Education Investment and Globalization in a Heterogeneous Population

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Abstract

This paper examines the properties of an optimal income taxation programme under general equilibrium, in which the public policy trade-off "equity *vs.* efficency" interacts with the accumulation of human capital. We analyse how globalization modifies the trade-off and how the change in optimal taxation reveals the efficiency of the public policy. Generically, opening to free trade locally decreases optimal income redistribution, while increasing subsidies to education. This leads to increased investment decisions in education, that could prove socially sub-optimal under certain conditions.

We develop a 2-good,2-factor model of general equilibrium with two levels of labour productivity and with heterogeneous costs of educating. The government redistributes income through wages taxation, which serves equity purposes but interfere as well with incentives to educate. Optimal taxation faces a screening problem which generates ineffiencies. Opening to international trade reshapes the optimal taxation problem because it modifies the sensitivity of agents' responses to a change in public policy.

1 Introduction

The present paper considers the interactions between human capital formation and the public policy debate "equity versus efficiency". To the best of our knowledge, little has been said about this link in general equilibrium. Although productive efficiency of human capital investment has been explored, little consideration has been given to its social impact and to its implications for public

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policy design. Similarly, studies about the efficiency of educational sector rarely connect it with social justice issues. Education is socially valuable since it improves the productivity of labour. But the government faces a screening problem since it gives to all agents the same incentives to educate. A fisrt-best optimal taxation design would require taking account of the disparity in the individual costs of acquiring educating. Informational issues impose public policies to be second-best: educational efforts and talents are unobservable and taxation is bound to be taken on wages. Two main applications are made possible. First, a government's preferences can be derived from the policy it actually implements. Second, social consequences can be evaluated when a change occurs in the redistributive policy.

The paper studies the ability of a government to deal with the consequences of globalization in the educational sector. Income redistribution is the policy tool . Redistribution serves equity purposes by redistributing wealth among agents, and it acts as well as an insurance device against the risk incurred when investing in education. Agents are supposed to be of two types, depending on their capabilities in improving their productivity by educating. The government faces a screening problem when agents are heterogeneous in their educating capabilities. This results in inefficient incentives to educate. The second-best equilibrium is modified when the economy opens to international trade. The propagation of constaints imposed by globalization alters the response of the economy to income taxation. Greater distorsions may arise from this.

The paper is organized as follows. In section (2) we build up a model and examine the general equilibrium under autarky. We first consider a laissez-faire economy (2.2) so that the role of taxation is made clear by comparison (2.3). Then the effects of opening to free trade are analysed in section (3). Section (4) concludes.

2 Autarky

2.1 The model

We build a model for a 2-good, 2-factor economy where wages taxation does not distort production. This allows to separate the distorting effect of taxation on education incentives from the distorting effect on the use of the factors in production[1]. The two factors represent different types of workers. For tractability reasons, sector 1 is supposed to use exclusively one of the two factors. The absence of distortion comes from the combination of inelastic labour supplies and CES preferences which allow for no income effect.

Four goods exist in our economy, of which two are produced (x^1 and x^2) from the two others (l_H and l_L, labours). In their productive activity, workers may have a high or a low level productivity ($i = H, L$). Agents may undertake an effort e in education to improve their probability $\pi(e)$ of becoming a highly

[1] Later on, globalization will bring up distortions in the productive sectors, while taxation will only affect incentives education.

productive worker. We suppose agents differ in their cost $C_t(e)$ of acquiring a certain level of education. This defines two types of "talents" ($t = T, N$ for the Talented and the Non-talented) Several interpretations of this heterogeneity could hold: differences in the family's ability to help pay for costly formation, in the social and cultural background relieving effort, in the social reward of certain careers, in the intensity of network effects, among others. A most direct interpretation fitting well our model's specification could be the following: a heterogeneity in the necessary number of years spent at school or university obtaining a degree, whatever the reasons for it. We will see that the joint determination of C and π allows for a functional normalization. We choose to set $\pi(e) = e$. This means that $C'(e)$ represents the cost of marginally increasing one's probability of acquiring productivity H instead of L. We suppose conditions on the function C_T relative to C_N to illustrate that determine what "talent" means. First, $C_N(e) > C_T(e)$ for any given effort (*i.e.*, probability) e. What is more, we suppose that the marginal cost is higher at any e for the less talented $C_N^{'}(e) > C_T^{'}(e)$. Thinking of C as the time spent studying to achieve the probability e of success, this means that the inequality is permanent and cannot be made up. We finally suppose INADA conditions on both C_t to avoid corner solutions: C is increasing and convex and $C(e)$ and $C'(e) \to +\infty$ as $e \to 1$ and $C'(0) = 0$.

The initial endowment given to workers is a quantity of time. We normalize it to one. The size of the population is also normalized to one. The share of talented agents in the population is named γ, while the share of highly productive workers is λ. Nature's decision on the aggregate level writes

$$\lambda(e_T, e_N) = \gamma e_T + (1 - \gamma) e_N \tag{1}$$

2.1.1 Timing, actions and utilities

The agents' lifetime consists of two periods. In the first one, they decide on how much to educate, enduring a cost of education (depending on their type, or talent, t). According to this effort, Nature reveals their productivity $i = H, L$ getting H with probability $\pi(e)$. The revelation of their productivity is the only risk faced by agents in this economy. Then *ex-post* and *ex-ante* will mean henceforth before and after the resolution of this risk. During the second period, goods are produced and agents choose their consumption of goods x^1, x^2 and leisure $(1 - l_i)$ in a general equilibrium framework with production, selling their time as working force at price w_i (depending on their productivity level i).

This lifetime's welfare is evaluated along the utility function u_t which is separable in time, and thus between effort and consumptions and between type t and level i of productivity.

$$u_t\left(e, x^1, x^2, l_i\right) = v(x_1, x_2, l_i) - C_t(e)$$

The agent is subject to the budgetary constraint $p_1x^1 + p_2x^2 + w_i(1 - l_i) = w_i \cdot 1$. Note that agents of any type and any productivity level derive the same utility $v(\cdot)$ from the consumption of goods x^1, x^2 and leisure l_i. Type t enters only in the evaluation of effort cost and level i of productivity in the budgetary constraint. Utility functions are supposed CES relative the consumptions

$$u_t\left(e, x^1, x^2, l_i\right) = \alpha \log\left(x^1\right) + \beta \log\left(x^2\right) + \gamma \log\left(1 - l_i\right) - C_t\left(e\right) \qquad (2)$$

with $\alpha + \beta + \gamma = 1$. In the ex-post programme (when productivity is given and education is sunk-cost), it is straightforward that labour supply will be constant: $l_i = (\alpha + \beta)$. This derives from the consumption's utility function being CES and the initial endowment being only given in time only. From the former, the share of wealth spent in leisure is a constant fraction of the total wealth, and from the latter, the wealth is evaluated through the same price as leisure: the cost of time, that is the wage rate w_i.

In the ex-ante programme, the level e of effort in education is decided in line with the expected utility hypothesis

$$U_t\left(e\right) = Eu_t = Ev - C_t\left(e\right)$$

2.1.2 Production

Sector 1 produces good 1 from labour L only, while sector 2 uses L and H as imperfect substitutes in a Cobb-Douglas production function where ν_2 measures how intesive the sector is in factor H

$$\begin{aligned} Y^1 &= BL_L^1 \\ Y^2 &= C\left(L_H^2\right)^{\nu_2}\left(L_L^2\right)^{(1-\nu_2)} \end{aligned}$$

Production functions are constant-return-to-scale to allow for a competitive micro-fundation of production with infinitively small firms.

2.2 Autarky in laissez-faire

Agents resolve their dynamic programme by backward induction, insuring this way time consistency in their decisions. We solve first the ex-post general competitive equilibrium. For this, we need to work on a given share λ of H workers (and, later, on a given level τ of taxation). Then agents may decide their optimal effort of education, for a given share λ. Perfect foresight require that the optimal levels of effort decided by agents when forecasting a certain share of H workers (λ) result in this same value of λ through Nature's decision (1). We note v^A the equilibrium value of variable v under autarky.

2.2.1 Ex-post equilibrium

Behaviours Marshall demand functions derive from CES specifications, both on the firms' and on the agents' sides. Note that the supposed endowments imply that labour supplies are inelastic and that technology in sector 1 defines the wage of agents L, $\frac{w_L}{p_1} = B$. Cobb-Douglas functions in both preferences and insure that a constant share of the value of income (respectively, sales) are spent in each good (factor).

General Competitive Equilibrium The general equilibrium is obtained when the four prices (three relative prices are independent, we now consider all prices relative to the one of good 1) result in Marshall demands satisfying equilibrium on the four good and labour markets. Thanks to the inelastic form of labour supplies, the two labour market equilibria and technology in sector 1 give the equilibrium level of output Y^1 of good 1: $Y^1 = (1-\lambda)(\alpha+\beta)\frac{\alpha}{\alpha+\beta(1-\nu_2)}B$ together with the sharing of labour L_L among sectors $\left(L_L^1\right)^A$ and $\left(L_L^2\right)^A$, the individual's consumptions in good 1 $\left(x_i^1\right)^A$ and the relative wage (or equivalently, the wage of the H)

$$\left(\frac{w_H}{w_L}\right)^A(\lambda) = \left(\frac{1}{\lambda}-1\right)\frac{\nu_2}{(1-\nu_2)}\frac{\beta(1-\nu_2)}{\alpha+\beta(1-\nu_2)}$$

Then technology in sector 2 determines output of good 2

$$\left(Y^2\right)^A(\lambda) = (\alpha+\beta)\lambda\left[\frac{(1-\lambda)}{\lambda}\right]^{(1-\nu_2)}\left[\frac{(1-\nu_2)\beta}{(\alpha+(1-\nu_2)\beta)}\right]^{(1-\nu_2)}C$$

individual's allocations in good 2 and relative good prices $\left(\frac{p_2}{p_1}\right)^A(\lambda) = p^A(\lambda)$

$$p^A(\lambda) = \frac{p_1}{p_2} = \frac{B}{C}\frac{1}{(1-\nu_2)}\left[\frac{1-\lambda}{\lambda}\right]^{\nu_2}\left(\frac{(1-\nu_2)\beta}{\alpha+(1-\nu_2)\beta}\right)^{\nu_2} \tag{3}$$

Note that the dependence of equilibrium allocations and prices on the share λ of H workers are common sense, and its writes linear or hyperbolic.

2.2.2 Effort level of education

For a given share λ of H workers, allocations and prices are known. The risk of getting allocation x_L instead of x_H define the incentives for the agents to educate. Now agents of type t can choose their optimal effort $e_t(\lambda)$ to maximize their expected utility ex ante

$$\max_{e_t} EU_t(e_t, \lambda)$$

Individuals being infinitely small compared to the their type's population, their own decision on effort e_t doesn't affect their prediction of the aggregate number of H workers λ. Then the first order condition to the individual's determination of λ is$C_t'(e_t^*(\lambda)) = \pi'(e_t^*(\lambda))[v_H(\lambda) - v_L(\lambda)]$ which becomes thank to our normalization

$$C_t'(e_t^*(\lambda)) = v_H(\lambda) - v_L(\lambda) \tag{4}$$

The left-hand member is increasing in respect to λ, since the functions $C_t'(e)$ are increasing in e. The right-hand member is decreasing because of a general equilibrium effect in sector 2. The more the H, the less they are paid relative to the L. A budgetary constraint effect comes in addition: the less the L, the more one can redistribute to them individually.

2.2.3 Perfect foresight

Now the perfect foresight hypothesis demands that the effort levels that are solution to the EU programme lead to a compatible level of λ. The programme is parameterized by λ and after the risk of education resolves, λ is determined by the chosen efforts through (ref Nature). Note that with our normalization, the right-hand member of equation (ref effort) is independent of the type t.

Independently of the actual incentives to educate, one may then define a perfect foresight level of effort compatible with a given λ. From the sole fact that $C'_T(e_T) = C'_N(e_N)$, one may define a $e_T(e_N)$ such that $C'_T(e_T(e_N)) = C'_N(e_N)$. This is an increasing function of e_N. Then there exists only one $e^*_N(\lambda)$ –and one $e^*_T(\lambda) = e_T(e^*_N(\lambda))$– such that $\gamma e_T(e_N) + (1-\gamma) e_N = \lambda$. We may then define $C'(\lambda) \equiv C'_N(e^*_N(\lambda)) = C'_T(e_T(e^*_N\{\lambda\}))$ the level of marginal effort of education made by every one in the population resulting in a given λ. The actual cost effort endured by the T is not comparable to the one endured by the N. But the effort made is higher for the T: their marginal cost is lower, so facing the same risk in term of utility gap, the talented concede a higher effort. Graphically, the curve $C'(\lambda)$ is simply obtained by tracing for each ordinate C' the abscissa λ that equals wheighted mean of (e_T, γ) and $(e_N, 1-\gamma)$ such that $C'_t(e_t) = C'$. Let us draw it in Fig. 1.

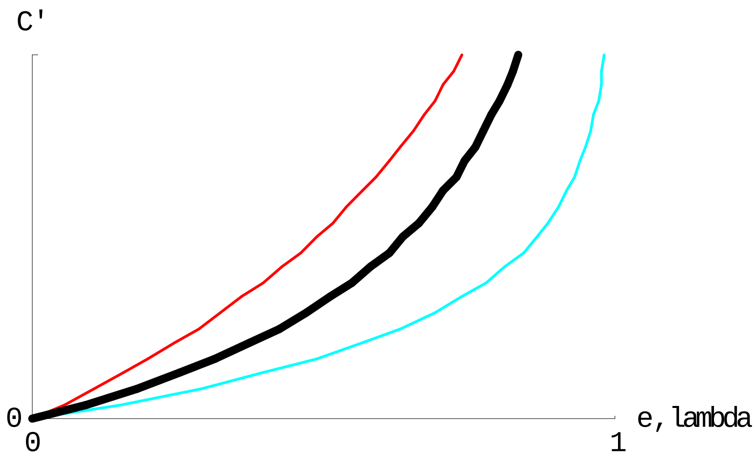

Fig. 1 – Looking for perfect foresight

Now in the plan (λ, C'), a rational expectation line is drawn (the thick line in Fig. 1), delimiting two zones. Above the curve lie marginal costs corresponding to choices of e that will result in a higher λ than expected. So an equilibrum must associate a level of cost and a level of anticipated λ described by the curve.

Individual's choice of effort corresponds to the trade-off between the cost and the gain from marginally increasing effort. Now in each case, we just need to characterize the dependence of marginal welfare gains from educating relative to lamda. By tracing its curve we build up a graph to illustrate how the equilibrium levels of effort and the equilibrium share of H agents are determined under perfect foresight. In a laissez-faire economy under autarky, the incentives to educate are

$$[v_H - v_L]^A(\lambda) = (\alpha + \beta)\log\left(\left(\frac{1}{\lambda} - 1\right)\nu_2\beta\frac{1}{\alpha + \beta(1 - \nu_2)}\right)$$

This is a decreasing function of the share λ of H agents in the economy. The marginal benefits from educating equal the utility gap between the two productivity equilibrium allocations. But when agents H are too numerous, their wage in sector 2 decreases compared to the one of the L. So we can solve in λ to fully define the equilibrium by equalizing marginal costs and gains from educating. This gives the equilibirum efforts under Laissez-faire.

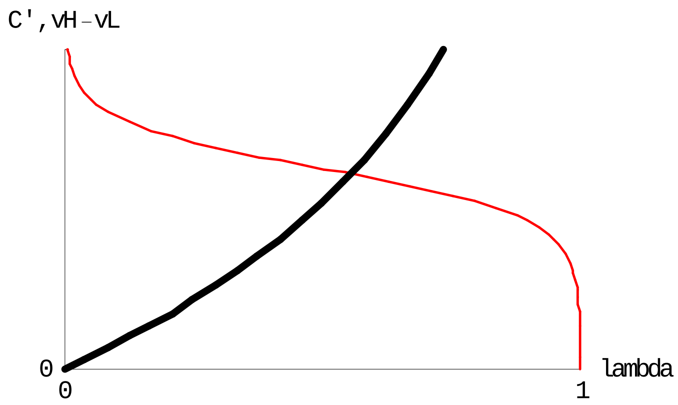

Fig. 2 – Marginal costs and gains from education at share λ

2.3 Redistribution

As was announced, taxation on wages won't interfere with the level of production. More specifically, for a given share λ of H and L workers in the economy, taxation will only transfer consumption from the H to the L. But this transfer provides an insurance against the risk in education investment. This modifies the incentives to educate. Individual effort decrease and so will the share of the highly productive workers to educate.

2.3.1 Taxing wages

The form we suppose for the taxation is a linear taxe on wages with tax rate τ. The result of it is redistributed among low-productivity workers, subject to a balanced budget constraint on the government.

Prices are distorted since firms pay the wage w whereas the agents earn

$$\hat{w}_i = 1 - \tau w_i$$

from selling their time of leisure. Nevertheless, aggregate demand functions are unchanged. Indeed, the aggregate increase in the demand from population L

exactly compensates for the decrease in population H. We note $\tilde{v}$ the value of variable v under taxation.

2.3.2 Ex-post

For a given level of λ, the only consequence of income taxation is to transfer consumption of goods x from agents H to agent L.

Equilibrium allocations in good j for agents i are modified with taxation into

$$\begin{aligned}\left(\tilde{x}_H^j\right)^A(\lambda,\tau) &= (1-\tau)\left(x_H^j\right)^A(\lambda)\\ \left(\tilde{x}_L^j\right)^A(\lambda,\tau) &= \left(1+\tau\frac{\lambda}{1-\lambda}\frac{(w_H)^A}{(w_L)^A}\right)\left(x_L^j\right)^A(\lambda)\end{aligned}$$

yielding welfares

$$\begin{aligned}\tilde{v}_H^A(\lambda,\tau) &= (\alpha+\beta(1-\nu_2))\log\left[\frac{\lambda}{(1-\lambda)}\right]+(\alpha+\beta)\log(1-\tau)+D\\ \tilde{v}_L^A(\lambda,\tau) &= \beta\nu_2\log\left[\frac{\lambda}{(1-\lambda)}\right]+(\alpha+\beta)\log\left(1+\tau\frac{\nu_2}{(1-\nu_2)}\frac{\beta(1-\nu_2)}{\alpha+\beta(1-\nu_2)}\right)+E\end{aligned}$$

where D and E are constants depending on sole parameters. As far as individual choice of effort is concerned, only the difference between v_H and v_L matters. But for the purpos of optimal taxation design, the utility levels import.

2.3.3 Education choices and time-consistency

We consider the government is fully credible and possesses a technology of commitment on its tax rate τ. So agents choose a level of education, taking for granted an announced level of income taxation[2]. A credibility concern is raised by such an hypothesis. Once productivities are revealed, agents are bound to their fate and the government could re-evaluate his programme, willing to reditribute the whole wealth, as far as productive distorsions allows it. We set aside this hold-up problem. We choose indeed to concentrate on the anti-selection problems associated with redistribution and investment in education. The assumption of the government's credibility could be justified by a repeated game framework, considering the policy design over several generations. This is consistent with the purpose of the parper, which is to tackle the long-term consequences of globalization.

The trade-off governing the choice of education remains $C' = v_H - v_L$, but now for a given level of redistribution τ The ex-post incentives to educate are

[2] In this sense, the credibility assumption comes along with the property that taxation doens't distrot production: once we choose to cancel this effect, we must perfect commitment from the government. Otherwise redistribution would be complete under both autarky and trade, and incentives to educate would be always zero.

now a function of the taxed wages $\hat{w}_i$

$$[v_H - v_L]^A(\lambda, \tau) = (\alpha+\beta)\log\left[\frac{\lambda}{(1-\lambda)}\right] - (\alpha+\beta)\log\left(\frac{1+\tau\frac{\nu_2}{(1-\nu_2)}\frac{\beta(1-\nu_2)}{\alpha+\beta(1-\nu_2)}}{1-\tau}\right) + \varepsilon$$

Educational effects of income taxation As shown in Fig. 3 the equilibrium level of λ decreases, as well as the marginal effort of education, as tax rate increases. (The tax rate τ increases as the line gets lighter and thicker) This means that the level of effort decreases for the two groups $t = T, N$. The change in equilibrium can be decomposed into two effects. The first is a decrease in the benefits from acquiring a high productivity, corresponding to the vertical translation of the curve $v_H - v_L$. For a given share λ of H workers, the higher the redistribution τ, the smaller the welfare gap $v_H - v_L$. Then the marginal cost of generating such a λ is greater than the marginal gain. So agents reduce their effort to reduce the former and improve the latter, which brings up the second effect.

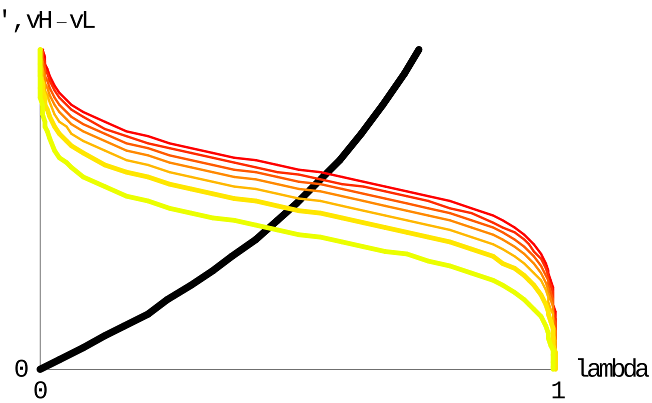

Fig. 3 – Different levels of taxation in Autarky

The fact that the right-hand member of equation (4) determining individual's choice of effort is independent of the agent's type is the very reason for the screening problem faced by a policy-maker. The first-best coud be attained if incentives for education could depend on the type, that is if the difference in the H *vs.* L ex-post welfare could integrate payments contingent on the type t of the agent and on the productivity of the worker.

2.3.4 Optimal taxation

The optimal taxation corresponds to a trade-off between the reduction of inequality and the effect of eviction: the tx abse decreases and interfere with production efficiency.

Social Welfare Function We adopt a definition the social welfare function with no aversion to inequality per se

$$\begin{aligned} SWF &= \lambda v_H + (1-\lambda) v_L - [\gamma C_H + (1-\gamma) C_L] \\ &= \underbrace{Sv(\lambda, \tau)}_{\text{social benefits from consumption}} - \underbrace{SC(\lambda)}_{\text{social costs of formation}} \end{aligned}$$

where $S(\cdot)$ stands for the social aggregator. Supposing government is credible when annoucing makes $\lambda(\tau)$, and $e_t(\lambda(\tau))$. So the optimal level of taxation under the assumption of perfect credibility τ^A is such that $\frac{dSWF}{d\tau}(\tau) = 0$, that is

$$\begin{aligned} 0 &= \underbrace{\lambda'(\tau)[(v_H - v_L)]}_{\text{increasing the share of the } L} + \underbrace{\lambda'(\tau)\left[\lambda \frac{\partial v_H}{\partial \lambda}(\lambda, \tau) + (1-\lambda)\frac{\partial v_L}{\partial \lambda}(\lambda, \tau)\right]}_{\text{general equilibrium effects}} + \\ &+ \underbrace{\lambda \frac{\partial v_H}{\partial \tau}(\lambda, \tau) + (1-\lambda)\frac{\partial v_L}{\partial \tau}(\lambda, \tau)}_{\text{reducing the gap } v_H - v_L} - \\ &- \underbrace{\lambda'(\tau)[\gamma e'_H(\lambda) + (1-\gamma) e'_L(\lambda)] C'(\lambda)}_{\text{reducing the cost of formation}} \end{aligned}$$

The first two terms depict the costs of raising more taxes, from eviction and from general equilibrium effect linked with moral hazard, while the two last terms account for the direct and indirect gains from distributing.

3 Small open economy

Take a small economy represented by our model and suppose it integrates into international trade of goods. The country is then price-taker in the relative price $p = \frac{p_2}{p_1}$, so $p = p^*$. From the international price p^*, one may infer an implicit share λ^* of H workers in the world. Considering that the production sectors of the world economy work the same way as the ones of our small economy, and noting that the rest of the world is almost in autarky, the price p^* would result from a fictitious share of workers λ^* such that equation (3) holds for (λ^*, p^*). This fiction about the world economy serves to compare the small economy (its autarky λ^A) to the world conditions of trade (its imposed price p^*). If the equilibrium autarky price p is inferior to p^* then the equilibrium share of H workers in autarky λ^A is greater than λ^*. So the ex-post economy owns a comparative advantage in H workers.

3.1 Ex-post equilibrium with taxation

We deal at once with income taxation, since the laissez-faire equilibrium is given by the case when a zero tax rate is announced. We note $\tilde{v}^G$ the equilibrium value of v under free trade with taxation, and v^G for zero taxation. The ex-post general equilibrium derives from three conditions: two labour market equilibria and a zero commercial balance. Two of them are independant, while two independent relative prices have to be found.

$$\begin{aligned} L_H &= L_H^2 \\ L_L &= L_L^1 + L_L^2 \\ \left(X_H^1 + X_L^1\right) + p^*\left(X_H^2 + X_L^2\right) &= Y^1 + p^* Y^2 \end{aligned} \tag{5}$$

Once again, the aggregate Marshallian demands do not depend on the level of taxation τ, so equilibrium prices and aggregate allocations will neither ($\tilde{v}^G = v^G$). Equilibrium outputs are $\left(Y^2\right)^G = C\left[\lambda(\alpha+\beta)\right]\left[(1-\nu_2)\,p^*\frac{C}{B}\right]^{\frac{1}{\nu_2}-1}$ and $\left(Y^1\right)^G = B(\alpha+\beta)(1-\lambda) - B(\alpha+\beta)\lambda\left[(1-\nu_2)\,p^*\frac{C}{B}\right]^{\frac{1}{\nu_2}}$ while the share of L workers employed in sector 2

$$\left(L_L^2\right)^G(p^*,\lambda) = \left[(1-\nu_2)\,p^*\frac{C}{B}\right]^{\frac{1}{\nu_2}}\left[\lambda(\alpha+\beta)\right]$$

depends on the relative wage

$$\left(\frac{w_H^1}{p_1}\right)^G(p^*,\lambda) = \frac{\nu_2}{(1-\nu_2)}\left[(1-\nu_2)\,p^*\frac{C}{B}\right]^{\frac{1}{\nu_2}} B \tag{6}$$

while $\left(\frac{w_H^1}{p_1}\right)^G(p^*,\lambda) = B$. It is very noticeable that the wage of the H is independant of λ. The international price determines it only. Actually, This comes from the fact that all the H workers concentrate in sector 2, which is thus competed directly by the H factor content of imported goods. So the workers H are remunerated as workers H in the world economy with a share λ^* of them. Inded we can check that $\left(\frac{w_H^1}{p_1}\right)^G(p^*,\lambda) = \left(\frac{w_H^1}{p_1}\right)^A(\lambda^*)$ for any λ. This results in the linear dependence on λ of the output in sector 2 Y^2. Sector 2 faces two price constraints: the relative good prices are fixed by international law, while the L wages are set by techonology in sector 1. So its output bears the whole burden of the price constraint,

Note that when p^* happens to equal the autarky value $p^A(\lambda)$ given by (3), the general equilibrium allocations and prices are the same than in autarky. This is not surprising, since we know from section (2.3.2) that when facing such a signal, other variables can adjust so that the agents' response set up a general equilibrium with no import or export. This is the basis for the standard gain-to-trade argument. For a given λ (that is, if λ were exogeneous), opening to free trade would allow agents to maximize utility on a larger set of possible allocations.

We can study the effects of the constraint on p imposed by globalization through the elasticity of ex-post equilibrium allocations relative to p. For a given value of λ, a raise from p^A to $p^* > p^A$ occasioned by international trade will naturally increase the wage $\frac{w_H}{p_1}$ of the H (with elasticity $\frac{1}{\nu_2}$) since sector

2 is intesive in factor H and the price of good 2 increases. The wage of the L remain unchanged (elasticity zero) since it derives from technical parameters of sector 1. So the weight of wage adjustment is all on agents H. Sector 2 will produce more (with elasticity $\frac{1}{\nu_2}-1$) and employ more workers L ($\frac{1}{\nu_2}$). Imports of good 2 will occur with elasticity between $\frac{1}{\nu_2}-1$ and $\frac{1}{\nu_2}$.

3.1.1 The ex-post effect of taxation in the small open economy

We are mostly interested in the welfare values of ex-post equilibrium, subject to λ and τ. Similarly to the autarky case, individuals' allocations are

$$\begin{aligned}\left(\tilde{x}_H^i\right)^G(p^*,\lambda,\tau) &= (1-\tau)\left(x_H^i\right)^G(p^*,\lambda)\\ \left(\tilde{x}_L^1\right)^G(p^*,\lambda,\tau) &= \left(1+\tau\frac{\lambda}{1-\lambda}\left(\frac{w_H^1}{w_L^1}\right)^G(p^*,\lambda)\right)\left(x_L^1\right)^G(p^*,\lambda)\end{aligned}$$

which entails the separation of the effects of taxation,of globalization and of the share of H workers on the ex-post levels of utility

$$\begin{aligned}\tilde{v}_H^G(p^*,\lambda,\tau) &= v_H^G(p^*,\lambda)+(\alpha+\beta)\log(1-\tau) \qquad (7)\\ \tilde{v}_L^G(p^*,\lambda,\tau) &= v_L^G(p^*,\lambda)+(\alpha+\beta)\log\left[1+\tau\frac{\lambda}{1-\lambda}\frac{\nu_2}{(1-\nu_2)}\left[(1-\nu_2)p^*\frac{C}{B}\right]^{\frac{1}{\nu_2}}\right]\end{aligned}$$

Since $\left(x_H^i\right)_{i=1,2}^G$ are of elastcity $\frac{1}{\nu_2}$ and $\left(\frac{1-\nu_2}{\nu_2}\right)$ relative to p^*, we can derive from the definition (2) of v the semi-elasticity of $v_H^G(p^*,\lambda)$ is $\frac{1}{\nu_2}(\alpha+\beta(1-\nu_2))$.

3.1.2 Education under free trade – specialization

The effects of globalization on the ex-post equilbrium are standard. They are described above for a given level of λ. Now the comparative advantage of the small country is endogeneous. But what's more, taxation dispruts the decision.

The individual choice of education still results from equalizing marginal gains and costs of investing. As before, we graphically solve the joint T and N equations under perfect foresight by plotting the costs ad benefits functions relative to a rationnaly compatible λ. The costs curve is unchanged, whereas the benefits curve radically changes. Equation (4) becomes $C_t'(e_t^*(\lambda)) = [\tilde{v}_H-\tilde{v}_L](p^*,\lambda,\tau)$.

Zero-taxation equilibrium effort With figure 4, we can link however the situations under autarky and free trade.

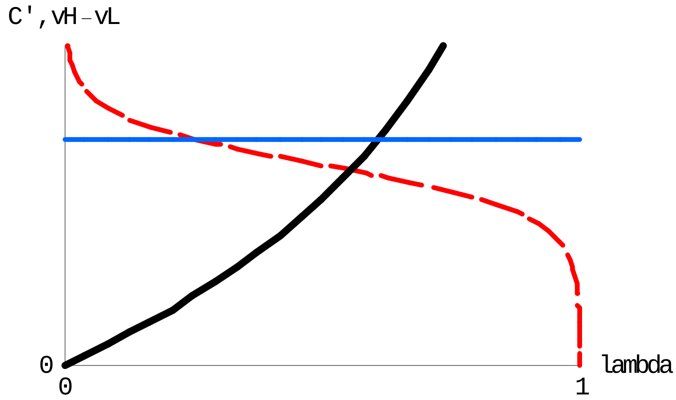

Fig. 4 – Autarky and Trade under Laissez-faire

For zero taxation, the marginal benefits from educating will be constant along λ. With zero taxation, the gap between the H and the L is allways the same, since wages for the one are determined by international competition and for the other by technology in sector 1. The value of this constant gap $v_H - v_L$ is the one in an economy under autarky where the share of H workers would be λ^*. We get $[v_H - v_L]^G_{\tau=0}(p^*, \lambda) = [v_H - v_L]^A_{\tau=0}(\lambda^*)$, for any λ. As a consequence, if $p^* > p^A$, then $\lambda^* < \lambda^A$ and $[v_H - v_L]^A_{\tau=0}(\lambda^*) > [v_H - v_L]^A_{\tau=0}(\lambda^A)$. Finally, the equilibrium $\lambda^G_{\tau=0}$ is larger than its autarky equivalent $\lambda^A_{\tau=0}$. The economy specialises in this model in two moves. First the productive allocation of factors change to adapt the new signal of prices. Second the incentives brought by the change strengthen the specialisation of the country.

Proposition 1 *For a laissez-faire economy (zero-taxation). If a small economy generates in autarky a high equilibrium level λ^A of H workers relative to the rest of the world (λ^*), then its agents will generally raise their effort of education when the economy opens to free trade. It will deepen the gap between the country and the world economy.*

Relatively to a case where factors are endogeneous, specialization is then increased and Stolper-Samuelsson effects are weakened.

Positive taxation For any given non-zero level of taxation $\tau > 0$, the result holds. Indeed, the incentives to educate are

$$
\begin{aligned}
\left[\tilde{v}_H - \tilde{v}_L\right]^G(p^*, \lambda, \tau) \quad &= \quad \frac{1}{\nu_2}(\alpha+\beta)\log p^* - F - \\
&\quad - (\alpha+\beta)\log\left[\frac{1+\tau\frac{\lambda}{1-\lambda}\frac{\nu_2}{(1-\nu_2)}\left[(1-\nu_2)\,p^*\frac{C}{B}\right]^{\frac{1}{\nu_2}}}{1-\tau}\right]
\end{aligned}
$$

where F is a constant. One can check again $[\tilde{v}_H - \tilde{v}_L]^A(\lambda, \tau) = [\tilde{v}_H - \tilde{v}_L]^G(p^A(\lambda), \lambda, \tau)$. The function being increasing in p^*, we know incentives are higher to educate in open economy if $p^* > p^A(\lambda^A(\tau))$.

3.2 Optimal taxation design under Free Trade

Two differences with autarky govern taxation design under free trade. First, the slope of the functions $\lambda \mapsto [\tilde{v}_H - \tilde{v}_L]^G(p^*, \lambda, \tau)$ are less negative than the slopes of the $[\tilde{v}_H - \tilde{v}_L]^A(\lambda, \tau)$. This entails that a downwards shift in the incentives curve causes a faster decrease in the equilibrium value of λ and of efforts $e_T(\tau)$ and $e_N(\tau)$.

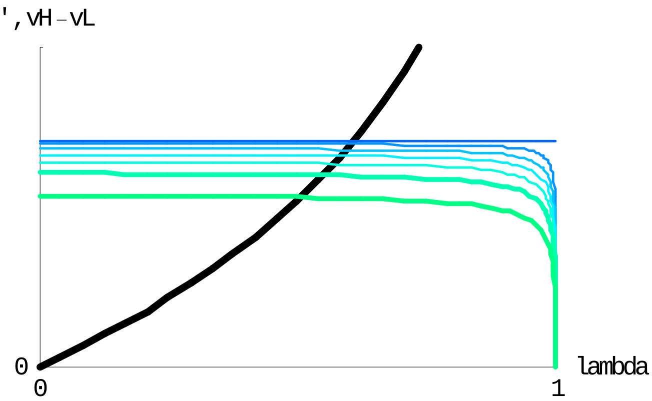

Fig. 5 – Taxation rates under Free Trade

3.3 Equity *vs.* efficiency

The programme of optimal taxation design is still $\frac{dSWF}{d\tau}(\tau) = 0$. But now p is not a function of τ any more, since globalization imposes $p = p^*$. The social welfare functions are given by (7) are thus less elastic relative to λ. The open economy can adjust less readily, so the response of agents to a change in τ is larger. This should amplify the distorsions induced by taxation Then the distortion

4 Conclusion

The papers proposes a basis to analyse the microeconomic impacts of a change in public policy. It still remains to examine the measures of inefficiencies, that is the social costs of providing the same education incentives to both groups. A key notion is the overall efficiency of the educating system.

A major weakness of the model is to suppose a technology of commitment for the government without producing it. The government is supposed to insure its credibility when announcing a future level of taxation, whereas there is no explicit repeated game in the model, and agents are supposed to be perfectly rational.

We can see two possible extensions for the model. First, introducing an index of the government's aversion to inequality could lead to characterize a set of optimal tax responses to globalization, depending on the index. Then, accounting for education subsidies would enrich the analysis of the social distorsions induced by taxation. The effect of globalization on the optimal form of subsidy could be studied in a framework of general equilibrium, leading to more refined measure of the public policy inefficiencies.

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