Inheritance Taxes and Human Capital Accumulation

Maciej Dudek
University of Michigan–Ann Arbor

Robert Kruszewski
SGH Warsaw School of Economics

Janusz Kudła (jkudla@wne.uw.edu.pl)
University of Warsaw

Konrad Walczyk
University of Warsaw

Research Article

Keywords: human capital, capital accumulation, inheritance taxation, economic modeling

Posted Date: March 14th, 2023

DOI: https://doi.org/10.21203/rs.3.rs-2647752/v1

License: © This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License
Abstract

The paper examines the relationship between inheritance taxation and human capital formation. We analyze the standard problem in three different settings and show that the results are sensitive to modeling specifications. The relation of human capital to physical capital and the accumulation rate of both types of capital may be affected by the inheritance tax or not, depending on the perspective of an agent. If human capital is intangible and proxied by wages, the inheritance tax on physical capital detrimentally impacts wages which may indirectly decrease human capital accumulation. If, on the other hand, human capital is purposefully formed by forward-looking economic agents, the rate of investment in human capital accumulation is not affected by the inheritance tax, but the ratio of human to physical capital in equilibrium is higher than it would be if the inheritance was not taxed. Finally, for short-term looking agents, the tax increases the rate of investment in human capital only if tax revenue is rebated to taxpayers. These results suggest that taxing inheritance, coupled with tax rebates, may act as an incentive to increase human capital accumulation.

JEL: E20, H21, H24, J24

1. Introduction

One of the less recognized aspects of inheritance in the economic literature is the impact of inheritance tax on the accumulation of human capital. This issue is particularly important for endogenous growth models where economic growth requires the accumulation of physical and human capital (Pestieau, Sato 2008). Unfortunately, there is no consensus about the direction of this impact. Conventional wisdom suggests that the concentration of wealth by older generations favors higher inheritance taxes to prevent a decrease in human capital formation by younger generations. The latter may accumulate less as they expect to receive higher transfers from their parents. Therefore, the net wealth tax may induce a substitution of physical capital for human capital (Heckman, 1976; Grüner and Heer 1994) or decrease the wealth effect of inheritances, thus inducing workers to accumulate more human capital (Hedlund 2020). Conversely, Ihori (1997, 2001) uses the general equilibrium overlapping generation model (OLG) with two types of capital to show that an increase in the tax on physical capital reduces human capital investment. Caballé and Raurich (2012) obtained similar results. Cremer and Pestieau (2002) and Farhi and Werning (2010) go even further and propose that human capital should be subsidized, with a higher marginal subsidy on lower investments. As Hendricks (2003) argues, opposing results may be due to different model assumptions about the intergenerational transmission of human capital. Specifically, infinite horizon models (King and Rebelo 1990; Caballe and Santos 1993) unrealistically assume high intergenerational persistence, making their implications of little practical importance.

The problem is also hard to solve using empirical evidence. Kopczuk attributes this to the fact that empirical measurement is difficult because [wealth transfers] are infrequent (at the extreme, occurring just at death), thereby allowing for a long period of planning, making expectations about future tax policy critical and empirical identification of the effect of incentives particularly hard (Kopczuk 2013: 330). Therefore, the taxation of intergenerational transfers and its effect on human capital accumulation has not yet received much attention in the economic literature despite the fact that, as Jessen et al. argue, it is a widely contentious topic, as it relates to personal notions of the societal role of the family (Jessen et al. 2019: 2).

In the paper, we model the impact of inheritance taxation on human capital accumulation by successive generations of agents in three different settings. In the first one, human capital is not a separate growth factor but
is approximated by wages. In the next two, human capital is accumulated together with physical capital, and the planning horizon of economic agents spreads over one or two periods. The results of the models are threefold. If agents are forward-looking the rate of investment in human capital accumulation is not affected by the inheritance tax, but the ratio of human to physical capital in equilibrium is higher than it would be if the inheritance was not taxed. For short-term looking agents, the tax increases the rate of investment in human capital only if tax revenue is rebated to taxpayers. Similarly, the ratio of human to physical capital is also higher if the tax is imposed. It becomes especially high if tax revenue is rebated because such a policy does not only reduce physical capital but also increases human capital accumulation (this effect is not present in the long-term model). If human capital is not a separate risk factor, inheritance taxation on physical capital detrimentally impacts wages which may indirectly decrease human capital accumulation. The detailed results involve the application of the constant relative risk aversion function (CRRA) and its special case - the logarithmic utility function.

Our results show under what conditions higher inheritance taxation is harmful to or supportive of economic growth. Inheritance taxation is harmful for human capital accumulation only when human capital is used for production, generated mainly by physical capital. In this situation, everything which is noxious to physical capital also adversely affects human capital. In other cases, the impact is neutral or positive supporting the policy of inheritance taxation.

The analysis sheds some light on the contradictory effects postulated in the literature because it relies on the same modeling approach but with different assumptions about the planning horizon (short or long), and substitutes physical and human capital (where substitution is possible and when human capital fully depends on the formation of physical capital). Thus, it is not necessary to assume the different behavior of agents as in life-cycle models or infinitely-living individuals models to obtain different results.

Our research fits in the more general trend of increased interest in the effects of inheritance taxes on wealth (Gale and Scholz 1994; Wolff 1999; Piketty 2011; Semyonov and Lewin-Epstein 2013; Karagiannaki 2015; Korom 2016; Hood and Joyce 2017; Ademon et al. 2018; Atkinson 2018; Ohlsson et al. 2020). The most important issues involve the complementation of income and consumption taxes (e.g. Bastani and Waldenström 2020), maximization of welfare through optimal inheritance taxation (e.g. Grossmann and Poutvaara 2005; Piketty and Saez 2013) or equity problems (e.g. Boserup et al. 2016; Elinder et al. 2018; Nekoei and Seim 2021). One can expect that this trend will continue over the coming decades due to demographic aging, productivity growth and declining intergenerational economic mobility (Piketty and Zucman 2015; OECD, 2021).

The rest of the paper is organized as follows. In the simple setting (Section 2), human capital cannot be a substitute for physical capital and the size of human capital is approximated by wages. In the long-term model (Section 3), human capital is a separate growth factor, substitutive for physical capital, and evolves according to the standard Lucas (1988) specification. Finally, in the short-term (Section 4), human capital is again a separate growth factor but the planning horizon is limited to two periods. The results are briefly discussed in Section 5 and summarized in the conclusion (Section 6).

## 2. Wages As A Proxy For Human Capital

We would like to start by considering an extreme case, which is a sub-case of a more general formulation. Let us assume that individual agents live only for one period and after their death, they are replaced by a new cohort. We
assume that there is a natural intergenerational link between any two consecutive cohorts. Specifically, the preferences of an individual born at time $t$ can be represented with

$$U_t = u(c_t) + \beta U_{t+1}$$

where $\beta < 1$ captures the degree of affection of the current generation to the next.

Formally, human capital is intangible and only proxy measures can be utilized in practice. We start by assuming that human capital can be marketed and its value is reflected in wages that can be earned by an individual. Consequently, we can restrict our attention to a single state variable in the form of physical capital and state the budget constraint – assuming no taxation at all – of an agent born at time $t$ as

$$k_{t+1} = (1 - \delta) k_t + r_t k_t + w_t - c_t$$

where the endowment of time is normalized to 1.

In such a case there is only a single state variable and we can summarize the problem of a person born at time $t$ as maximizing (1) subject to (2). The solution to the above problem is trivial, and simply leads to a familiar Euler-type equation, which can be stated as

$$\frac{u'(c_t)}{u'(c_{t+1})} = \beta (1 - \delta + r_{t+1})$$

which, together with the budget constraint and the initial value of $k$, allows to determine the value of consumption in all periods for a given path of wages and the rental price of capital.

Before we proceed we want to state formally that in equilibrium, the wage and the rental price are determined by the supply side of the economy. Specifically, if we assume that the aggregate output takes the form

$$Y_t = A(K_t)^{\alpha} (L_t)^{1-\alpha},$$

then we can state that $r_t = \alpha (k_t)^{\alpha-1}$, and $w_t = (1 - \alpha) (k_t)^\alpha$.

Let us now introduce taxation into the above model. We will assume that inheritance, if any, is taxed at a given rate $\tau$. Let us note formally that the given individual values the well-being of her descendants and, in principle, may have an incentive to leave them bequests. Such bequests, in the current setup, take the form of physical capital. Note that a given individual who leaves $k_{t+1}$ units of capital to her descendants will \textit{de facto} leave only $(1 - \tau) k_{t+1}$ units while the remainder will be captured by the government at time $t$.

The revenue collected by the government, $\tau k_{t+1}$, could be used to finance a required level of expenditure – benefits which the public may or may not enjoy – or could be rebated to the public in the form of lump-sum transfers. We start by assuming the latter option and denote with $\Gamma_t$ the transfers, if any, received by a household.
at time $t$. We want to emphasize that such rebates are treated as given by all individuals. Furthermore, those transfers occur at the end of period $t - 1$, i.e. when capital stock $k_t$ is actually formed. We would like to add that any part of the capital captured by the government is not used in the process of production and is transformed into a consumption good consumed by the government.

The taxation of bequests affects welfare through two distinct channels. First, it reduces the amount of capital that the current cohort receives from their parents and second, it reduces the amount left to descendants. Note, that if the previous cohort leaves $k_t$, only $(1 - \tau) k_t$ reaches the next cohort, and similarly only $(1 - \tau) k_{t+1}$ will reach the subsequent cohort.

Under such assumptions, the budget constraint can be restated as

$$k_{t+1} = (1 - \delta + r_t) [(1 - \tau) k_t + \Gamma_t] + w_t - c_t$$

Furthermore, we need to note that taxation at time $t$ not only influences the budget constraint at time $t$, but it also affects the value function as only a fraction $1 - \tau$ of the capital left will reach the next generation. Therefore, the happiness of an agent born at time $t$ can be represented as

$$U_t = u(c_t) + \beta U [(1 - \tau) k_{t+1} + \Gamma_{t+1}]$$

For the record, let us note that if rebates were at 100% and individuals were to fully internalize them, then the above function would simply be the same as (1). Here, however, we treat the rebates as lump-sum and exogenous. Hence, formula (5) is formally distinct from (1).

The solution to the optimization problem is

$$\frac{u'(c_t)}{u'(c_{t+1})} = \beta (1 - \tau) (1 - \delta + r_{t+1})$$

Observe that taxation impacts the form of the Euler equation as condition (6) is different from (3). The tax policy directly affects the intertemporal trade-off. In addition, there might be indirect effects operating through the interest rate $r_{t+1}$. In order to determine these let us focus on the steady state, where $c_t = c_{t+1}$. Naturally, in such a case we have $u'(c_t) = u'(c_{t+1})$, and the Euler equation implies that $r^* = \frac{1}{\beta(1-\tau)} + \delta - 1$, which is higher than the value when there is no bequest taxation at all.

Furthermore, recall that we have $r = \alpha k^{\alpha-1}$, where $k$ denotes the amount of capital per capita in the economy. In our case, in the steady state, we simply have $r^* = \alpha [(1 - \tau) k^* + \Gamma^*]^{\alpha-1}$. Recall that any capital left
after the government rebates are performed is consumed and does not contribute to the capital stock available in production.

Given that the value of \( r^* \) is affected by the presence of taxation, we can conclude that the value of
\[
(1 - \tau)k^* + \Gamma^* \]

is affected as well. Specifically, given that the steady state value of the interest rate increases with the tax rate, we can conclude that the total amount of capital available for production falls with the tax rate.

Recall that the government collects \( \tau k^* \) in taxes in the steady state as the amount \( k^* \) is bequeathed to the future cohort. The revenue can be used for a number of purposes including government consumption, or it can be rebated back to the public. Let us now assume that a fraction \( \lambda \) of the revenue is transferred back to the public while the remainder finances government consumption.

We can state that the overall amount of capital in the economy in the steady state is still equal to
\[
k^{**} = (1 - \tau)k^* + \Gamma^*,
\]

which leads to
\[
k^{**} = (1 - \tau)k^* + \lambda \tau k^*,
\]

and in turn implies that
\[
k^* = \frac{1}{1 - (1 - \lambda)\tau}k^{**}.
\]

Furthermore, we also have
\[
r^* = \alpha(k^{**})^{\alpha - 1},
\]

which implies that
\[
k^{**} = \left[ \frac{\alpha}{r^*} \right]^{\frac{1}{1 - \alpha}} = \left[ \frac{\alpha}{\frac{1}{1 - \tau}} \right]^{\frac{1}{1 - \alpha}}.
\]

Thus, we can conclude that taxation does affect the overall amount of capital in the economy in the steady state. In fact, the level of the available capital stock falls with the tax rate. Furthermore, as long as rebates are incomplete, i.e. \( \lambda < 1 \), the level of private gross bequests depends on the tax rate \( \tau \) directly and for a given value of \( k^{**} \) it increases with the tax rate. To summarize, the steady state level of capital, and hence output, depends on the level of taxation of bequests. In particular, as the tax rate increases the overall amount of capital in the economy falls.

Now we want to examine the effects of the taxation of bequests on human capital. At this stage, we choose to proxy human capital with wages actually earned by individuals. In our case, the wage rate is simply given with
\[
w_t = (1 - \alpha)(k_t)^\alpha.
\]

Given that we have argued that the overall amount of capital in the steady state is negatively affected by the presence of taxation, we can conclude that wages actually earned by individuals are negatively affected as well. Thus, we can state that taxation of bequests does affect human capital in a negative manner in the steady state.

### 3. Human Capital As A Separate State Variable

As before, let us continue to assume that a given agent lives for one period and later is replaced by a new agent, and this process continues indefinitely. The preferences of a single individual are represented with (1). The meaning of all symbols remains unchanged. However, we now choose to consider a richer framework and model human capital as an independent state variable. Specifically, human capital is formed as a product of purposeful economic activity. Furthermore, human capital influences the level of output positively. Such standard assumptions imply that there are benefits and costs to human capital formation. The higher the stock of human capital, the more productive the agents are and the higher their wages. On the other hand, the creation of human capital requires resources, and as such, must be occupied with forgone income. Accordingly, in each period
economic agents must balance the effects and costs of human capital accumulation and invest accordingly. Our goal is to examine how the taxation of bequests affects human capital formation.

The introduction of human capital as a separate state variable allows us to rewrite the value function as

\[ U(k_t, h_t) = \max_{c_t, \rho_t} \{ u(c_t) + \beta U(k_{t+1}, h_{t+1}) \} \]

Abstracting temporarily from taxation, we can write the equation that describes how physical capital evolves over time as

\[ k_{t+1} = (1 - \delta + r_t) k_t + w_t (1 - \rho_t) h_t - c_t \]

where \( \rho_t \) denotes the fraction of human capital devoted towards human capital formation while \( 1 - \rho_t \) is a fraction of human capital used in the production of physical capital.

In addition, let us assume that human capital is formed through purposeful activity. Specifically, human capital evolves according to

\[ h_{t+1} = (1 - \delta_H) h_t + B\rho_t h_t \]

where \( B \) is a constant.

Note that we formally assume that the endowment of time, which is normalized to 1, must be allocated between human capital formation and the production of physical goods.

The first-order conditions imply that in equilibrium, the net rate of return of physical capital is equal to the rate of return of human capital:

\[ 1 - \delta + r_{t+1} = (B + 1 - \delta_H) \frac{w_{t+1}}{w_t} \]

If we assume the Cobb-Douglas production function, then

\[ y_t = A (k_t)^\alpha [(1 - \rho_t) h_t]^{1-\alpha} \]

hence, the wage paid to a unit of human capital takes the form

\[ w_t = A (1 - \alpha) (1 - \rho_t)^{-\alpha} (k_t)^\alpha (h_t)^{-\alpha} \]

and similarly, we have

\[ r_t = A \alpha (1 - \rho_t)^{-1-\alpha} (k_t)^{\alpha-1} (h_t)^{1-\alpha} \]

Substituting these relationships to Eq. (10) we obtain
Following the traditional approach, in an equilibrium, $\rho$ and the rate of human capital growth should be constant. In such an equilibrium we have

$$
\frac{h}{k} = \frac{1}{1 - \rho} \left( \frac{B + \delta - \delta_H}{A \alpha} \right)^{1 - \alpha}
$$

and

$$
\frac{h_{t+1}}{h_t} = 1 - \delta_H + B \rho
$$

Let us now examine how the taxation of bequests affects the process of the formation of human capital. As before, let us assume that physical capital left to the next generation is taxed at the rate $\tau$, and the revenue $\tau k_{t+1}$ is possibly partially rebated back, with $\Gamma_{t+1}$ being transferred lumpsum to the public. Then, the equation describing the evolution of physical capital by the public is provided with

$$
k_{t+1} = (1 - \delta + r_t) [(1 - \tau) k_t + \Gamma_t] + (1 - \rho_t) h_t w_t - c_t
$$

and the accumulation of human capital is unaffected. However, given the presence of taxation, economic agents enjoy only $(1 - \tau) k_{t+1} + \Gamma_{t+1}$ units of capital when actual bequests are given with $k_{t+1}$. Therefore, the value function takes the form

$$
U ((1 - \tau) k_t + \Gamma_t, h_t) = \max\{u(c_t) + \beta U ((1 - \tau) k_{t+1} + \Gamma_{t+1}, h_{t+1})\}
$$
As before, in equilibrium the net rate of return of physical capital is equal to the rate of return of human capital:

\[(1 - \tau)(1 - \delta + r_{t+1}) = (B + 1 - \delta_H) \frac{W_{t+1}}{W_t}\]

Now, taxation directly influences the above conditions and hence the equilibrium. In addition, there are also indirect effects.

Let us denote the overall amount of physical capital available to economic agents at time \(t\) as \(K_t\). Naturally, we have \(K_t = (1 - \tau) k_t + \Gamma_t\). Again, let us reiterate that we assume that any capital that remains in the possession of the government is not used for production purposes and serves to finance government consumption. Recall that \(r_{t+1} = A\alpha (K_{t+1})^{\alpha-1} [(1 - \rho_{t+1}) h_{t+1}]^{1-\alpha}\) and \(w_{t+1} = A (1 - \alpha) (1 - \rho_{t+1})^{-\alpha} (K_{t+1})^{\alpha} (h_{t+1})^{-\alpha}\), so we can rewrite the above condition as

\[(1 - \tau)(1 - \delta + A\alpha (1 - \rho_{t+1})^{1-\alpha} (\frac{K_{t+1}}{h_{t+1}})^{\alpha-1}) = (B + 1 - \delta_H)(\frac{1 - \rho_{t+1}}{1 - \rho_t})^{-\alpha} (\frac{K_{t+1}}{h_{t+1}} \frac{h_t}{K_t})^{\alpha}\]

As before, let us search for an equilibrium where \(\frac{K}{h}\) and \(\rho\) are constants. In such a case the above condition reduces to

\[(1 - \tau)(1 - \delta + A\alpha (1 - \rho)^{1-\alpha} (\frac{K}{h})^{\alpha-1}) = B + 1 - \delta_H\]

providing

\[\frac{h}{K} = \frac{1}{1 - \rho} ((\frac{B + 1 - \delta_H}{1 - \tau} - 1 + \delta) \frac{1}{A\alpha})^{\frac{1}{1-\alpha}}\]
and pins down the equilibrium interest rate at \( r^* = \frac{B + 1 - \delta_H}{1 - \tau} - 1 + \delta \).

Note that we have established that the presence of taxation affects the equilibrium interest rate. In particular, a higher level of tax rate leads to a higher level of interest rate. Until now, we could only identify the relationship between physical and human capital. To determine the impact of taxation on human capital we have to know the form of the utility function to calculate the value of \( \rho \) in equilibrium. Let us consider the two typical utility functions:

**A. The case of the CRRA utility function**

If the utility function is of the CRRA type, then \( u(c) = \frac{c^{1-\theta}-1}{1-\theta} \). Now, (16) becomes

\[
(1 - \delta_H + B\rho)^\theta = \beta (B + 1 - \delta_H)
\]

which allows in turn for the derivation of the equilibrium value of \( \rho \), given with [1]

\[
\rho^* = \frac{1}{B} \{[\beta (B + 1 - \delta_H)] \frac{1}{\theta} - 1 + \delta_H} \}
\]

Having found \( \rho^* \), we can determine the rate of growth of \( h \) using Eq. (9), given that the ratio of human capital to physical capital is constant, as is the rate of growth of physical capital. The same rates of growth for human and physical capital imply that the output grows at the same rate as well.

In summary, we have found an equilibrium in which \( h, k, \) and \( y \) all grow at the same rate determined by \( \rho^* \), and \( \rho \) itself is constant and given with condition (21). We observe that the value of \( \rho^* \) is not affected by the tax policy.

We have just established that the presence of bequests taxation does not affect the fraction of human capital devoted to the process of producing human capital. Earlier we showed that \( \frac{h}{K} \) were simple functions of \( \rho \) and \( \tau \) (see Eq. (19)).

**B. The case of the logarithmic utility function**

In the case of the logarithmic utility function \( u(c) = v(c) = \log(c) \), and taking into account that \( \frac{u(c_t)}{u(c_{t+1})} \) is equal to \( \frac{c_{t+1}}{c_t} \) (for \( \theta = 1 \)), we can rewrite formula (20) to obtain \( \rho = \beta + [\frac{B}{\beta} - 1] (1 - \delta_H) \).

Once again taxation in the steady state does not affect the value of \( \rho \), confirming that taxation does not distort the accumulation of human capital. Naturally, all other conclusions obtained in the more general CRRA case...
remain valid.

In summary, we can conclude that by taxing the bequests the accumulation of human capital is not affected in a given period. However, it influences the human to physical capital ratio while leaving the rates of growth of all variables unaffected in the steady state.

[1] Naturally, only values between 0 and 1 are admissible.

4. The Two-periods Model

Let us consider now a situation where the economy lasts for two periods. In the first period, the parent generation makes decisions, in particular with regard to the magnitude of bequests that are to be inherited by their descendants who live only in the second period. The parents, who live in the first period, value the well-being of their children and their preferences are represented by the utility function

\[ U = u(C_1) + \beta v(C_2) \]

and the preferences of those living in the second period are simply represented with \( v(C_2) \), so that they depend on consumption in the second period (the previous cases depended on physical capital or physical and human capital).

The evolution of physical capital takes the form

\[ K_2 = (1 - \delta) K_1 + r_1 K_1 + W_1 (1 - \rho) H_1 - C_1 \]

where \( W_1 \) denotes the wage and \( r_1 \) is the rental price of physical capital, given with

\[ W_1 = A (1 - \alpha) (K_1)^\alpha ((1 - \rho) H_1)^{-\alpha} \quad \text{and} \quad r_1 = A \alpha (K_1)^{\alpha - 1} ((1 - \rho) H_1)^{1 - \alpha}. \]

Naturally, we assume that physical output is represented traditionally with \( Y_1 = A (K_1)^\alpha ((1 - \rho) H_1)^{1 - \alpha} \), where \( 1 - \rho \) denotes the fraction of human capital, available in period 1, engaged in the process of the production of physical goods.

Human capital evolves according to

\[ H_2 = (1 - \delta_H) H_1 + B \rho H_1 \]

Let us assume that bequests, which take the form of physical capital, are taxed at a rate \( \tau \). Consequently, the fraction \((1 - \tau) K_2\) of capital left by the parents becomes available to the next generation. Then we can express the budget constraint of the children's generation as
\[
C_2 = (1 - \delta + r_2) [(1 - \tau) K_2 + \Gamma_2] + w_2 H_2
\]

where \(\Gamma_2\) denotes rebates – if any – from the government, as there is no need to create any additional human capital in the second period. The total amount of capital available in the second period is \((1 - \tau) K_2 + \Gamma_2, Y_2\), physical output in the second period is simply given with \(Y_2 = A[(1 - \tau) K_2 + \Gamma_2]^{\alpha} (H_2)^{1-\alpha}\), and the wage and the rental price take the form \(w_2 = A(1 - \alpha) [(1 - \tau) K_2 + \Gamma_2]^{\alpha} (H_2)^{-\alpha}\) and \(r_2 = A\alpha[(1 - \tau) K_2 + \Gamma_2]^{\alpha-1} (H_2)^{1-\alpha}\).

Under such conditions, we can express the utility of the parents in the first period as

\[
U = u[(1 - \delta + r_1) K_1 + w_1 (1 - \rho) H_1 - K_2] + \beta v [(1 - \delta + r_2) [(1 - \tau) K_2 + \Gamma_2] + w_2 H_2]
\]

Optimization leads to

\[
(1 - \delta + r_2) (1 - \tau) = B \frac{w_2}{w_1}
\]

which can be replaced with the values of the wages and the interest rate to give, as \(H_2 = (1 - \delta_H + B\rho_1)H_1\):

\[
(1 - \tau) (1 - \delta + \alpha A\frac{(1 - \delta_H + B\rho) H_1}{(1 - \tau) K_2 + \Gamma_2}]^{1-\alpha} = B\frac{(1 - \tau) K_2 + \Gamma_2}{K_1} \frac{1 - \rho}{1 - \delta_H + B\rho}]^\alpha
\]

We can find the equilibrium values of \(K_2\) and \(\rho\). If we assume that \(\delta = \delta_H = 1\) and \(\Gamma_2 = \lambda \tau K_2\), then

\[
K_2 = \frac{\alpha (1 - \tau) \rho}{1 - \tau (1 - \lambda)(1 - \rho) A(K_1)^\alpha (H_1)^{1-\alpha}}
\]

which reveals implicitly the relation between \(\rho\) and \(K_2\). To explicitly determine \(\rho^*\) we should assume a form of the utility function. Again, we shall consider the CRRA and the logarithmic utility functions.

A. The case of the CRRA utility function
When \( u(c) = v(c) = \frac{c^{1-\theta} - 1}{1-\theta} \), then \( u'(c) = c^{-\theta} \) and condition (29) becomes

\[
K_2 = \frac{[\beta r_2 (1 - \tau)]^{\frac{1}{\theta}} [w_1 (1 - \rho) H_1 + r_1 K_1] - r_2 \Gamma_1 - w_2 B \rho H_1}{r_2 (1 - \tau) + [\beta r_2 (1 - \tau)]^{\frac{1}{\theta}}}
\]

If we assume that fraction \( \lambda \) of tax revenue is rebated back to the public, \( \Gamma_2 = \lambda \tau K_2 \), and noting that

\[
\frac{w_2}{r_2} = \frac{A(1-\alpha)[(1-\tau)K_2+\Gamma_2]^{\alpha\theta} \rho}{A\alpha[(1-\tau)K_2+\Gamma_2]^{\alpha-1}(H_2)^{1-a}} \text{ and } w_1 (1 - \rho) H_1 + r_1 K_1 = A(K_1)^\alpha [(1 - \rho) H_1]^{1-\alpha},
\]

then (30) takes the form

\[
K_2 = \frac{\alpha [\beta r_2 (1 - \tau)]^{\frac{1}{\theta}} A(K_1)^\alpha [(1 - \rho) H_1]^{1-\alpha}}{r_2 (1 - \tau + \lambda \tau) + \alpha [\beta r_2 (1 - \tau)]^{\frac{1}{\theta}}}
\]

Obviously, because we know that \( r_2 = A\alpha [(1 - \tau) K_2 + \Gamma_2]^{\alpha-1} (H_2)^{1-a} \), which can be re-written as

\[
r_2 = \frac{\alpha A(K_2)^{\alpha-1} (H_2)^{1-a}}{(1-\tau+\lambda \tau)^{1-a}},
\]

then \( r_2 \) as a function of \( \rho \) is equal to

\[
r_2 = \frac{\alpha A(BH_1)^{1-\alpha}}{(1 - \tau + \lambda \tau)^{1-\rho} (K_2)^{\alpha-1}}
\]

Using (31) to substitute for \( K_2 \) in (32), we implicitly get \( \rho \). The relationship is non-linear but can be simulated numerically. For the set of parameters: \( \alpha = \frac{1}{3}, \beta = 0.98, \theta = 3, A = 1, B = 1, H_1 = 1, K_1 = 1, \) an increase in the inheritance tax positively affects the accumulation of human capital as \( \rho \) increases (see Fig. 1). This effect is stronger for high tax rates and may be enhanced by positive tax rebates. These parameters include the standardized values of capital stocks \( H_1 \) and \( K_1 \) and exogenous productivities \( A \) and \( B \) set at one, the value of \( \beta \) slightly lower than one (future utility is less valued then current utility), the share of physical capital in production equals 1/3 and \( \theta \) greater than 1 to get the elasticity of substitution (which is \( 1/\theta \)) lower than one.

It should be noted that inheritance tax can decrease \( \rho \), if \( \theta < 0 \). However, such a value of \( \theta \) is not likely in the utility function.

**B. The case of the logarithmic utility function**

When the utility function is logarithmic, we have \( u(c) = v(c) = \log c \). In such a case \( \theta = 1 \) and condition (32) becomes
\[
\rho = \frac{1 - \tau + \tau \lambda}{2(1 - \tau + \tau \lambda) + \alpha \beta (1 - \tau)}
\]

The above expression defines the fraction of human capital in the first period that is used in the process of the formation of human capital. Again, for the set of parameters \( \alpha = \frac{1}{3}, \beta = 0.98, \theta = 3, A = 1, B = 1, H_1 = 1, K_1 = 1 \) the relationship between \( \rho, \tau \) and \( \lambda \) is illustrated by Fig. 2. It shows that if no tax rebates are granted, the tax induces human capital formation only for extremely high rates. However, with an increase in rebates, the positive impact of inheritance tax on the accumulation of human capital appears, including modest rates of tax.

On the whole, we conclude that the accumulation of human capital is positively affected by inheritance tax, however, the size of the effect depends on the fraction of tax revenues transferred back to the public.

5. Discussion

The obtained results have crucial implications for policy-making. If physical and human capital are substitutes, then inheritance taxation together with tax rebates can stimulate the accumulation of human capital in the short term, according to the model from Section 4. In highly developed economies, where the level of physical capital is substantial, the presence of inheritance taxation may facilitate the transition from physical capital-intensive to human capital-intensive production. However, for developing countries, physical capital can hardly be replaced (it is rather complementary to human capital). Therefore the promotion of technology inflow can be crucial for the stimulation of growth (Stokey, 2015). Since the inheritance tax reduces accumulated wealth with possibly no compensatory effect in the form of induced human capital, such a tax might not be recommended, according to the model from Section 2. The complementarity is also postulated in the literature (Cervellati, Meyerheim and Sunde, 2022). These theoretical implications are in line with the observation that inheritance taxation is frequently imposed in affluent countries and rather absent in poorer ones [2].

The inheritance tax does not affect production in the long term but affects the composition of production factors. Therefore, inheritance taxation can be used to change the composition of growth factors. For example, it can enhance the utilization of human capital instead of physical capital in an economy. It is especially worth considering if policy-makers prefer to better utilize the existing workforce (to decrease unemployment) or make economic growth less harmful to the environment (through lower use of physical capital). These effects stem from increasing the ratio between the two types of capital in favor of using human capital and the observation that human capital is more intensively using labor and less harmful to the environment.

The imposition of the inheritance tax should be accompanied by tax rebates, as they inevitably enhance short-term human capital accumulation. This would be a novelty because the use of tax rebates provides an additional policy instrument, complementing the long-term effects of inheritance taxation and fostering the transition to a state of higher utilization of human capital. This possibility stems from the different perspectives of agents: it has been shown that they behave differently when they decide based on long-term vs short-term horizons. Therefore, a policy can take advantage of this by applying different tools to influence agents making choices in different time frames (to tax long-term-oriented individuals and to offer tax rebates for short-term-oriented individuals).
individuals). It should be noted that irrespective of the rebates, taxation does not negatively affect human capital accumulation in the short-term or long-term, as long as both physical and human capital are substitutes. Therefore, the idea that such a tax induces too low accumulation of human capital is not supported. However, too low accumulation of physical capital is an issue. This is not a problem for economic growth but it can be a problem for policy-making concerning the promotion of physical investment.

Unfortunately, the discussed models do not encompass the situation where human capital spurs the productivity of human and physical capital through technical progress. It is, however, hard to suppose that taxation which negatively affects only physical capital can be detrimental to human capital inducing technological progress. A more likely situation is that a higher level of human capital used for production will also stimulate the utilization of this capital for technological progress which is for example consistent with findings of Mastromarco and Simar (2021).

[2] It does not exclude the ordinary explanation that inheritance taxes are low (or not existing) in poorer countries as lower accumulated wealth would make the tax revenues negligible.

6. Conclusion

In this paper, we study how taxation of bequests affects human capital formation. In three separate frameworks, we analyze successive generations of agents who live for one or two periods, with some degree of altruism on the part of the ancestral generation towards their descendants.

In the first framework, we study a simple one-sector model where human capital was intangible but can be approximated with wage income. We conclude that in the steady state the taxation of bequests negatively affects the accumulation of human capital.

In the second framework, human capital is purposefully formed and the process requires resources so that at each period economic agents must balance the effects and costs of human capital accumulation. In this case, the rate of human capital growth is not affected by the presence of taxation, regardless of whether the utility function is of the CRRA type or takes a more simple logarithmic form.

Finally, we consider a two-periods model. As long as the tax revenue is at least partially rebated back to the public, individuals tend to spend more time on human capital formation as the rate of the tax on bequests increases. In other words, a reduction – due to taxation – in physical capital transferred to the next generation is partially offset by an increase in human capital. However, if the policymaker chooses not to rebate any tax revenues, the formation of human capital remains unaffected.

Declarations

This work has not been published previously and is not under consideration for publication elsewhere and publication is approved by all authors.

Competing interest and funding

The publication has been financed by the Polish National Science Centre as research project no. 2018/29/B/HS4/01021
The authors have no relevant financial or non-financial interests to disclose.

The work is analytical and contains no dataset.

CRediT author statement: Maciej Dudek: Conceptualization, Methodology, Formal analysis, Writing - Original Draft, Writing - Review & Editing, Robert Kruszewski: Formal analysis, Visualization, Supervision, Janusz Kudła: Methodology, Writing - Original Draft, Writing - Review & Editing, Project administration, Konrad Walczyk: Investigation, Writing - Original Draft, Writing - Review & Editing, Supervision.

Acknowledgments

The publication has been financed by the Polish National Science Centre as research project no. 2018/29/B/HS4/01021

References


   Diskussionsbeiträge - Serie II. 227, Universität Konstanz, Sonderforschungsbereich 178 - Internationalisierung
der Wirtschaft, Konstanz.
   84(4):11-44. https://doi.org/10.1086/260531
15. Hadlun A (2020) Estate taxation and human capital with information externalities Macroeconomic
   Dynamics and Control 27(9):1639-1662. https://doi.org/10.1016/S0165-1889(02)00074-X
17. Hood A, Joyce R (2017) Inheritances and inequality across and within generations IFS Briefing Note BN192
   The Institute for Fiscal Studies, London.
   522. https://doi.org/10.1016/S0164-0704(97)00026-8
   https://doi.org/10.1016/S0047-2727(00)00098-0
   of Political Economy 98:s126-s150. https://doi.org/10.1086/261727
23. Korom P (2016) Inherited advantage: The importance of inheritance for private wealth accumulation in
   Europe MPIfG Discussion Paper 16/11. Max Planck Institute for the Study of Societies, Cologne.
   42. https://doi.org/10.1016/0304-3932(88)90168-7
   021-00597-x
29. Ohlsson H, Roine J, Waldenström D (2020) Inherited wealth over the path of development: Sweden, 1810-
   https://doi.org/10.3982/ECTA10712


Figures

Figure 1: The simulated values of $\rho$, when $\tau$ and $\lambda$ fall within $(0; 1)$.

Figure 1

See image above for figure legend
Figure 2: The values of $\rho$, when $\tau$ and $\lambda$ fall within $(0; 1)$.

Figure 2

See image above for figure legend