the different scenarios. Although the transfer to the unskilled in this scenario is low, the highest social utility is obtained for the lowest cost of education case.

Table 2a – Is maximizing output a desirable policy? Developed economy case

<table>
<thead>
<tr>
<th>Inequality Aversion</th>
<th>$\theta = 2$</th>
<th>$\theta = 4$</th>
<th>$\theta = 6$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education Cost</td>
<td>Average re-distr. Tax (%)</td>
<td>Social Utility</td>
<td>Average re-distr. Tax (%)</td>
</tr>
<tr>
<td>$\lambda_s = 1$</td>
<td>27.95</td>
<td>8.6</td>
<td>27.95</td>
</tr>
<tr>
<td>$\lambda_s = 3$</td>
<td>29.4</td>
<td>6.2</td>
<td>29.4</td>
</tr>
<tr>
<td>$\lambda_s = 5$</td>
<td>29.8</td>
<td>3.7</td>
<td>29.8</td>
</tr>
<tr>
<td>$\lambda_s = 10$</td>
<td>30.0</td>
<td>-4.2</td>
<td>30.0</td>
</tr>
<tr>
<td>$\lambda_s = 20$</td>
<td>30.2</td>
<td>-34.8</td>
<td>30.2</td>
</tr>
</tbody>
</table>
A similar pattern is obtained when I increase inequality aversion to $\theta = 4$ and $\theta = 6$. In both cases the policy maker chooses the lower cost of education (i.e., imposing a high education subsidy), while tax rates remain similar; note, however, that social utility increases because of the high value of re-distribution as inequality aversion goes up.

In Table 2b I characterize the optimal policy of a developing economy. For a developing country the maximizing output policy is not optimal. In fact, given the low income of the unskilled it is better for the government to avoid reducing the individual's educational cost by using the subsidy $s$. In one hand, the subsidy would help reducing educational cost to the skilled individuals; but in the other hand, it does not bring the economy to the higher social utility scenario. This scenario is obtained when $\lambda_S = 3$ for a low inequality aversion ($\theta = 2$), and when $\lambda_S = 5$ for higher inequality aversion ($\theta = 4$ and $\theta = 6$). The intuition of this result is the following: since in the developing economy the social utility of the unskilled is extremely high, by avoiding subsidizing high education it becomes more expensive; thus, the demand for education becomes more rigid, allowing for a higher optimal re-distributional average tax rate. In fact, when $\lambda_S = 5$ we can see that the transfer given by the government signifies a substantial increase in social utility of the poorer individuals, helping explaining the rise in total social utility when we move from $\lambda_S = 3$ (when social utility is negative) to $\lambda_S = 5$; i.e., from simulation results it is clear-cut that maximizing educational attainments is not the optimal policy – since for this case social utility is substantially lower. Note that with low educational costs the optimal tax is remarkably lower, implying insufficient re-distribution to the poorest individuals.
Table 2b – Is maximizing output a desirable policy? Developing economy case

<table>
<thead>
<tr>
<th>Inequality Aversion</th>
<th>( \theta = 2 )</th>
<th>( \theta = 4 )</th>
<th>( \theta = 6 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education Cost</td>
<td>Average re-distr. Tax (%)</td>
<td>Social Utility</td>
<td>Average re-distr. Tax (%)</td>
</tr>
<tr>
<td>( \lambda_S = 1 )</td>
<td>27.95</td>
<td>8.0</td>
<td>27.95</td>
</tr>
<tr>
<td>( \lambda_S = 3 )</td>
<td>29.4</td>
<td>41.0</td>
<td>29.4</td>
</tr>
<tr>
<td>( \lambda_S = 5 )</td>
<td>29.7</td>
<td>16.2</td>
<td>29.74</td>
</tr>
<tr>
<td>( \lambda_S = 10 )</td>
<td>30.0</td>
<td>14.8</td>
<td>30.0</td>
</tr>
<tr>
<td>( \lambda_S = 20 )</td>
<td>30.2</td>
<td>13.1</td>
<td>30.2</td>
</tr>
<tr>
<td>( \lambda_S = 30 )</td>
<td>30.2</td>
<td>12.8</td>
<td>30.2</td>
</tr>
</tbody>
</table>

3.3.3 A Policy Trap: the role of an international institution

An interesting result is obtained when the developing economy is stacked at a bad equilibrium, represented by the case where \( \lambda_S = 30 \). By looking at Table 2b, we learn that this equilibrium is related to high private educational costs and lack of subsidy by the government (which would imply further increasing the tax rate). In this case, the optimal average distributional tax rate is high and reaches 30.2 percent. Note, however, that under this scenario the economy maybe close to the Laffer's curve peak tax rate\(^{16}\), which does not allow further increasing the tax rate in order to finance an increase in \( s \). In fact, by looking at table 2b we see that the needed change in \( s \) is the one needed for

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\(^{16}\) See Srebrnič and Strawczynski (2016).
reducing high education cost parameter from 30 to 3 (for $\theta = 2$) or to 5 (for $\theta = 4,6$), which would imply a further increase in the tax rate to finance the additional expenditure on the subsidy $s$.

In that case, two possible policy measures could improve the situation of the developing economy; the first would occur if it was possible to generate a big externality of the type $A(s)$, as occurs in the developed economy. This kind of externality would allow improving efficiency and re-distribute in a less restricted way, as we have seen in Table 2a for the developed economy. However, this externality does not effectively operate in the developing country context, and thus such a policy tool is associated to a fundamental reform in institutions, that is beyond the scope of the present paper.

A second policy tool, which is feasible and implementable, would be to obtain a designated subsidy for high education at the developing economy. This economy could benefit from a policy that implies a move from an equilibrium of $\lambda_5 = 30$ to one in which $\lambda_5 = 3.5$ respectively (provoked by increasing $s$). For that change to occur, an international institution – like the World Bank - may provide financial aid to be used for reducing high education cost to the skilled (and even subsidizing it). In the new equilibrium, social utility would substantially increase, without a need of imposing additional taxation with its correspondent excess burden, under a situation of a previous high average tax rate.

4. Dual Economy in a developing country: two polar cases

4.1 Universal Transfers

One of the well-known problems with the implementation of means-tested transfers is the inexistence of efficient mechanism for identifying the limits of the system, which maybe also accompanied by moral hazard. In fact, Apps et al. (2020) and Strawczynski
and Tirosh (2021) show that this type of system is associated with deadweight losses. In this section I check the sensitivity of the results when the means-tested mechanism is substituted by a universal transfer. Since under optimal non-linear taxation the amount of money transferred to the unskilled decreases substantially, it is interesting to see whether the solutions found in the previous section remain similar. I assume that the amount of tax revenues collected is transferred in equal amounts to all individuals in the economy. Thus, in this case government re-distribution toward the unskilled is scarcer, raising the question whether in this case the government will choose maximization of output ($\lambda_S = 1$).

Results are shown in Table 3.

**Table 3 - Social Utility in the developing country under universal transfers**

<table>
<thead>
<tr>
<th>Inequality Aversion</th>
<th>$\theta = 2$</th>
<th>$\theta = 4$</th>
<th>$\theta = 6$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education Cost</td>
<td>Average Tax (%)</td>
<td>Social Utility</td>
<td>Average Tax (%)</td>
</tr>
<tr>
<td>$\lambda_S = 1$</td>
<td>27.95</td>
<td>8.18</td>
<td>27.95</td>
</tr>
<tr>
<td>$\lambda_S = 3$</td>
<td>29.4</td>
<td>28.3</td>
<td>29.4</td>
</tr>
<tr>
<td>$\lambda_S = 5$</td>
<td>29.7</td>
<td>11.0</td>
<td>29.7</td>
</tr>
<tr>
<td>$\lambda_S = 10$</td>
<td>30.0</td>
<td>12.7</td>
<td>30.0</td>
</tr>
<tr>
<td>$\lambda_S = 20$</td>
<td>30.2</td>
<td>11.9</td>
<td>30.2</td>
</tr>
</tbody>
</table>

Note that social utility is reduced in almost all cases compared to Table 2b, since in this case the income of the unskilled declines as a consequence of the decline in re-
distribution sums received by them. Note, however, that there is a change on the preferred policy by planners with high inequality aversion, who switch their policy to obtain a different education cost: $\lambda_S = 5$ instead of $\lambda_S = 3$. It is remarkable that also in this case the social planner at the developing country does not maximize output, due to the need of enhancing social utility in the dual economy.

4.2. Rawlsian allocation in a developing country

A polar case is when the policy-maker is Rawlsian; i.e., $\theta$ tends to infinity, which means that the social planner cares about the utility of the poorest individual. Note that since the income of the poorest (unskilled) individual is low, the transfer of the government is a crucial component of his/her income.

Figure 4 is the optimal non-linear income tax schedule for the desired value of $\lambda_S$.

Figure 4 - Rawlsian optimal tax schedule
I obtain in the simulation that the maximum level of $\lambda_S$ occurs at $\lambda_S = 16^{17}$, which implies an average tax rate of 30.32 percent. When the value of $\lambda_S$ is further increased, the social utility decreases. Interestingly, the Rawlsian solution consists of a very high marginal tax rate (50 percent) for skilled workers, with a tiny reduction of marginal tax rates as income increases.

5. Summary and Conclusions

In this paper I analyze the implications of a dual economy for choosing government's high education policy under optimal non-linear income taxes. In a dual economy the unskilled is unable to invest in high education, deriving in persistently low wages. Government choice of skilled high education costs generates a dilemma because of two polar consequences that must be considered in the context of a dual economy: while a low high education cost is helpful to achieve a large aggregate output, at the same time it generates elastic skilled demand for education, which is associated with low optimal income tax rates. Since a dual economy is characterized by the need of providing government transfers to the unskilled, this fact poses a dilemma – especially in a developing economy; as opposed to a developed economy, the former does not enjoy a positive externality in high education with the intensity that characterizes the latter.

By performing simulations for both developed and developing representative economies, I show that there is a trade-off between maximizing output and maximizing social utility. When pursuing the first goal, social utility is maximized only at the

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17 Note that when $\theta$ tends to infinity, the left-hand side of equation 9 tends also to infinity. Thus, in order to have the right-hand side trending to infinity, the optimal marginal tax rate must be $0$ for all income levels. In other words, we obtain the peak of the Laffer curve. Since at this exercise we are interested on checking what is the value of $\lambda$ that approaches the equality to the peak of the Laffer curve, we shall choose a value of $\theta$ that does not imply a zero marginal tax rate. For the purpose of this simulation the simulated approximation of infinity occurs for $\theta = 109$. 
developed economy; the main feature that backs this result is a substantial positive externality which enhances skilled wages.

By contrast, in the developing economy, and in particular with planners with high inequality aversion, the desired high education policy does not require maximizing output. In this case, the government chooses to increase the cost of high education, implying a more rigid skilled education demand. As a consequence of that, optimal marginal tax rates are higher, implying larger tax revenues – which helps the government to provide larger means-tested transfers to the unskilled. By performing a sensitivity analysis, I show that this result is maintained even when resources available for re-distribution are lower, as implied by the implementation of universal transfers. I also show that a Rawlsian social planner, who is the one that cares the most about weak individuals at the dual economy, will choose high education costs, which allow for a high average tax rate in order to finance re-distribution.

Finally, I show that in a case where the developing country is trapped under substantial high-education private costs, the unfavorable situation can be alleviated by implementing a designated subsidy from an international institution, that is targeted on reducing individual's costs of high education.
Appendix A – Individual's maximization problem

In equation 13 I add to Dahan and Strawczynski (2012) a last term that internalizes the education decision:

\[
\frac{\tau}{1-\tau} = \left[ \varepsilon(w) \right] \left[ \frac{\int_{0}^{\gamma} \frac{U_c(x)}{\gamma(1-F(w))} f(x) dx}{U_C(w)} \right] \left[ \frac{1-F(w)}{f(w)} \right] \frac{\lambda}{\ln(n)} , f(w) \equiv \frac{dF}{dw}
\]

The first term in the RHS can be denominated as the "efficiency" effect. It implies that the higher is the compensated elasticity of labor, the lower the optimal marginal income tax rate in order to reduce the excess burden of taxation. The second term, which is the marginal utility of consumption, affects the desired labor supply through its effect on income elasticity. As explained in any basic textbook in economics, raising income tax rate works to reduce net income and as a result individuals work more. For high income levels, the marginal utility of consumption decreases with income, and thus the incentive to work harder as a result of net income reduction becomes lower. The third effect is the "inequality aversion effect" which is increasing in \( w \). This term equals to the average of \( \gamma/U_c - g \) from a particular level of \( w \) to the top of the distribution. The inequality aversion effect is increasing in \( w \) with concave utility of consumption (\( U_c \) is decreasing in \( w \)) and constant \( g \), or for concave social welfare function. The last effect is the "distribution effect": the higher the proportion of individuals above the income level relative to the proportion of individuals at this level, the less distortionary is the marginal tax rate, since for these individuals the marginal tax rate acts like a "lump-sum" tax. Thus, a higher ratio of \( (1-F) \) over \( f \) implies a higher optimal tax rate.

The novelty of using this equation is that in my model, the skilled wage \( w \) will be determined by individual's investment in education. The new term, shown at the end of the RHS in the equation above, follows the internalization of investing in education. Since the government influences \( \lambda \) and is aware about individuals' decision as shown
in Figure 1, it is necessary to add to government's maximization the elasticity of education's decision. This decision implies that a high \( \lambda \) implies a more rigid education demand. Following the inverse-elasticity rule, I check the elasticity of education to its cost \( \lambda \); using (3) I obtain:

\[
\phi = \frac{\partial X}{\partial \lambda} = -n\lambda \left( \frac{1}{\lambda^2} \right) \ln (n) = -\frac{\ln (n)}{\lambda}
\]

i.e., the higher is \( \lambda \) the lower is the education demand elasticity, allowing for a higher tax with lower efficiency effect. The introduction of this term is implemented through the well-known "inverse elasticity rule".

**Appendix B – The cost of education**

The following are the assumptions for different scenarios about the cost of education.

**Table B.1 – Developed Economy**

<table>
<thead>
<tr>
<th>( \lambda )</th>
<th>( \lambda^S = 1 )</th>
<th>( \lambda^S = 1.2 )</th>
<th>( \lambda^S = 1.5 )</th>
<th>( \lambda^S = 2 )</th>
<th>( \lambda^S = 2.5 )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S</td>
<td>U</td>
<td>S</td>
<td>U</td>
<td>S</td>
</tr>
<tr>
<td>( \lambda^1(S) )</td>
<td>0.5</td>
<td>0.5</td>
<td>0.6</td>
<td>0.6</td>
<td>0.75</td>
</tr>
<tr>
<td>( \lambda^2 )</td>
<td>0.2</td>
<td>1</td>
<td>0.24</td>
<td>1.2</td>
<td>0.3</td>
</tr>
<tr>
<td>( \lambda^3(R) )</td>
<td>0.2</td>
<td>0.2</td>
<td>0.24</td>
<td>0.24</td>
<td>0.3</td>
</tr>
<tr>
<td>( \lambda^4 )</td>
<td>0.1</td>
<td>0.2</td>
<td>0.12</td>
<td>0.24</td>
<td>0.15</td>
</tr>
</tbody>
</table>
Table B.2 – Developing Economy

<table>
<thead>
<tr>
<th>$\lambda$</th>
<th>$\lambda^S = 1$</th>
<th>$\lambda^S = 2$</th>
<th>$\lambda^S = 5$</th>
<th>$\lambda^S = 10$</th>
<th>$\lambda^S = 30$</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>U</td>
<td>S</td>
<td>U</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>$\lambda^1$</td>
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<td>0.5</td>
<td>1</td>
<td>2.5</td>
<td>5</td>
</tr>
<tr>
<td>$\lambda^2$</td>
<td>0.2</td>
<td>0.4</td>
<td>1.5</td>
<td>6</td>
<td>30</td>
</tr>
<tr>
<td>$\lambda^3(R)$</td>
<td>0.2</td>
<td>0.4</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>$\lambda^4$</td>
<td>0.1</td>
<td>0.2</td>
<td>0.4</td>
<td>1.5</td>
<td>3</td>
</tr>
</tbody>
</table>

Appendix C – Government Investment in high education

Figure B.1 compares government investment in high education at different countries. Among the countries with larger expenditure in high education we find U.S.A., Canada and South Korea. The ones with low expenditure are Brazil, Hungary, Greece and Turkey.

Figure C.1 – Government spending in high education, 2000 and 2013

(\% of GDP, source: OECD)
Bibliography


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