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ABSTRACT

The Political Economy of Education and Development in an Open Economy*

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The Political Economy of Education and Development in an Open Economy*

François Bourguignon and Thierry Verdier†

December 11, 2001

Abstract

If the price effect of opening up a developing economy may be expected to act as a disincentive for investment in human capital, the opposite is likely to be true of the income effect, especially in the presence of credit market imperfections among the poor. It is shown in this paper that this may not be the case anymore in a society initially dominated by an oligarchic capitalist Elite that is afraid of losing its political control in favor of an educated middle class. Although it may sometimes be in its interest to democratize by subsidizing education when the economy is closed, incentives to do so disappear when the economy is open to trade or factor flows.

1 Introduction

Globalization increasingly seems an unavoidable fact. It affects countries through various channels: international trade, financial liberalization, foreign direct investment, migrations and technology transfers. While generating potentially important economic gains for the world economy, globalization is

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being questioned in terms of its distributional effects. A growing literature is now seeking to identify the various mechanisms through which deeper international integration may affect distribution and generate domestic redistributive conflicts. In particular, a important stream of the recent trade and labor literature tried to identify the respective roles of skill biased technological changes and foreign trade in explaining the increase in wage inequality or unemployment observed in several developed and developing economies in the last decades. A discussion also started on the role of domestic institutions in sheltering open economies from the hazards of globalization and in making external liberalization socially acceptable (Rodrick 1999, 2000a, 2000b).

A channel which received less attention - although it may explain very much of the diversity of countries' experiences with respect to globalization - is education, or more exacty the response of human capital investments to opening up national economies. This channel may actually be quite important. First, human capital accumulation may be an important determinant of growth and poverty reduction. Second, as education has a direct effect on distribution, the educational response may mitigate, or on the contrary reinforce the distributional effects of opening up. Third, the strong link between education and political participation emphasized by political scientists and sociologists might be responsible for opening up having some impact, at least in the medium term, on political and redistribution institutions.

This paper explores the channels through which globalization can generate different domestic educational responses in developing economies and their implications for distribution and domestic institutions. To do this, we extend previous work on the political economy of education (Bourguignon and Verdier 2000a and 2000b) to an archetypical model of a small open developing economy. The model is a simple two period Ricardo-Viner economy with two tradable sectors and three factors of production: unskilled labor, skilled labor and physical capital. The sector, in which the economy has a natural comparative advantage uses unskilled labor as a specific factor and physical capital. The other sector competes against imports and uses skilled labor as a specific factor as well as physical capital, assumed to be mobile across sectors. The volume of skilled labor and the stock of physical capital in the second period result from investment in human capital by workers and investments in physical capital by capitalists in the first period. In addition, the model exhibits two important additional features. First, the credit market is realistically supposed to be imperfect. So, human

and physical capital investments are determined by the liquidity constraints faced by agents. Second, education enhances the political participation of individuals and therefore enlarges the effective political class with a voice on redistributive policies[1]. Despite this, it may be in the interest of the oligarchical capitalist Elite, that is supposed to have political control during the first period, to subsidize the education of the poor workers in the first period, so as to increase the return to capital and therefore its income in the second period.

Within this context, opening up to trade, which may be assimilated to increasing the relative price of the unskilled labor sector, has various effects on education. First, it reduces the wage skill gap and makes education privately less profitable for those who may afford it.[2] Second, it may lessen the liquidity constraint of the poor unskilled workers, thus contributing to more investment in human capital being undertaken. Third, it may also reduce the incentive of the capitalist elite to invest in the skill of the labor force and to slow down the move towards more democracy and more redistribution. To the extent that trade may be considered as some substitute for international factor movements, globalization through capital or labor flows may be expected to have very much the same types of effects.

That part of the analysis that deals with democratization and redistribution can also be viewed as a contribution to the recent literature discussing the role of domestic institutions for the social acceptability of globalizing forces. For instance, Rodrick (1999, 2000b) emphasizes how domestic institutions like political participation, the rule of law, civil liberties, the efficiency and honesty of the bureaucracy may help translate openness into benefits that are shared by society at large, thus facilitating the social acceptability of external integration. In this literature, institutions are generally assumed to be exogenous. On the contrary, the analysis in this paper emphasizes that these institutions are endogenous and may themselves be affected by the forces of globalization.

The paper is organized as follows. Section 2 presents the basic model. The three following sections discuss the impact of increased external integration within this model. Section 3 investigates increased trade integration according to the logic of comparative advantage. Section 4 considers the

[1] see Fraser (1972), Frey (1971), and Verba S., Nie and Kim (1978) for thoughful discussions on the relationhip between political participation, education and income.

[2] See for instance Findlay R., Kierzkowski H., 1983.

consequences of more elastic flows in international factor markets. Finally, section 5 discusses the implications of international technology transfers. In all cases, the discussion focuses on the relationship between external liberalization, education and political regimes. This is done by investigating how globalization and the associated educational responses may affect the dynamics of political power balance by changing the pattern of political participation and the formation of political coalitions. The paper concludes with some policy implications for development aid.

2 The model

- **The production side**

Consider a Ricardo-Viner small open economy with two sectors M and T. Good M (simple manufactured products) is produced out of unskilled labor U and physical capital K_M with a Cobb-Douglas production function:

$$Q_M = U^{\alpha} K_M^{1-\alpha} \qquad \text{with } 0 < \alpha < 1$$

Good T (high tech goods) is produced out of skilled labor S and physical capital K_T with the same Cobb-Douglas function :

$$Q_T = S^{\alpha} K_T^{1-\alpha} \qquad \text{with } 0 < \alpha < 1$$

While for analytical convenience we concentrate on these functional forms, all results that follow may be generalized to more general production technologies (see appendix 2).

The price of good M is supposed to be equal to foreign prices, whereas that of good T differs from foreign prices by a factor θ which stands for the effect of tariffs. If foreign prices are set to unity, the relative domestic price of good M is therefore $p = 1/\theta$. At a point of time, given this price, p, the endowments of unskilled labor, U, skilled labor, S and capital, K, profit maximization and the full employment of resources ensure that the remuneration rate of unskilled labor, w_u, that of skilled labor, w_s, and of capital, r , are equal to their marginal productivity:

$$\begin{aligned} w_u &= \alpha\, p\, (K_M/U)^{1-\alpha} \\ w_s &= \alpha\, (K_T/S)^{1-\alpha} \\ r &= (1-\alpha)\, p\, (K_M/U)^{-\alpha} = (1-\alpha)\, (K_T/S)^{-\alpha} \end{aligned} \tag{1}$$

Recalling that $K_M + K_T = K$, we can derive the intersectoral allocation of capital between the two sectors and all factor prices as functions of p, U, S, and K . it is easily seen that the equilibrium production of the economy is identical to what would be obtained with an economy endowed with the following single production function: $Y = K^{1-\alpha}.(S + p^{1/\alpha}.U)^{\alpha}$. It follows that:

$$w_S/w_U = p^{-1/\alpha};\ r = (1-\alpha)[(S + p^{1/\alpha}U)/K]^{\alpha};\ K_M/K_T = p^{\frac{1}{\alpha}}(U/S) \quad (2)$$

As it seems natural to assume that the rate of return to education is positive, so that there is an incentive to become a skilled worker, it is assumed that $p^{-\frac{1}{\alpha}} > 1$ and therefore that :

$$\text{assumption A1:} \qquad p < 1$$

- **Population, preferences and credit constraints**

We consider an economy with a population scaled to unity. A fraction u of agents are workers (unskilled and skilled) while the remaining fraction $1-u$ is made of capitalists. Each individual i lives two periods 0 and 1, has identical Cobb-Douglas preferences over the two goods in each period given by $u(c_{Mi,}c_{Ti}) = \beta^{-\beta}(1-\beta)^{-(1-\beta)}c_{Mi}^{\beta}c_{Ti}^{1-\beta}$ and maximizes the discounted sum of these intratemporal utilities. Let D_i be the discount factor of individual i. It is a simple matter to see that intertemporal utility over the two periods is given by

$$U(E_{0i}, E_{1i}) = \frac{E_{0i}}{p_0^{\beta}} + \frac{1}{D_i}\frac{E_{1i}}{p_1^{\beta}}$$

where E_{ti} is (nominal) consumption expenditures of individual i at period t (=0,1) and p_t is the relative price of good M in period t.

A fraction s_0 of workers are initially skilled. The rest, $1-s_0$ is unskilled. However, every unskilled worker may become a skilled worker in period 1 by investing an amount γ of good T in period 0. Each worker (skilled or unskilled) is endowed with one unit of his/her type of labor.

It is assumed that the time discount rate depends on the wealth of individuals, with rich people - i.e. capitalits - having a lower discount rate than poor people, that is unskilled workers. Namely, let D_C, D_S, and D_u be respectively the discount factors of capitalists, skilled and unskilled workers, and define $\Delta_i = D_i.p_1^{\beta}p_0^{-\beta}$ the price corrected discount factor for the three

classes of individuals i = C, S and U. Then, the following assumptions are made:

assumption A2: $\Delta_C < r_1 < \Delta s\,;\ r_1 < \Delta u < \left(w_S^1 - w_u^1\right)/\gamma;\ w_u^0 < \gamma$

The first two inequalities imply that only the capitalists are willing to invest in physical capital in period 0, but without possibility of borrowing abroad they cannot invest more than their total income in period 0. It follows that their consumption expenditures in period 0 are zero. The opposite is true of skilled workers. Their time preference is such that they would rather borrow from the domestic credit market in order to consume more than what they receive in period 0. But credit market imperfections prevent them to do so. Unskilled workers are in the same situation with respect to physical capital. However, they would be willing to invest in human capital, the return to which $\left[\left(w_S^1 - w_u^1\right)/\gamma\right]$ is supposed to be higher than the returns on physical capital and their own time discount rate. However, they cannot finance the cost γ of education and their are credit constrained. Thus they invest neither in physical nor in human capital.

These various assumptions are consistent with the idea of unskilled workers being close to subsistence consumption and being therefore unable to pay the fixed cost of education, whereas information asymmetries are responsible for their inability to borrow on the credit market. Because, both capitalists and skilled workers are assumed to be educated since period 0, the return to education is meaningless for them. The assumption that only capitalists have a discount rate low enough to save and invest is made for convenience. It would perfectly be possible to handle the case where skilled workers would save in period 0 and would therefore own part if the capital being put to production in period 1.

- **Political participation and redistribution decisions in each period**

It is assumed that capitalists inherited from their parents an amount of physical capital equal to k_0 as well as some education that allows them to participate in the political decision process of period 0. The latter is also assumed to be true of skilled workers. In the second period, however, some unskilled workers may have become skilled because of educational subsidies decided in period 0. The reason why capitalists may be in favor of such a subsidy is because increasing the proportion of skilled workers in period 1

increases the rate of return on their capital as may be seen in (2) - provided of course that p <1. Of course, there are two costs in doing so. First, the cost of the subsidy itself is $\gamma - w_u$ for each unskilled worker being educated. Clearly, if capitalists have the majority of vote in period 0 ($u > s_0$), they can transfer part of that cost onto skilled workers. This would not be possible in the opposite case but some redistribution would still take place from capitalists to all workers that could permit unskilled workers to pay for their education. [3] Second, if the educated skilled workers are numerous enough, they will then be able to impose some redistribution of period 1's income in their favor. For simplicity, it is assumed that the only redistribution policy available consists of a tax on capital income at the fixed rate τ^+, the proceeds of which is distributed equally within the whole population.

In short, redistribution is concerned with public expenditures on education in period 0 and current income redistribution in period 1. This is not an unrealistic feature in view of the most obvious differences in redistribution systems in developing and developed countries. In any case, it is clear that capitalists will accept subsidizing the education of unskilled workers in period 0 only if they draw some benefit from it over the two periods. They will also choose the number e of people to be educated so as to maximize this benefit, taking into account that if e is too large they will lose political control and will be taxed at τ^+ in period 1. It may be seen that the latter will occur whenever $e \leq u(1 - s_0)$. Of course, capitalits will engage in such 'democratization strategy' only if they find it in their interest, that is if the tax rate τ^+ is not too high [4] and/or their net return on capital is large enough. [5]

- **Analysis of the model**

In period 0, our description of the supply side of the economy provides

[3] This case is not considered in what follows.

[4] Note that it would be possible to make that tax rate endogenous. This was done in Bourguignon and Verdier (2000). In the present case, this would unncessarily complicate the analysis.

[5] It must be stressed that the economy which has just been described may clearly be inefficient. Indeed, efficiency may require (for some configuration of the parameters) that all the workers be educated. Both capitalists and workers could then be better off in period 1. But this would be possible only if the working class could commit itself not to redistribute away from the rich in the second period, or in other words to leave political control to the capitalist oligarchy even though it could overthrow it. In what follows, in order to keep a non trivial political economy approach of education, we assume that such a commitment not to exercise political control when feasible is not possible.

immediately the initial factor prices w_u^0, w_s^0 and r^0 for unskilled labor, skilled labor and capital as:

$$w_u^0 = \alpha p_0^{\frac{1}{\alpha}} \left(\frac{(1-u)k_0}{s_0 u + p_0^{\frac{1}{\alpha}}(1-s_0)u} \right)^{1-\alpha} ; \; w_s^0 = \alpha \left(\frac{(1-u)k_0}{s_0 u + p_0^{\frac{1}{\alpha}}(1-s_0)u} \right)^{1-\alpha}$$

$$r^0 = (1-\alpha) \left(\frac{s_0 u + p_0^{\frac{1}{\alpha}}(1-s_0)u}{(1-u)k_0} \right)^{\alpha}$$

A key variable in all what follows is the cost of the educational subsidy in case a number e of unskilled workers have to be educated in period 0. Assuming that the capitalists have the majority in period 0 and are able to impose the equal sharing of that cost with skilled workers, [6] the cost of the subsidy per taxpayer is by :

$$e.(\gamma - w_u^0)/(u.s_0 + (1-u)) = e.\Sigma(k_0,\, p_0,\, u,\, s_0)$$

with $\Sigma(.)$ being the cost of education of one unskilled worker per taxpayer. We now analyze in more detail the behavior of the various agents and derive from it the optimal behavior of the capitalist oligarchy in period 0, that is the proportion of people, e, whose education it decides to subsidize. To do so, we start from the situation in period 1. Two cases must be considered. Either e is small enough so that the capitalist oligarchy retains its political control, or the newly educated class reaches a voting majority. We consider these two cases in turn.

- *Case (i): the capitalist retains political power:* $e < 1 - u - s_0 u$

Under the assumption of full depreciation of capital in one period the total discounted utility of a capitalist over the two periods as a function of the number of educated workers, e is given by:

$$\Phi(e) = \frac{(r_0 k_0 - e.\Sigma \, - \, I_0)}{p_0^{\beta}} + \frac{1}{D_C} \, \frac{r_1 I_0}{.p_1^{\beta}} \tag{3}$$

[6] Several alternative assumptions about the financing of the subsidy are actually possible. We could have made the capitalists (or the skilled workers) the only tax payers of the educational subsidies of the poor unskilled workers). It would have also been possible to have a tax levied on the entire population, including the unskilled workers not being educated. That would not affect substancially the analysis.

where I_0 is the investment made competitively by each capitalist in period 0 and r^1 is the equilibrium return to capital in period 1 [7]. The assumption was made above that the discount rate of capitalist is always smaller than the rate of return to capital. It may be checked that the following condition ensures that this holds in all cases:

Assumption A.2 $$D_C < \frac{p_0^{\beta}}{p_1^{\beta}}(1-\tau^{+})\,(1-\alpha)\left[\frac{us_0 + p_1^{\frac{1}{\alpha}}(1-s_0)u}{r_0.k_0}\right]^{\alpha}$$

This assumption ensures that the after tax real return to domestic capital in period 1 will be high enough so that competitive capitalists will find themselves liquidity constrained in their investment. The optimal level of investment I_0 of each capitalist is then simply their net income of period 0:

$$I_0 = r_0.k_0 \; - e.\Sigma \tag{4}$$

As it was assumed that unskilled workers do not save in period 0, it follows that the capital stock per capitalist in period 1, k_1, is simply I_0. The corresponding equilibrium return to capital in period 1 is then given by (2) that is :

$$r_{\,1} = (1-\alpha)\left[\frac{us_0 + e + p_1^{1/\alpha}(u(1-s_0) - e)}{(1-u)I_0}\right]^{\alpha} \tag{5}$$

where$(s_0u + e)$ and $u(1-s_0) - e$ now are respectively the number of skilled workers and unskilled workers in period 1[8]. Substituting 4 and 5 in the definition of capitalists' lifetime utlity leads to the following maximized level of utility and referring explicitly to the role of e and the price system p_1 of period 1, it comes that:

$$\widehat{\Phi}(e,p_1) = \frac{(1-\alpha)}{D_C.p_1^{\beta}}\;(1-u)^{-\alpha}\left[(s_0u+e) + p_1^{\frac{1}{\alpha}}[u(1-s_0)-e]\right]^{\alpha}[r_0k_0 - e\Sigma]^{1-\alpha}$$

- *Case(ii): The oligarchy loses political control in the second period*: $e > 1-u-s_0u$.

[7] Note that in this specification, capital goods have a relative price of 1. Hence, as for human capital, investment in physical capital is made in terms of T goods.

[8] It may be checked that this rate of return to capital is always higher than the rate of return that appears on the RHS of Assumption A2. If that assumption is satisfied, it will thus indeed be the case that capitalists are liquidity constrained.

The capitalist oligarchy is then unable to veto a redistribution policy voted by the middle class of educated workers, that is the $e + s_0 u$ workers who are skilled during period 1. As the liquidity constraint remains binding, it is easily checked that the total investment of capitalists is the same as in case (i). This is also true of the capital stock in period 1, I_0, and the pre-tax return, r_1. The intertemporal utility of capitalists is the same function as above except for a taxation correction factor, $(1 - \tau^+)$.

Putting cases (i) and (ii) together and denoting $\overline{Y}_k(e)$ the maximized utility of capitalists conditionally on the number of unskilled workers, e, educated in period 0, it comes that :

$$\left| \begin{array}{ll} \overline{Y}_k(e) = \widehat{\Phi}(e, p_1) & \text{if } e \leq 1 - u - s_0 u \\ \overline{Y}_k(e) = (1 - \tau^+)\widehat{\Phi}(e, p_1) & \text{if } e > 1 - u - s_0 u \end{array} \right|$$

The capitalist oligarchy chooses the optimal number e of subsidized educated workers which maximizes $\overline{Y}_k(e)$. To describe the solution ot the problem of the capitalist Elite, it is first convenient to describe the maximization of the function $\widehat{\Phi}(e, p)$ with respect to e with $0 \leq e \leq u(1-s_0)$, where the upper bound is the proportion of non-educated workers. The interior solution, whenever it exists, is given by:

$$e^*(r_0 k_0, w_u^0, s_0, \gamma, p_1) = \alpha \frac{r_0 k_0 . [u s_0 + (1-u)]}{(\gamma - w_u^0)} - (1-\alpha) \frac{s_0 u + p_1^{\frac{1}{\alpha}} u(1-s_0)}{(1 - p_1^{\frac{1}{\alpha}})} \quad (6)$$

To get a non-trivial positive solution $e^* > 0$, we impose the following restriction:

Assumption A.3 $$\frac{\alpha}{1-\alpha} \frac{r_0 k_0}{s_0 u + p_1^{\frac{1}{\alpha}} u(1-s_0)} > \frac{(\gamma - w_u^0)}{(1 - p_1^{\frac{1}{\alpha}})[u s_0 + (1-u)]}$$

which may be interpreted as a lower bound on the initial income of the capitalists.

It follows that the complete solution to the maximization of the function $\widehat{\Phi}(e, p)$ with respect to e is given by:

$$e^{op}(y_k^0, w_u^0, s_0, \gamma, p_1) = Min \left\{ e^*(y_k^0, w_u^0, s_0, \gamma, p_1), u(1-s_0) \right\}$$

The shape of the intertemporal capitalist utility $\overline{Y}_k(e)$ is plotted in figure 1. Abstracting from the political loss of power constraint, this function

reaches a maximum at the point $e^{op} > 0$. Taking into account the political shift of power constraint $e \lesseqgtr 1-u-s_0u$, it is easy to derive the optimal strategy of capitalists with respect to the number of subsidized educated workers e. Three cases I , II or III are possible and described in figure 1. They are summarized in the following proposition:

Proposition 1 *Let $\widetilde{e}$ be the single point such that $0 < \widetilde{e} \leq e^{op}$ and :*

$$\widehat{\Phi}(\widetilde{e}, p) = (1-\tau^+) Max_e \ \widehat{\Phi}(e, p) = (1-\tau^+)\widehat{\Phi}(e^{op}, p) \tag{7}$$

The various political regimes that may obtain period 1 can then be described as follows:

I) Pure oligarchy. The capitalist oligarchy retains political power if : $e^{op} < 1-u-s_0u$

II) Balance of power. If $\widetilde{e} \leq 1-u-s_0u < e^{op}$, the optimal number of subsidized educated workers is $1-u-s_0u$, the number of skilled workers is just equal to $1-u$ and there is a balance of power between capitalists and skilled workers. Because of this, capitalists can veto redistribution.

III) Political majority to skilled workers. When $1-u-s_0u < \widetilde{e}$, then the optimal number of subsidized educated workers is e^*, the number of skilled workers is larger than $1-u$. Capitalists lose political power and capital income gets taxed by the new majority of skilled workers.

These three possibilities can be described in terms of the parameters γ, r_0k_0, w_u^0, τ^+ or the initial factor endowments k^0, s^0, u. The effect of these parameters on the decision of capitalists is rather obvious. An increase in the cost of the educational subsidy of the unskilled workers, i.e. $\gamma - w_u^0$, reduces the number of educated workers in period 1 and makes the balance of power or the oligarchical regimes more likely. The same is true of the tax rate, τ^+. The initial income of the capitalists or the inital stock of capital would go in the opposite direction. More of it would make the marginal product of capital too low in period 1 in comparison with some initial equilibrium. This may be corrected by having more skilled workers, which reduces the amount of capital put to work in period 1 and increases the rate of return by providing more skilled workers. Comparative statics results are ambiguous for the initial proportion of educated workers, s^0u. Comparative statics on the other parameters of the model is undertaken in the next sections.

3 Trade liberalization

Following the definition used above, trade liberalization is equivalent to reducing the tariff factor, θ, on the import competing good, T and therefore to increase the relative price, p, of the exportable good, M. A simple way of analyzing the opening up of the economy is thus to do comparative static analysis on the terms of trade p. In the present dynamic framework, this raises an issue, however. Should the increase in p concern the two periods 0 and 1, or should it be limited to period 1 and fully anticipated by all agents in period 0? In the short run, it seems natural to limit the increase of p to period 1, whereas increasing *both* p_0 and p_1 in the same proportion would correspond to the permanent or long run effects of trade liberalisation. Keeping this interpretation in mind, we may therefore analyze the impact of globalization going through trade integration by investigating both comparative statics on p_0 and p_1.

It is first easy to see from (6) that an increase in p_1 should decrease e^*, the optimal number of subsidized educated workers even without taking political economy considerations into account. The intuition of this result is simple and corresponds to the standard Hecksher-Ohlin view at trade liberalisation. By making unskilled-labor intensive exports relatively more attractive, trade liberalisation moves relative incomes in favor of unskilled workers. It reduces the skill wage gap and makes education less attractive. The former phenomenon has been the subject of intensive recent research - see Wood (1997) (1998), Leamer (1998), Robbins (1996). The second phenomenon is behind the analysis of the relationship between trade and growth that goes through human capital investment, as for instance in Findlay and Kierzkowski (1983); or Kim and Kim (2000). Things are slightly different in the present model, however. The price effect is analogous but its impact on human capital investment actually goes through the decision of the capitalist oligarchy about subsidizing the education of unskilled workers. As the relative price of the unskilled labor intensive M sector increases, increasing the return of capital by one additional unskilled worker in the M sector becomes more profitable for the capitalist Elite at the margin than increasing that same return by one addtional skilled worker in the T sector. It follows that the incentives of the capitalists to subsidize the education of poor workers is reduced.

As long as the number of educated unskilled workers is unconstrained by political considerations of the capitalist elite - that is either in the case of democracy, that is when the majority in period 1 is initially held by skilled

workers, or in the case of the pure oligarchy - the preceding argument shows that trade liberalisation locally reduces public expenditures on education. Paradoxically, nothing happens when the initial equilibrium is that of the balance of power. Indeed, in that case, the educational subsidy is determined by pure political considerations and is not affected (locally) by trade liberalisation. At the same time, it is clear that trade liberalisation may modify the political regime. By moving $\widetilde{e}$ leftwards in figure 1, it makes oligarchical control or balance of power more likely. A rigorous proof of this is given in the appendix.

Proposition 2 *In the short run, trade liberalization (as reflected by an increase in the relative price of exports p_1) reduces expenditures on education whenever the equilibrium regime is not the balance of power regime. It also reduces the likelihood of a political majority to skilled workers (regime III) and makes more likely that the capitalist oligarchy remains in power.*

To get the long run effect of trade liberalization, it is now necessary to consider the comparative statics on p_0. It is quite immediate to see that the effects of p_0 on educational responses go through the initial capitalist income $r_0.k_0$, and unskilled wage w_u^0. Given that the country under analysis has a comparative advantage in good M, standard Ricardo-Viner results provide that both r_0 and w_u^0 are increasing in p_0. From this, it follows that the optimal unconstrained educational responsed $e*$ increases with p_0.This corresponds to a double income effect. First, with an increase in their per capita income, capitalists invest more in physical capital and increase the domestic stock of capital in period 1. Everything else being equal, this in turn creates a larger demand for skilled labor in the import competing sector and stimulates the educational response of the capitalist Elite. Second, unskilled workers have a higher wage income w_u^0,which reduces the amount of the educational subsidy $\gamma - w_u^0$ to be spent on poor worker to be educated.

With the same argument as before, the preceding effects will be absent if the initial situation was one of balance of power in period 1 and if the trade liberalization is limited. At the same time, the increase in $\widetilde{e}$ makes more likely the democratization of the economy. A full proof of this is given in the appendix.

Proposition 3 *a) Initial trade integration (as reflected by an increase in the relative price of exports p_0) increases the equilibrium endogenous education*

response whenever the equilibrium regime is not the balance of power regime. It also increases the likelihood of a political majority to skilled workers (regime III) and makes it less likely to have the capitalist oligarchy remaining into power in period I.

The positive income effects of trade liberalization in proposition 3 essentially correspond to income effects that relax the liquidity constraints faced in the economy by both capitalists and unskilled workers. Capitalists have more to invest and it costs less to educate unskilled workers in period 0. This in turn is translated into more people being educated and a higher likelihood of democratization, as long as the redistribution eventually implied by this process is not too costly to the initial political Elite (the capitalists). Coupling the results of proposition 2 and 3 lead to both bad and good news on the likely impact of trade liberalization on domestic educational responses and political transitions. From proposition 2, it comes that the short run impact of trade liberalization is likely to reduce the incentives of the domestic political Elite to subsidize the education of the poor and let political institutions become more open. Proposition 3, suggests however that there is a countervailing impact in the long run. As long as trade liberalization triggers enough positive income effects on the economy, one may expect the Elite to be more willing to subsidize the education of the poor and by this way, to allow a political transition process with more representative institutions to start up. As a matter of fact, when the trade induced income effect is strong enough on the poor and raises their wage rate w_u^0 above the fixed cost of education γ, there is actually nothing that the capitalist Elite can do (besides repression) to prevent the emergence of larger political participation. But then even repression may not be sustainable in the long run.

More generally one may also wonder about the implications of trade liberalization not only on poverty, that is here essentially the fate of unskilled workers, but also on inequality within the economy. In the present framework, it is not difficult to show that trade liberalisation reduces the income gaps between the three classes of individuals, that is between skilled and unskilled workers but also between capitalists and the two classes of workers. It is more difficult to see the effect of the changes in the proportion of unskilled workers because this is known to produce ambiguous effects on the Lorenz curve defined by the three classes. Altogether, however, it is likely that the non-ambiguous income gap effect dominates the effect of the change in the proportion of unskilled workers.

4 International Integration of Factor Markets

Instead of, or in addition to liberalizing trade, the economy may liberalize its factor markets by allowing unconstrained access to the international credit market or the free migration of skilled or unskilled workers. In the extreme case where factor mobility between the (small) domestic economy and the rest of the world is perfect, it follows that some or all factor prices are set internationally and become exogenous. This in turn modifies the constraints and incentives of agents to become educated or to subsidize the education of others. As a consequence the conclusions obtained in the previous sections are deeply altered.

Consider first the case of free capital flows with the rest of the world in period 0 at the fixed international real interest factor R.[9] For the sake of comparison, it seems natural to assume that this rate is indeed equal to the discount rate of the capitalists in the closed economy, $R = D_C$, and that there is no change in the pattern of trade integration across periods, $p_0 = p_1 = p$. Other things being the same, and in particular the imperfection of the credit market to finance education, the key question is whether the incentives of the capitalist oligarchy to subsidize the poor's education are affected by the free access to the international capital market.

Free international capital mobility implies that the after tax domestic rate of return on capital is given by R, whereas the stock of capital in the domestic economy is such that its after tax marginal revenue product is indeed equal to R. The difference with the investments financed by domestic capitalists in period 0, I_0, corresponds to foreign investment or borrowing abroad.

Formally, the arbitrage condition between the domestic and the foreign capital markets writes:

$$[1 - \tau^{+}\Im(e < 1 - u - s_0 u)]r^1 = R \tag{8}$$

where r^1 is the domestic return to capital in period 1 and $\Im(e > 1 - u - s_0 u)$ is an indicator function taking the value 0 (resp. 1) when $e \leq 1 - u - s_0 u$ (resp. $e > 1 - u - s_0 u$). As domestic capitalists invest all their income in period 0, their lifetime utility is given by :

[9] See Bourguignon and Verdier (2000b) for a one sector economy analysis with capital mobility.

$$\overline{Y}_k(e) \;=\; \widehat{\Phi}(e, p_1) \;= R.(r_0.k_0 - e\Sigma)/(p^{\beta} D_C) = (r_0.k_0 - e\Sigma)/p^{\beta} \qquad (9)$$

Whether capitalists have political control in period 1 or not, that is whether capital income is taxed or not, is now irrelevant because the arbitrage condition 8 implies that rate of return on capital is the same in both cases. As this rate does not depend on domestic endowment anymore, it follows that capitalists should not fear the switch to democracy anymore but also that they have no gain in subsidizing the education of unskilled workers. As shown by 9, their lifetime utility now depends negatively on the number unskilled workers whose education is being subsidized, and the optimal value of this number is therefore zero.

The intuition is simple and extends what Bourguignon and Verdier (2000b) described in a one sector model. Two markets are missing in the initial closed economy model. On the one hand, there is no credit market to finance investment in education. Hence poor unskilled workers cannot finance their education by themselves even if this is privately and socially profitable. On the other hand, there is no credit market for physical capital investments. Hence capitalists have to finance their investments out of retained profits. For high enough domestic returns on capital (assumption $A.1.$), investment is constrained by capitalists savings. The liquidity constraint both for human and physical capital introduces a complementarity between capital and skilled labor in the whole economy, and there is an incentive for capitalists to partially substitute physical capital accumulation for human capital accumulation. This process is however mitigated by the threat of a change in political power. With free access to the international capital market, competitive capitalists are free to borrow as much as they want in order to equalize their after tax domestic return to the international rate of interest. Thus, the complementarity between skilled workers and physical capital domestic accumulation completely breaks down when the capital market is opened up. Incentives for the capitalist oligarchy to subsidize the poors' education and to initiate the process of political change induced by the accumulation of human capital vanish.

The same mechanism is at work when labor flows rather than capital flows are liberalized. Assume for instance that migration is allowed in period 1, so that domestic wage rates are determined by foreign wage rates. Although this is not really necessary for the argument to go through, consider the limit case

where population flows equalize wages in the domestic economy and abroad. If that equalization occurs for unskilled labor, then w_u^1 is given by the wage rate for unskilled workers in the rest of the world, $\overline{w}_u$. As output prices are also set by the rest of the world - for a given domestic tariff policy - it follows from the homogeneity of the production functions that the capital labor ratio in sector M becomes exogenous in period 1. The same is true of the return to capital in that period 1, r^1, which is thus independent from the number of skilled workers in the economy in this period [10]. It then follows immediately from the previous analysis that the capitalist's Elite has no incentive anymore to subsidize the education of unskilled workers in period 0.

Consider now that migration occurs among skilled workers in period 1 - i.e. brain drain - and suppose similarly that domestic skilled workers can get a wage $\overline{w}_S$ in the rest of the world high enough to induce migration outside the country. The same argument as above goes through. The equalization of w_S^1 and $\overline{w}_S$ pins down the capital labor ratio in sector S and makes the rate of return on capital independent from the number of skilled workers in period 1. Incentives for capitalists to subsidize the education of unskilled workers in period 0 vanish. More directly, it may be seen in the present case that the capitalist cannot make any profit from subsidizing an unskilled worker in period 0 who will migrate in period 1.

All these results[11] can be then summarized in the following simple proposition:

Proposition 4 *When there is free movement of at least one factor of production (capital, skilled or unskilled labor), there is no subsidy to education, $e = 0$ and therefore no change in the structure of political power.*

Note that factor price equalization is not really necessary for this proposition to hold. What is needed is that factor mobility implies that domestic

[10] It is simple to see that (1) implies that

$$\frac{K_M}{U'} = \left(\frac{\overline{w}_u}{\alpha p}\right)^{\frac{1}{1-\alpha}} \text{ and } r^1 = (1-\alpha)p\left(\frac{\alpha p}{\overline{w}_u}\right)^{\frac{\alpha}{1-\alpha}}$$

with the domestic capital market equilibrium condition providing the endogenous number of unskilled workers U' in the economy in period 1.

[11] The case where migration would take place both for skilled and unskilled workers is not considered since it would generally imply the specialization of the economy in a single sector.

factor prices depend on exogenous foreign parameters. In presence of trade, factor prices then become independent from local factor endowments, which in turn shuts down any incentive for the local Elite to try to directly modify these endowments through educational policies.

5 Technology Transfer

A third channel through which globalization can affect the educational response of a small open developing economy is technology transfer. In our archetype economy, we may introduce this feature in various ways. Technology transfers may occur naturally as simple international spillovers of the process of external liberalization. These spillovers may augment total factor productivity nationwide or in one particular sector of the economy. This in turn will typically affect the allocation of resources in the country and, as a result, the incentives to accumulate human and physical capital. New technologies may also be introduced in the country through multinationals, foreign direct investment, international licensing or joint-ventures. In most cases, the local benefits of these new technologies will require the existence of a large enough skilled labor force. This obviously generates additional channels through which globalization will affect the incentives of the local Elite to provide education to the poor.

Consider first with the case where globalization only affects the local economy by technological spillovers which translate into sector specific increases in total factor productivity in the export oriented M sector or in the import competing T sector. Formally, the country is endowed with new production functions:

$$Q_T = AS^{\alpha}K_T^{1-\alpha} \text{ and } Q_M = BU^{\alpha}K_M^{1-\alpha}$$

with $A \geq 1$ and $B \geq 1$ being parameters reflecting the technology scale effect. It is a simple matter to show that the equilibrium allocation of capital and corresponding factor prices are now given by :

$$\begin{aligned} K_M/K_T &= (Bp/A)^{\frac{1}{\alpha}}.(U/S) \quad w_u = \alpha A.(Bp/A)^{\frac{1}{\alpha}}\left([S+(Bp/A)^{\frac{1}{\alpha}}U]/K\right)^{-(1-\alpha)} \\ w_S &= w_u.(Bp/A)^{-\frac{1}{\alpha}} \quad r = (1-\alpha).A.\left([S+(Bp/A)^{\frac{1}{\alpha}}U]/K\right)^{\alpha} \end{aligned}$$

It may be seen on this expressions that productivity gains may have two types of effects on the economy. If they are of the same relative magnitude in the two sectors of the economy they simply increase all factor prices in the same proportion, thus resulting in a pure income effect. If technological spillovers are biased towards a particular sector, however, then they are strictly equivalent to the effect of a change in the relative price of the two sectors. Indeed, what now matters to trade off the output of the two sectors is not p anymore but the expression pB/A. It follows that the comparative statics undertaken on the price p in section (3) above may be used to analyze the effect of technological spillovers.

The pure income effect of productivity changes increases the income of both capitalists and workers. When it takes place in period 0, this gain leads to an increase in the number of unskilled workers being educated, except as before when the initial equilibrium is the balance of power. This effect is similar to an increase in the price p_0. With more income, capitalists invest more and, with unchanged prices in period 1, demand more skilled workers. At the same time, the education subsidy costs less, which also contributes to increasing the optimal number of unskilled workers that capitalists would find optimal to subsidize, when the balance of power constraint is not binding.

A bias of technological spillovers towards the export sector, M has contradictory effects on top of the preceding ones. As it is equivalent to an increase in the relative price of good M, it contributes to reducing the relative return that capitalists may obtain from educating an unskilled worker in period 1. At the same time, however, it reinforces the income effect that would come from neutral technological spillovers in period 0. A bias towards the import sector T, has precisely the opposite effects. It dampens the capitalist income effect that would comes from neutral productivity gains in period 0 and increases the profitability in period 1 of subsidizing the education of unskilled workers. In the opposite direction, a bias in favor of the import sector may also lead to a fall in w_u, by making the export sector and therefore unskilled workers relatively much less atractive. In this case, technological spillover effects would actually increase the cost of subsidizing unskilled workers. Overall, the effect of productivity gains biased towards the import sector may thus be ambiguous.

The preceding results are summarized in the following proposition :

Proposition 5 *a) A neutral total factor productivity increase contributes to more unskilled workers being educated as long as the nitial ppolitical regime*

is not balance of power. It also makes democracy more likely.

b) The preceding effect becomes ambiguous if productivity gains are sufficently biased towards one or the other sector. It reduces the gain for capitalists from educating unskilled workers when the bias is towards the export sector, and it may increase the cost of doing so when the bias is sufficently in favor of the import sector.

The preceding argument is based on the assumption that international technological transfers are like free positive externalities falling in different proportions on the two sectors of the economy. Things may not be as simple. First, in order to reap all the social benefits of technology transfers, the economy often needs to have a large enough domestic skilled base, which give an another incentive to capitalists to subsidize education. Second, technology transfers may be closely associated to other aspects of globalization such as trade in goods, capital mobility, foreign direct investment and various costly international arrangements associated with multinationalisation. In that case, the conclusions summarized in the preceding proposition should logically be combined with those obtained earlier in this paper.

6 Introducing land and a class of landlords

One may wonder whether the preceding results would still hold if, besides capitalists, the ruling elite initially included a class of landlords with no direct interest in increasing the supply of skilled workers because of the almost exlusive reliance of agriculture on unskilled labor. If this were the case and if the class of landlords were initially dominant, one could fear that it would simply oppose the educational subsidy pushed forward by capitalists. Opening up the economy would thus affect education only insofar as the income effect for unskilled workers is large enough to free them from the liquidity constraint.

That the identity of the class that initially dominates the political Elite may matter for educational policy and the democratization process is an interesting idea. However, it turns out to be in contradiction with a simple, but yet rather general, extension of the basic framework used so far. This extension consists of adding a third sector, A, that produces an agricultural product out of land, as a specific factor, and unskilled labor, shared with

the 'traditional' sector, M. As with the other sectors, it is assumed that this good is traded with the rest of the world, its (relative) domestic price, after tariff or subsidy, being p_A. By writing down the equilibrium conditions on the four domestic factor markets (capital, land, skilled and unskilled labor), it is not difficult to show that, under fairly general conditions, the rate of return on capital and the rent on land vary in the same direction when there are changes in the endowments of the economy. The interest of landlords thus appears to be *complementary* of that of the capitalists Transforming unskilled into skilled workers through an educational subsidy in period 0 is profitable for both classes, although not necessarily in the same proportion. It follows that landlords and capitalists will in general agree to subsidize some unskilled workers. But they will generally disagree on the number to subsidize, and on whether it is profitable for them to lose political control.

Solving the whole model under this new specification is complicated because of the necessity to take into account the strategy of the two classes that initially share political control. Instead, the rest of this section essentially shows that capitalists' and landlords' interests in the extended framework just described are complementary rather than substitute.

Let L be the land available. It is used for the production of good A according to the constant return technology represented by the following function:

$$Q_A = U_A f_A(L/U_A)$$

where U_A stands for the unskilled workers employed in agriculture and $f_A()$ is the intensive expression of the production function. Instead of the Cobb-Douglas technology considered above, consider, as in Appendix 2, the following general representation of production technology in sectors M and T:

$$Q_M = U_M f_M(K_M/U_M)\,,\; Q_T = S.f_T(K_T/S)$$

If all factor markets are competitive, one gets the corresponding unit cost functions $C_A(w_U, \mu)$, $C_M(w_U, r)$ and $C_T(w_S, r)$ with μ the rent price on land. The equilibrium of the economy is given by the following familiar set of equations:

$$p_A = C_A(w_U, \mu)\,;\;\; p_M = C_M(w_U, r)\,;\; 1 = C_T(w_S, \mu) \tag{10}$$

$$\frac{\partial C_A}{\partial w_U}.Q_A + \frac{\partial C_M}{\partial w_U}.Q_M \;\; = \;\; U \tag{11}$$

$$\frac{\partial C_M}{\partial r}.Q_M + \frac{\partial C_T}{\partial r}Q_T = K \quad (12)$$

$$\frac{\partial C_A}{\partial \mu}.Q_A = L \quad (13)$$

$$\frac{\partial C_T}{\partial w_S}.Q_T = S \quad (14)$$

where Q_A, Q_M and Q_T are output levels respectively in sectors A, M, and T.

The first equation (10) states the equality between price and unit cost of production (assuming non specialization). Using Shepard's lemma on unit factor demand functions, (11) and (12) are respectively the equilibrium conditions on the unskilled labor market and the capital market. Similarly the last two equations reflect full employment of land and skilled labor. Manipulation of (10) gives immediately the factor price frontiers:

$$\mu = \psi_A(w_U) \text{ and } r = \varphi_M(w_U) \quad (15)$$

Now, after several substitutions, the equilibrium condition on the market for unskilled labor may be written as :

$$L\ \frac{\partial C_A}{\partial w_U}/\frac{\partial C_A}{\partial \mu}. + \left[K - S\frac{\partial C_T}{\partial r}/\frac{\partial C_T}{\partial w_S}\right]\frac{\partial C_M}{\partial w_U}/\frac{\partial C_M}{\partial r} = U \quad (16)$$

where the equilibrium conditions (12) of the capital market,(**??**) for land and (14) for skilled labor have been taken into account. The solution of the model is obtained by (15) and (16), or in other words, the factor price frontiers and an endowment constraint equation that yields the equilibrium price of unskilled labor. However, equations (15) show that there are relationships between factor prices which are independent of endowments. In particular, as both functions $\psi_A()$ and $\varphi_M()$ are necessarily decreasing, eliminating w_U between the two equations in 15 yields a relationship between the rate of return to capital, r, and the rent on land, μ, which is increasing. Thus capitalists' and landlords' interest vary in the same direction when the endowments of the economy, and in particular the number of skilled and unskilled workers, are modified.

To some extent the preceding result reinforces the conclusions obtained earlier in the paper under the assumption of a homogeneous ruling class, the members of which had identical interest. The complementarity of interest which has just been proven for landlords and capitalists in an extended

3-sector and 4-factor Ricardo-Viner model suggests that these conclusions should carry over in a broader framework. Of course, this result depends on the assumption made about the factors used by the various sectors of the economy. Clearly, the key assumption here is the specificity of land in sector A and capital in sectors M and T. In order for capitalists and landlords to have opposite interests, at least one sector in the economy should be using both capital and land.

Also, though they might be affected in the same direction by a change in labor endowments, capitalists and landowners may disagree on the exact amount of education to be subsidized in this economy. To see this, consider again the simple preceding framework. Differentiating logarithmically (10), holding good prices p_A and p_M constant and noting as usual $\widehat{x} = dx/x$ provides the following conditions:

$$0 = \theta_{AU}\ \widehat{w}_U + \theta_{AL}\ \widehat{\mu}$$

$$0 = \theta_{MU}\ \widehat{w}_U + \theta_{MK}\ \widehat{r}$$

$$0 = \theta_{TS}\ \widehat{w}_S + \theta_{TK}\ \widehat{r}$$

with θ_{ij} the cost share of factor $j \in \{U, S, K, L\}$ in the unit cost of sector $i \in \{A, M, S\}$ (for instance $\theta_{AU} = [\frac{\partial C_A}{\partial w_U} w_U]/C_A$, etc...). After elimination of $\widehat{w}_U$ this gives :

$$\widehat{\mu} = \frac{\theta_{AU}}{\theta_{AL}}\ \frac{\theta_{MK}}{\theta_{MU}}\ \widehat{r}$$

or taking the definition of θ_{ij} into account:

$$\frac{d\mu}{dr} = \left[\frac{\frac{\partial C_A}{\partial w_U}}{\frac{\partial C_A}{\partial \mu}}\right] / \left[\frac{\frac{\partial C_M}{\partial w_U}}{\frac{\partial C_M}{\partial r}}\right] \tag{17}$$

$\frac{\partial C_A}{\partial w_U}/\frac{\partial C_A}{\partial \mu}$ is the unskilled labor/land ratio in the agricultural sector A while $\frac{\partial C_M}{\partial w_U}/\frac{\partial C_M}{\partial r}$ is the unskilled labor/capital ratio in the manufacturing sector M.

Hence, though a change in labor endowments of the economy affects both landowners and capitalists in the same direction, it may have a larger or smaller impact on landowners than on capitalists depending crucially on the relative intensity of use of unskilled labor between the two sectors A and M. Indeed, when the agricultural sector is rather "land intensive" and the manufacturing sector is rather "unskilled labor intensive", from (17), one deduces $d\mu/dr < 1$. Capitalists are then more positively affected by

a change in the skilled labor force than landowners, revealing the potential conflict between the two classes over the exact amount of education to be subsidized.

7 Summary and Conclusion

An important channel through which international integration may affect education in a small developing economy is through relieving the liquidity constraint faced by the poorest families of unskilled workers in educating their children. Thus, it would mostly be the income effect of trade and factor movement liberalization that could affect positively human capital investments. The main argument developed in this paper is that this may not be the case if the economy is initially ruled by an educated Elite made up of capitalists and possibly landlords. When the economy is closed to factor movements and only imperfectly open to trade, the Elite may find in its interest to subsidize the education of unskilled workers because this may increase the rate of return on the assets of its members. In some cases, it may even accept to lose political control because of increased political participation due to more people being educated. When the economy opens up, this may not be the case anymore, however. If any factor -capital, skilled or unskilled labor- becomes mobile internationally, then domestic factor prices become exogenous and the ruling Elite has no incentive anymore to subsidize the education of the poor. It is only if the effect of free factor movements on the wage of unskilled workers is high enough, so as to free them from the liquidity constraint, that liberalization will have a positive impact on education.

As far as trade is concerned, the effects of lowering tariffs has an ambiguous effect. The effect is negative in the short-run if the exportable is intensive in unskilled labor and the importable in skilled labor, because this make investing in skilled labor less attractive for capitalists. In the long-run, however, the income effect on skilled labor and on capitalists works in the opposite direction. It costs less to educate unskilled workers and capitalists have more to invest in physical capital, thus demanding more skilled workers.

Another conclusion suggested by the political economy argument in this paper is that there may be situations where opening up or opening more will have absolutely no effect on the domestic economy. This will be the case where the initial educational policy of the Elite is to subsidize the education of a number of unskilled workers that will just allow the Elite to

retain political control on the society when newly educated people become politically active. This regime, that was was labeled 'balance of power', exhibits the peculiar property that the sectoral and inter-sectoral allocation of factors within the economy do not react anymore to small changes in the international environment of the economy.

This, as well as the conclusions obtained in cases where the Elite is not so hardly constrained may be features to take into account when gathering stylized facts about the effects of globalization on educational policy and human capital accumulation.

Appendix 1

- $\widetilde{e}$ **is decreasing in** p_1 :

Proof. : By definition, $\widetilde{e}$ is given by the relationhip$\Phi(\widetilde{e}, p_1) = (1-\tau^+)Max_e$ $\Phi(e, p_1) = (1-\tau^+)\Phi(e^*, p_1)$. Hence , using the envelope theorem,

$$\frac{\partial \widetilde{e}}{\partial p} = \frac{(1-\tau^+)\frac{\partial \Phi}{\partial p}(e^{op}, p_1) - \frac{\partial \Phi}{\partial p}(\widetilde{e}, p_1)}{\frac{\partial \Phi}{\partial e}(\widetilde{e}, p_1)}$$

As $\widetilde{e} < e^{op}$, we have that $\frac{\partial \Phi}{\partial e}(\widetilde{e}, p) > 0$. Hence the sign of $\frac{\partial \widetilde{e}}{\partial p}$ is given by the sign of the numerator.

It can be easily seen that $\frac{\partial \Phi}{\partial p}(e, p_1)$ is proportional to:

$$\left(\frac{y_k^0 - \frac{e(\gamma - w_u^0)}{us_0 + (1-u)}}{(s_0 u + e) + p_1^{\frac{1}{\alpha}}[u(1-s_0) - e]} \right)^{1-\alpha} (u(1-s_0) - e)\, p_1^{\frac{1-\alpha}{\alpha}}$$

As $1 > p_1^{\frac{1}{\alpha}}$, it follows this expression is itself decreasing in e. Hence the second cross derivative with respect to p and e is negative

$$\frac{\partial^2 \Phi}{\partial p \partial e} < 0$$

As $\widetilde{e}(p) < e^*(p)$, it follows that

$$\frac{\partial \Phi}{\partial p}(e^*, p_1) < \frac{\partial \Phi}{\partial p}(\widetilde{e}, p_1)$$

Hence

$$(1-\tau^+)\frac{\partial \Phi}{\partial p}(e^*, p_1) - \frac{\partial \Phi}{\partial p}(\widetilde{e}, p_1) < \frac{\partial \Phi}{\partial p}(e^*, p_1) - \frac{\partial \Phi}{\partial p}(\widetilde{e}, p_1) < 0$$

and the threshold level $\widetilde{e}$ is decreasing in p_1, the relative price of good M in period 1 . ■

- $\widetilde{e}$ **is increasing in** p_0 **when** τ^+ **is not too large**

Proof. : First it is easy to see that the impact of p_0 on $\widetilde{e}$ goes through y_k^0 and w_u^0. Denoting generically $a = y_k^0$ or w_u^0, the envelope theorem provides,

$$\frac{\partial \widetilde{e}}{\partial a} = \frac{(1-\tau^+)\frac{\partial \Phi}{\partial a}(e^{op}, a) - \frac{\partial \Phi}{\partial a}(\widetilde{e}, a)}{\frac{\partial \Phi}{\partial e}(\widetilde{e}, a)}$$

eAs $\widetilde{e} < e^{op}$, we have that $\frac{\partial \Phi}{\partial e}(\widetilde{e}, p) > 0$. Hence the sign of $\frac{\partial \widetilde{e}}{\partial a}$ is given by the sign of the numerator.

It can be easily seen that $\frac{\partial \Phi}{\partial y_k^0}(e, y_k^0)$ is proportional to:

$$\left(\frac{(s_0 u + e) + p_1^{\frac{1}{\alpha}}[u(1-s_0) - e]}{y_k^0 - \frac{e(\gamma - w_u^0)}{us_0 + (1-u)}} \right)^{\alpha}$$

As $1 > p_1^{\frac{1}{\alpha}}$, it follows this expression is itself increasing in e. Hence the second cross derivative with respect to y_k^0 and e is positive

$$\frac{\partial^2 \Phi}{\partial y_k^0 \partial e} > 0$$

Similarly $\frac{\partial \Phi}{\partial w_u^0}(e, w_u^0)$ is proportional to:

$$\left(\frac{(s_0 u + e) + p_1^{\frac{1}{\alpha}}[u(1-s_0) - e]}{y_k^0 - \frac{e(\gamma - w_u^0)}{us_0 + (1-u)}} \right)^{\alpha} \frac{e}{us_0 + (1-u)}$$

As $1 > p_1^{\frac{1}{\alpha}}$, it follows this expression is also increasing in e. Hence the second cross derivative with respect to w_u^0 and e is positive

$$\frac{\partial^2 \Phi}{\partial w_u^0 \partial e} > 0$$

As $\widetilde{e} < e^{op}$, then for $a = y_k^0$ or w_u^0,

$$\frac{\partial \Phi}{\partial a}(\widetilde{e}, a) < \frac{\partial \Phi}{\partial a}(e^{op}, a)$$

As long as τ^+ is not too high, it follows that

$$(1-\tau^+)\frac{\partial \Phi}{\partial a}(e^{op}, a) - \frac{\partial \Phi}{\partial a}(\widetilde{e}, a) > 0$$

and the threshold level $\widetilde{e}$ is increasing in y_k^0 and w_u^0. As in turn y_k^0 and w_u^0 are increasing in p_0, $\widetilde{e}$ is also increasing in p_0 the relative price of good M in period 0 ■

Appendix 2: A model with general production functions:

- *Technologies and factor prices* **:**

Consider the general case where $Q_M = F(U, K_M)$ and $Q_T = G(S, K_T)$. $F(.,.)$ and $G(.,.)$ are standard neoclassical production functions homogenous of degree 1 which can be restated more coveniently in intensive forms as: $Q_M = f(K_M/U)U$ and $Q_T = g(K_T/S)S$ with $f'(.) > 0, f"\ (.) < 0$, $g'(.) > 0, g"(.) < 0$.

At a point of time, given this price, p, the endowments of unskilled labor, U, skilled labor, S and capital, K, profit maximization and the full employment of resources ensure that the remuneration rate of unskilled labor, w_u, that of skilled labor, w_s, and of capital, r , are equal to their marginal productivity:

$$w_u = p\ [fk_M) - k_M f'(k_M)]\ ;\ w_s = g\,(k_T) - k_T g'(k_T)\ ;\ r = p\ f'(k_M) = g'(k_T)$$

where for convenience we denote $k_M = K_M/U$ and $k_T = K_T/S$ the capital intensities in sectors M and T. The capital resource constraint $K_M + K_T = K$ writes also as :

$$k_M\ U + k_T\ S = K$$

Eliminating k_M and using $U + S = u$This implies that $k_T = k_T(K, S, p)$ determined by the relationship :

$$pf'(\frac{K - k_T S}{u - S}) = g'(k_T) \tag{A.1}$$

Total differentiation of (A.1) provides :
Therefore

$$\frac{\partial k_T}{\partial K} = \frac{pf"}{(u - S)\ g" + S\ pf"} > 0 \tag{18}$$

$$\frac{\partial k_T}{\partial p} = \frac{f'(u - S)}{(u - S)\ g" + S\ pf"} < 0 \tag{19}$$

$$\frac{\partial k_T}{\partial S} = \frac{pf"[k_M - k_T]}{(u - S)\ g" + S\ pf"} \lessgtr 0 \text{ as long as } k_M \lessgtr k_T \tag{20}$$

The return of capital can then be written as:

$$r(K, S, p) = g'(k_T(K, S, p))$$

Assuming that the T sector is more capital intensive than the U sector (ie. $k_M < k_T$), (18), (19) and (20) then imply that

$$r'_K = \frac{\partial r}{\partial K} < 0 \ ; \ r'_S = \frac{\partial r}{\partial S} > 0 \ ; \ r'_p = \frac{\partial r}{\partial p} > 0$$

The condition $w_u < w_s$ to have a positive return to education writes as:

$$p\ [f(k_M) - k_M f'(k_M)] \ < \ g\,(k_T) - k_T g'(k_T)$$

which we also assume to be satisfied.

- *Equilibrium Regimes:*

Consider now the choice problem of the capitalist Elite. In period ,1 $U = u(1-s_0) - e$ and $S = us_0 + e$. The political majority shifting constraint is $e \leq 1 - u - s_0 u$ and the liquidity constraint of the capitalist class $I_0 \leq r_0.k_0 \ - e.\Sigma$ writes as

$$\frac{K}{1-u} + e\ \Sigma \leq r_0.k_0 = y_0^k \tag{21}$$

When we assume an assumption equivalent to Assumption A.2 in the text:

$$\text{Assumption A'.2} \qquad D_C < \frac{p_0^\beta}{p_1^\beta}(1-\tau^+)\ r(y_0^k, us_0, p_1)$$

we can ensure that capitalists will be liquidity constrained in terms of their investment and that (21) will be binding. Following the same steps as the main text and using (21), the choice problem of the capitalists can be conveniently rewritten as:

$$Max_{K,e}\ \frac{1}{D_C}\ \frac{(1-\tau^+\Gamma(e)]}{p_1^\beta}\ r[K, us_0 + e, p_1]\frac{K}{1-u} \tag{22}$$

$$s.c.\ \frac{K}{1-u} + e\ \Sigma \leq y_0^k \text{ and } e \leq u(1-s_0)$$

_with $\Gamma(e)$ being the indicator function taking value 0 (respectively 1) when $e \leq 1 - u - s_0 u$ (respectively $e > 1 - u - s_0 u$) and reflecting the change of political regime. In order to get a precise characterization of the solution

of (22), additional assumptions on the shape of the capital return $r(K,S,p)$ have to be made. More precisely we assume the following assumptions:

$$\text{Assumptions H: } r"_{KK}\ K + 2r'_K < 0 \tag{23}$$

$$r"_{KS}\ K + r'_S > 0 \tag{24}$$

$$r"_{Kp}\ K + r'_p > 0 \tag{25}$$

$$r"_{Sp} < 0 \tag{26}$$

(23) simply states the condition for the total capitalist income $r[K,S,p]\ K$ to be concave in the capital stock K. This is quite a natural assumption implying that capitalists' income has the shape of a laffer curve in terms of the capital stock K. Abstracting from the liquidity constraint $\frac{K}{1-u} + e\ \Sigma \leq y_0^k$, the optimal capital stock $K^{\max}(S,p)$ would be given by the first order condition $r'_K\ K + r = 0$. Condition (24) says that the marginal return of investing in capital for the capitalist class is increasing in the skilled labor force S. Hence $K^{\max}(S,p)$ is in fact increasing in S (or e). This assumption entails therefore a certain degree of complementarity in the economy between physical capital and human capital accumulation. Condition (25) says that the marginal return of investing in capital for the capitalist class is increasing in price p the relative price of good M in terms of good T. It implies that $K^{\max}(S,p)$ is increasing in that price p[12]. Finally condition (26) assumes that the marginal return for the capitalists to have more skilled workers $r'_S K$ is decreasing in the price p of the sector using unskilled labor. In other words, this assumption says that one additional skilled worker is less worth for capitalists when actually the sector using unskilled labor has an increase in its relative price.

To solve Problem (22), it is useful to note

$$V(K,e,p_1) = r[K, us_0 + e, p_1]\ K$$

[12]To understand intuitively this relationship, recall that capital goods are in fact T sector goods. Ceteris paribus, an increase in the price of the T sector actually decreases the optimal level of investment in physical capital in the economy. Indeed, from the standard Ricardo-Viner model, one knows that the return to capital (the mobile factor here) would increase less than proportionally with the price level of T goods. Given that capital goods are T goods, this means a reduction on the real return to physical capital investment and reduced incentives to accumulate physical capital in the economy.

From assumptions H, we clearly have the relationships

$$\begin{aligned} V'_K &\gtreqless 0 \text{ when } K \lesseqgtr K^*(us_0+e,p_1)\ ;\ V"_{KK}<0\ ;\ V"_{Kp}>0 \\ V'_e &> 0\ ;\ V"_{ep}<0 \\ V"_{Ke} &> 0 \end{aligned}$$

Consider then the problem (27) defined as

$$Max_{K,e}\ V(K,e,p_1) \qquad s.c.\ \frac{K}{1-u}+e\ \Sigma \leq y_0^k \text{ and } e \leq u(1-s_0) \qquad (27)$$

and illustrated in figure II. In the plane (e,K) we draw the isoquants $V(K,e,p_1) = cte$. These curves are downward sloping (resp. upward sloping) in the region $K < K^{\max}(us_0+e,p_1)$, (resp. $K > K^{\max}(us_0+e,p_1)$). The curve $K = K^{\max}(us_0+e,p_1)$ is itself upward sloping. The liquidity constraint $\frac{K}{1-u}+e\Sigma \leq y_0^k$ is drawn as a budget line BB with slope $\Sigma(1-u)$ and going through the point $(0,y_0^k)$ on the vertical axis. The relevant "budget set" is delimited by the budget line BB and the fact that $e \leq u(1-s_0)$. The constraint of political regime switching is given by the vertical line DD representing $e \leq 1-u-s_0$.

The point of tangency $(e^*(p_1,\Sigma,y_0^k), K^*(p_1,\Sigma,y_0^k))$ between the highest isoquant $V(K,e,p_1) = cte$ and the budget line BB characterizes the interior solution of (27). Taking into account the constraint $e \leq u(1-s_0)$, the solution of (27) is simply $(e^{op}(p_1,\Sigma,y_0^k), K^{op}(p_1,\Sigma,y_0^k))$ such that :

$$e^{op}(p_1,\Sigma,y_0^k) = Min\{e^*(p_1,\Sigma,y_0^k),\ u(1-s_0)\} \text{ and } \frac{K^{op}}{1-u}+e^{op}\ \Sigma = y_0^k$$

To get the solution of Problem (22), one simply needs to consider the isoquant $V(K,e,p_1) = V(K^{op},e^{op},p_1) = V^{op}$. Then there is another lower isoquant $V(K,e,p_1) = (1-\tau^+)V^{op}$ which necessarily crosses the budget line BB at a point $\widetilde{E} = (\widetilde{e}(p_1,\Sigma,y_0^k), \widetilde{K}(p_1,\Sigma,y_0^k))$ with $\widetilde{e} < e^{op}$. The characterisation of the solution of program (22) is simply given by the relative position of $\widetilde{E}$ and the vertical line of political regime switching $e = 1-u-us_0$. One gets the following proposition:

Proposition 6 *The various political regimes that may obtain in period 1 can then be described as follows:*

I) Pure oligarchy. The capitalist oligarchy retains political power if : $e^{op} < 1-u-s_0u$

II) Balance of power. If $\widetilde{e} \leq 1-u-s_0u < e^{op}$*, the optimal number of subsidized educated workers is* $1-u-s_0u$*, the number of skilled workers is just equal to* $1-u$ *and there is a balance of power between capitalists and skilled workers. Because of this, capitalists can veto redistribution.*

III) Political majority to skilled workers. When $1-u-s_0u < \widetilde{e}$*, then the optimal number of subsidized educated workers is* e^**, the number of skilled workers is larger than* $1-u$*. Capitalists lose political power and capital income gets taxed by the new majority of skilled workers.*

- *Comparative Statics*

Effects of p_1 :

Given that $V"_{Kp} > 0$ and $V"_{ep} < 0$, the absolute value of the slope V'_e/V'_K of an isoquant $V(K, e, p_1) = cte$, is decreasing in p_1. From that, it is easy to conclude that the point of tangency (K^*, e^*) moves along BB in the northwest direction. Hence e^* i decreasing in p_1.

To get the effect of p_1 on $\widetilde{e}$, just notice that

$$\Phi(\widetilde{e}, p_1) = (1-\tau^+)\Phi(e^*, p_1)$$

with

$$\Phi(e, p_1) = V(y_0^k(1-u) - e\Sigma(1-u),\ e,\ p_1)$$

As

$$\begin{aligned} \frac{\partial \Phi(e,p_1)}{\partial e} &= -\Sigma(1-u)V'_K + V'_e \\ \frac{\partial^2 \Phi(e,p_1)}{\partial e \partial p_1} &= -\Sigma(1-u)V"_{Kp} + V"_{ep} < 0 \end{aligned}$$

Hence by an argument similar to the one developed in appendix 1, the threshold level $\widetilde{e}$ is decreasing in p_1, the relative price of good M in period 1.

Effects of p_0 :

It is clear that an increase in p_0 affects both Σ (negatively by an increase in w_u^0) and y_0^k positively (by an increase in r_0) Differentiation of $\Phi(e, p_1)$ provides

$$\frac{\partial^2 \Phi(e,p_1)}{\partial e \partial \Sigma} = -(1-u)V'_K + \Sigma e(1-u)^2 V"_{KK} - e(1-u)V"_{eK} < 0$$

and

$$\frac{\partial^2 \Phi(e, p_1)}{\partial e \partial y_0^k} = -\Sigma(1-u)^2 V_{KK}^{"} + (1-u) V_{eK}^{"} > 0$$

an argument similar to that used in appendix 1 provides that e^* is decreasing in Σ and increasing in y_0^k. Hence e^* is increasing in p_0

Similarly, when τ^+ is not too large, $\widetilde{e}$ is decreasing in Σ and increasing in y_0^k. Hence $\widetilde{e}$ is increasing in p_0. ■

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