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Redistribution as Social Insurance and Capital Market Integration

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Abstract

In this paper we claim that increased economic integration can call for an increase in redistribution among workers. When individuals are risk averse and no human capital insurance is available, the share of workers who choose to invest in "specific" human capital will be inefficiently low. Redistribution among workers plays the role of the missing insurance market by making the investment in the specific skills more attractive. If on the one side increased capital mobility makes labour income taxation more distortionary, on the other, by increasing the variance of specific labour wage, it increases the scope for risk protection through redistribution. We show that the insurance effect of redistribution can be stronger than the distortionary effect, so that the optimal tax rate on labour income can increase when capital markets become more integrated.

Keywords: redistribution, Welfare State, international integration, specific investments in human capital

JEL classification: H10, F20, J24

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1. Introduction

There is concern among economists and in public debates that increased international integration can bring about a rolling back of the welfare state and can threaten the redistributive function of the state. As factors become mobile it becomes difficult to levy taxes on them, and redistribution from mobile to immobile factors is severely limited. Tax competition forces a "race to the bottom" where countries are induced to reduce the tax rate on mobile factors.

It is generally unquestioned that capital markets have become increasingly integrated, and that a reduction in capital taxes is taking place. As to labour mobility, its extent seems to be more controversial: because of cultural and linguistic barriers, and because of the costs of breaking personal relations and leaving one's own home country, labour is not so keen to move in response to differences in job opportunities; when it does, nonmonetary costs can be very high. Labour markets are certainly not as much integrated as capital market, even where, as in the European Union, barriers to movement among nations have been formally dismantled.

Does it mean that we can expect that labour income taxes and redistribution among workers are not so much affected by the integration process, at least as long as labour mobility is low? It should be clear that integration not only affects the ability to tax mobile factors: taxation on labour and labour market institutions are affected even when we assume that labour is immobile and integration takes place only in the final product market (Andersen, Haldrup and Sørensen, 2000).

Product market competition forces firms in one country to confront with firms in countries where factors prices and production conditions can be different. In this situation, higher taxes on labour reduce competitiveness. Moreover, as long as this is made possible by the removal of barriers among nations, many firms respond to international differences in factor prices and production costs by moving a part (or all) of their production lines in countries where costs are lower. Hence, labour demand is made more elastic and competitive pressure on immobile labour is made worse by capital mobility.

The interpretation of the effects of product and capital market integration on labour market protection and social protection in general varies among analysts (and so do policy recommendations): on the one side, it is claimed that increased international competition calls for a reduction of protection as the only way to reduce labour costs and restore competitiveness on international markets[1]. On the other, some have emphasized that higher exposure to risk coming from growing integration can explain why more open economies are very often those with higher social protection and larger government spending (Rodrik, 1998).

In this paper, we claim that cutting down social protection can be a suboptimal response

[1]The effect of increased capital mobility on social protection in the form of a minimum wage provision when labour is immobile is discussed by Gabszewicz and van Ypersele (1996). In a model which uses the median voter approach, they show that social protection never increases, and often decreases dramatically, with international competition.

to product and capital market integration, as it discourages investments in human capital. Instead, we show that in some circumstances the best strategy for a country engaged in a process of product and capital market integration might be an increase of social protection, which helps maintaining an adequate level of skills[2].

Our results is somehow at odds with what is usually held about the effect of integration on the optimal level of redistribution. The reason is that we emphasize, and take explicitly into account, the role played by redistribution and the welfare state in general in insuring agents against otherwise uninsurable risks; as it has been recognized (Sinn, 1995, 1996; Bird, 1998; Estevez-Abe, Iversen and Soskice, 2001; Moene and Wallerstein, 2001), one of the main functions of the welfare state is to encourage profitable risk taking by the individuals in the form of investments in specific human capital[3].

We will stress the role played by *specificity* of investments (both in human and in physical capital). An asset is said to be *specific* (to a certain use, firm or sector) if its value is lower outside that use (Williamson, 1985)[4]. Production requires investments which are specific to the sector where the firm operates both by the enterpreneur (e.g. advertisments, a sales network, market researches are typical examples of investments specific to a certain sector) and by workers (the skills required to produce fashionable clothes are not the same required for running a hotel). The value of some of these assets and skills is considerably lower outside that particular sector.

Usually, higher productivity is coupled with a higher degree of specificity; unfortunately, in the context of a rapidly changed environment such as that characterising market economy, where growth is associated with a continuous process of "creative destruction", specific assets are exposed to relevant risks[5]. Because of specificity, capital and labour cannot respond to arisen differences in remuneration by moving to other sectors. Moreover, while investments in physical capital can be quite easily diversified, diversification is usually not possible with human capital.

There is a major case of market failure here, as adequate insurance for the risks on human capital is not provided by private insurance markets. Several explanation can be advanced for this: moral hazard, adverse selection (consider that such an insurance, unless it is offered very early in the life of an individual and it is never renegotiated, would be offered when the worker has acquired some information advantage over the insurer), economies of scale (much of the risks have a systemic character and their pooling requires that the population is sufficiently numerous and diversified). When individuals are risk averse and

[2]Our analysis is in the same spirit as that of Andersen (2002), though in that paper a growth in product markets integration is considered, while we emphasize the effect of growing capital/business mobility.

[3]Though this point of view on the welfare state has been rejuvenated only recently, the general idea that taxation can encourage investments can be traced back to Domar and Musgrave (1944). On the insurance effect of redistributive taxation, see also Varian (1980).

[4]The concept of specificity is very close to that of liquidity of an asset, though the latter concept is not commonly used with reference to human capital.

[5]We can talk of a trade-off between the advantages of flexibility on the one side and those of specialisation on the other. For a more extensive discussion of this trade-off, and its implication for our view of the welfare state, see D'Antoni and Pagano (2002).

no insurance is available against losses in human capital, the investment in specific skills will be inefficiently low[6].

In the context described, social protection can play the role of the missing insurance markets for human capital investments, and make the investment in specific skills more attractive, enhancing productivity. Note that, though we have been talking of social protection programmes, similar conclusions on the insurance role of government could be drawn for redistribution in general and other forms of interventions, as long as they contribute to smoothing income distribution[7]. As claimed by Sinn (1996, p. 260), “the government budget is by far the largest risk absorption device available”.

The paper is organised as follows: section 2 describes a two-periods stylised economy in which in the first period individuals decide whether to acquire a skill, while in the second the equilibrium factor prices are determined. We distinguish two regimes: that of a “closed” economy where product markets are internationally integrated but capital markets are not, and that of an “open” economy where capitals are internationally mobile as well. Section 3 completes the setup of the model by introducing labour supply and government’s objective function. Section 4 introduces taxation, and discusses the general form of the optimal tax condition. In section 5 the main results are presented. We compare the two regimes of closed and open economies considering two cases: in the first, in which there are no sector-specific shocks, the standard conclusion that the optimal level of redistribution is lower with international integration is obtained; in the second, we illustrate our main claim that this conclusion is not warranted when sector-specific shocks are taken into account.

2. The economy

We consider an economy with *n* sectors, producing *n* goods and selling these goods on internationally integrated product market. Product prices are assumed to be fixed and are not influenced by what happens in the economy (small country hypothesis).

In the production process capital and labour are used. A central assumption is that both physical and human capital, once invested in a particular sector, become *specific*, in the sense that they have no value if they are employed outside that sector (we are in fact assuming an extreme degree of specificity).

Labour is assumed to be internationally immobile: it cannot be exported or imported,

[6] As increased international integration opens the possibility for a mobile factor to move to another country (while remaining in the same sector) where production costs are lower and its remuneration is higher, mobility can be seen as a form of “insurance”. Wildasin (2000) shows how interregional mobility of skilled labour can mitigate exposition of labour to region-specific risk, reducing ex post earning inequality. However, in that paper the role played by capital mobility is not analysed. Moreover, assuming that labour is mobile would overstate the possibility for labour to “insure” by moving in those situations where mobility and integration take place among countries characterized by marked differences in language, culture, etc., such as the European Union.; such an assumption would be more appropriate in a federal state with a homogeneous language and culture, where barriers to labour mobility are much less important.

[7] Even public provision of public and private goods, as long as their financing deviates from a strict application of the benefit principle, can be considered in this perspective.

because of cultural and/or linguistic barriers. As to international movements of capital, we consider and compare two different regimes, representing two extreme cases: in the first regime (*closed economy*), capital cannot be moved abroad; in the second regime (*open economy*) capitalists can respond to adverse country-specific conditions by moving their business in a different country at no cost. The change from a regime of *closed* to one of *open* economy represents in a stylized way the current process of growing integration of business which is taking place in Europe.

In order to give content to the notion of specificity (illiquidity, irreversibility) of investments, we consider a two period model:

1. In the first period, identical individuals choose whether to acquire or not the skill necessary to be employed; if they want to become skilled, they decide a sector of specialisation as well.

   At the same time, capitalists choose a sector where they invest their capital.

2. In the second period, technological shocks affect each sector. We consider technological shocks which are both sector- and country-specific.

   Given these shocks and the decisions taken in the first period about factors supply, the wage and profit rate are determined in each sector, bringing about differences in individual labour income.

   The difference between the two regimes is that in the closed economy both capital and labour are fixed, while in the open case capital, but not labour, can respond to a negative (positive) shock by flowing out of (into) the country.

2.1. The first period

We consider a population of N identical individuals. In the first period, before uncertainty is resolved, an individual will acquire skill i if the expected utility from specialising in that skill, less the cost c of skill acquisition[8] (we assume this is uniform across sectors and across individuals) exceeds his/her reservation utility. We take reservation utility as exogenous[9] and normalise it to zero, so that the equilibrium allocation of individuals between workers and non workers, and of among sectors, must satisfy the following condition:

$$U(\omega_i, M_h - c) = 0 \quad \forall i, h \tag{1}$$

where U is utility as a function of ω_i (net wage in sector i; note that this is uncertain in the first period) and lump sum income M_h less the cost of skill acquisition. Individuals are assumed to be *risk averse*.

[8] Here we do not refer (only) to formal education and training, but include more broadly all costs borne by the individuals to acquire a skill.

[9] Reservation utility can be thought of as utility when the individual is not part of the labour force, but also as utility from some unskilled alternative work.

Let H_i be the number of individuals who decide to specialise in sector i, so that $H = \sum_i H_i$ is the total number of individuals who have made an investment in human capital (i.e. the number of *workers* in the second period).

Because of the possibility to diversify the investment in physical capital, decisions on capital allocation depend only on the expected rate of return (not on its variance). We have:

$$E[r_i] = E[r_j] \qquad i, j = 1, \dots, n \tag{2}$$

2.2. *The second period*

The actual values of w_i (wage before taxes) and r_i are determined in the second period. The equilibrium conditions can be expressed as follows:

$$w_i = p_i \frac{\partial f^i(L_i, K_i, \theta_i)}{\partial L} \qquad i = 1, \dots, n \tag{3}$$

$$r_i = p_i \frac{\partial f^i(L_i, K_i, \theta_i)}{\partial K} \qquad i = 1, \dots, n \tag{4}$$

where f^i is sector i's production function, which depends on a random variable θ_i representing a sector- (and country-) specific technological shock; p_i is good i's international market price. We assume that θs are independent random variables.

L_i is the total amount of labour employed in sector i. K_i, the quantity of capital in sector i, is taken as given in the second period if the economy is *closed*, because it depends solely on the investment decisions in the first period. In the *open* case the quantity of capital can change, and the following condition must be satisfied

$$r_i = \overline{r} \qquad i = 1, \dots, n \tag{5}$$

where $\overline{r}$ is the rate of return on capital on international markets[10].

We assume that technology exhibits *decreasing* returns to scale, because of some immobile and non-reproducible factor which we do not consider explicitly. Thus, in each sector total income exceeds the sum of capital and labour income. We will assume that all individuals are endowed with equal shares of capital and of the non-reproducible factor invested in each sector. This is consistent with our claim that while investment in physical capital can be differentiated, this is not possible for human capital, which must be concentrated in a single sector.

Note that capital market integration can bring about a change in the equilibrium factor prices; the direction and magnitude of these change depend on there being a net inflow or outflow of capital. In some cases, it will be useful to assume that *in equilibrium* the *aggregate* quantity of capital is the same in the open and in the closed case. Though quite

[10] Since capital in the second period is specific to a certain sector, we must assume that, although it can move across countries, it is employed always in the same sector. Therefore, we are implicitly assuming that the international rate of return for specific capital is the same for all sectors.

unrealistic, this hypothesis can be justified by assuming that there are number of identical countries behaving symmetrically, so that capital is allocated evenly among them.

For analytical convenience, we assume that prices p_i and production functions f^i of all sectors are equal one to another, and that θs are all drawn from the same probability distribution. As a consequence, we can assume that in the first period H_i and K_i are allocated evenly among sectors, so that $H_i = H/n$ and $K_i = \sum_i K_i/n$ (note however that in the open case the final amount of capital in each sector is in general different, according to the different realizations of θs).

We adopt a Cobb-Douglas formulation for the production function, so that

$$Y_i = f^i(L_i, K_i, \theta_i) = \theta_i L_i^a K_i^b \qquad a, b > 0 \quad a + b < 1 \tag{6}$$

where all θs are drawn from the same probability function, or $\theta_i \sim F$.

We rewrite (3) and (4) as

$$w_i = a\theta_i L_i^{a-1} K_i^b \qquad i = 1, \ldots, n \tag{3'}$$

$$r_i = b\theta_i L_i^a K_i^{b-1} \qquad i = 1, \ldots, n. \tag{4'}$$

It is useful to write the expression of w_i in the open economy case, taking account of the fact that the quantity of capital is not fixed. By using (5) together with (3′) and (4′), we have

$$w_i = a(b/\overline{r})^{b/(1-b)} L_i^{(a+b-1)/(1-b)} \theta_i^{1/(1-b)} \qquad i = 1, \ldots n. \tag{7}$$

3. Workers' utility, labour supply and government's objectives

We will analyse individual choice under uncertainty using the mean/variance approach. As is well known, this approach involves no loss in generality when all random variable distributions are characterised by their first two moments. This will be granted in our model by assuming that all such variables have a log-normal distribution.

Within the mean/variance approach, workers' utility can be represented by

$$E[y_h] - R(S[y_h]) \tag{8}$$

where y_h is a random variable representing income, S is the standard deviation operator and R is an increasing and convex function (we make the further assumption that $R'(0) = 0$ and $\lim_{\sigma \to \infty} R'(\sigma) = \infty$). This is tantamount as assuming constant absolute risk aversion.

3.1. Individual labour supply

In order to take account of the distortionary effect of taxation, we have to consider individual labour supply. Let disutility from labour (measured in units of income) be expressed by the function $D(s) = s^{(1+\varepsilon)/\varepsilon}$ with $\varepsilon > 0$, where s is individual labour supply; it is $D' > 0$ and $D'' > 0$.

We introduce an individual source of risk and variability by taking the individual *effective* labour supply as given by $l_h = x_h s_h$, where x_h is a random variable representing worker h's labour efficiency. We assume that all xs are identically and independently distributed.

Worker h chooses s_h after the realization of x_h to maximise

$$y_h = M_h + \omega x_h s_h - s_h^{(1+\varepsilon)/\varepsilon} \tag{9}$$

where $\varepsilon > 0$, M_h is lump sum income, ω is the *net* (= net of taxes) wage rate. We differentiate with respect to s_h, and get the first order condition

$$\omega x_h = \frac{1+\varepsilon}{\varepsilon} s_h^{1/\varepsilon} \tag{10}$$

from which we obtain the labour supply function

$$s_h = \left(\frac{\varepsilon \omega x_h}{1+\varepsilon}\right)^{\varepsilon} \tag{11}$$

whose elasticity is constant and equal to ε. By substituting in (9) we have:

$$\begin{aligned} y_h &= M_h + \omega x_h \left(\frac{\varepsilon \omega x_h}{1+\varepsilon}\right)^{\varepsilon} - \left(\frac{\varepsilon \omega x_h}{1+\varepsilon}\right)^{1+\varepsilon} \\ &= M_h + \frac{1}{1+\varepsilon}\left(\frac{\varepsilon}{1+\varepsilon}\right)^{\varepsilon} (\omega x_h)^{1+\varepsilon} \end{aligned} \tag{12}$$

which expresses income, net of labour supply cost, as a function of the wage rate ω, of lump sum income M_h and of the individual index of labour efficiency x_h.

3.2. *Aggregate labour supply*

We add up individual (effective) labour supplies in order to obtain sector i's aggregate (effective) labour supply,

$$\begin{aligned} L_i = \sum_{h \in H_i} x_h s_h &= \sum_{h \in H_i} x_h \left(\frac{\varepsilon}{1+\varepsilon}\right)^{\varepsilon} (\omega_i x_h)^{\varepsilon} \\ &= \left(\frac{1}{H_i} \sum_{h \in H_i} x_h^{1+\varepsilon}\right) H_i \left(\frac{\varepsilon}{1+\varepsilon}\right)^{\varepsilon} \omega_i^{\varepsilon} \end{aligned} \tag{13}$$

For H_i large enough we have

$$L_i = E[x^{1+\varepsilon}] H_i \left(\frac{\varepsilon}{1+\varepsilon}\right)^{\varepsilon} \omega_i^{\varepsilon} = H_i \omega_i^{\varepsilon} \tag{14}$$

where we have normalised $E[x^{1+\varepsilon}]$ so that $E[x^{1+\varepsilon}](\varepsilon/(1+\varepsilon))^{\varepsilon} = 1$. Note that L_i depends only on the expected value of x_h, because of statistical independence of xs: the actual realizations of xs affect individual incomes but have no influence on the market wages.

3.3. *Government's objective*

Since all individuals are ex ante equal, the objective of the government is to maximise the utility of the representative individual. In the first period, equilibrium condition (1) is satisfied. This means that participation to the labour force yields the individual nothing more than the reservation utility.

However, taxation, by modifying the equilibrium, can change the reward to the other factors, which accrues to the individuals in addition to labour income, and through this channel it can affect the final level of their utility. More specifically, in the closed case the per capital level of this reward will be

$$\sum_i \frac{Y_i - w_i L_i}{N} = \frac{1-a}{N} \sum_i Y_i \tag{15}$$

where Y_i is sector i production. In the open case:

$$\sum_i \frac{Y_i - w_i L_i - \bar{r} K_i}{N} + \bar{r}\frac{\bar{K}}{N} = \frac{1-a-b}{N} \sum_i Y_i + \bar{r}\frac{\bar{K}}{N} \tag{16}$$

where $\bar{K}$ is the quantity of capital owned by the individuals of the country (which we are here allowing to differ from the total capital employed in the country). In both cases, government's objective will be to maximise total income $\sum_i Y_i$ under the constraint (1), which we can now rewrite as

$$E[y_h] - R(S[y_h]) - c = 0. \tag{17}$$

4. Taxation

We are now ready to analyse the effect of redistributive taxation. We consider a simple redistribution scheme, consisting of a proportional tax of rate t on workers' earned income which finances a uniform lump sum transfer B benefiting workers. The fact that only workers are entitled to the transfer reflects a typical feature of many welfare state institutions (note that here non-working individuals are not unemployed).

We will exclude other forms of taxation, e.g. taxation on capital. Though quite unrealistic[11], this assumption allows us to concentrate on the impact of integration on the optimal amount of redistribution among workers, which is the main focus of this paper[12].

We will consider the choice of t as the only choice variable for the government. B is not set independently, since the government's budget constraint must be satisfied:

$$t \sum_i L_i w_i = HB \tag{18}$$

[11]Disregard of capital taxation would be fully justified only when such taxation is not affected by integration, which is clearly the case only if there is some form of international coordination limiting tax competition, or if all countries adopt a residence-based taxation.

[12]Note also that in our setting, where the amount of capital is given and individuals are endowed with equal capital shares, a capital tax would have no distortionary effect and would be equivalent to a uniform lump sum tax levied on all individuals. To take account of capital taxation, we would need to model capital supply explicitly and to consider different hypotheses on its distribution among individuals.

note that we are considering a purely redistributive tax; no public good is produced. The tax rate is credibly announced in the first period, and there are no time inconsistency problems. We use (14) and solve for B:

$$\begin{aligned} B &= t(1-t)^{\varepsilon} \sum_i w_i^{1+\varepsilon} \frac{H_i}{H} \\ &= \frac{t}{1-t} \sum_i \omega_i^{1+\varepsilon} \frac{H_i}{H}; \end{aligned} \tag{19}$$

note that, with a proportional tax, $\omega_i = (1-t)w_i$.

4.1. *Taxation and market equilibrium*

We calculate the equilibrium wage in the presence of taxation with reference to the two regimes of closed and open economy.

For the case of a closed economy we use (14) to substitute for L_i in (3′); recalling that $\omega_i = (1-t)w_i$, we obtain

$$\omega_i^{1+\varepsilon(1-a)} = (1-t)aH_i^{a-1}K_i^b\theta_i \qquad i = 1,\dots,n. \tag{20}$$

For the case of an open economy, we substitute for L_i in (7), and get

$$\omega_i^{1+\varepsilon(1-a/(1-b))} = (1-t)a(b/\overline{r})^{b/(1-b)}H_i^{-[1-a/(1-b)]}\theta_i^{1/(1-b)} \qquad i = 1,\dots n \tag{21}$$

From these expressions we can easily calculate and compare the elasticities of (net) wage with respect to $(1-t)$; we have, for the closed and the open case respectively:

$$\eta_{1-t}^c \equiv \frac{1}{1+\varepsilon(1-a)} < \frac{1}{1+\varepsilon[1-a/(1-b)]} \equiv \eta_{1-t}^o < 1 \tag{22}$$

which means that the incidence of taxation on labour is higher when the economy is open; this is not surprising, since in this case mobile capital can escape taxation. Note however that even in the open case not the whole burden of taxation is borne by labour, due to the presence of decreasing returns to scale (some of the burden is shifted to the "fixed" factor responsible for decreasing returns); the right hand side would be equal to one if we had $b = 1-a$ (constant returns to scale).

Similarly we define η_H as the elasticity of ω_i with respect to H_i; we have:

$$\eta_H^c \equiv -\frac{1-a}{1+\varepsilon(1-a)} < -\frac{1-a/(1-b)}{1+\varepsilon[1-a/(1-b)]} \equiv \eta_H^o \tag{23}$$

this reflecting the fact that the effect of the number of workers on the marginal productivity of labour is higher if the quantity of capital in each sector is fixed than if capital can move[13].

[13] In the open case, the change in marginal productivity depends on the presence of the fixed factor responsible for the diminishing returns to scale; indeed, no change in w_i would be brought about by a change in H_i if there were constant returns to scale, so that $1-b = a$.

4.2. *Optimal tax rate*

We know that the optimal tax rate maximizes national income. It solves

$$\max_{1-t} \sum_i Y_i. \tag{24}$$

(to make things simpler, we use $1-t$ as control variable). We have the following first order condition

$$\sum_i \left[\frac{\partial Y_i}{\partial \omega_i}\frac{d\omega_i}{d(1-t)} + \frac{\partial Y_i}{\partial H_i}\frac{dH_i}{d(1-t)}\right] = \sum_i \left[a\varepsilon\frac{Y_i}{\omega_i}\frac{d\omega_i}{d(1-t)} + a\frac{Y_i}{H_i}\frac{dH_i}{d(1-t)}\right] = 0 \tag{25}$$

We multiply (25) by $1-t$ to obtain

$$\sum_i aY_i \left[\varepsilon\eta_{1-t} + \frac{1-t}{H_i}\frac{dH_i}{d(1-t)}\right] = \sum_i aY_i \left[\varepsilon\eta_{1-t} + \phi_i\right] = 0 \tag{26}$$

where ϕ_i is the elasticity of H_i with respect to $1-t$. This is obtained differentiating the equilibrium conditions (1):

$$\phi_i \equiv \left(\frac{1-t}{H_i}\right)\frac{dH_i}{d(1-t)} = -\left(\frac{1-t}{H_i}\right)\frac{dU_i/d(1-t)}{dU_i/dH_i}. \tag{27}$$

Condition (26) makes clear that the optimal tax trades off two effects: the first is the commonly discussed distortionary effect of taxation on labour supply $\varepsilon\eta_{1-t}$, given here by the product of the elasticity of individual labour supply and the elasticity of net wage with respect to the tax rate (the latter measures the incidence of the income tax on labour income). The second is the effect of taxation on first period incentives to acquire a skill and enter the labour market: this can have a positive effect on national income because of the insurance effect of taxation; in our framework, taxation plays the role of an insurance device, pooling individual risk over the whole population of workers.

In the next section will discuss how condition (26), and therefore the optimal tax rate, is affected when international integration takes place.

5. Optimal redistributive taxation and international integration

In this section we will prove the main thesis of this paper. In section 5.1 we will show that the claim that taxation should be lower the more open is the economy can be justified when there are no sectoral shocks, so that the only sources of uncertainty and variance in individual ex post incomes are idiosyncratic shocks. In section 5.2 we will show that the introduction of sectoral shocks will result in a very different picture.

5.1. *Idiosyncratic shocks*

In our model, we can represent a situation in which risks are idiosyncratic by assuming that there is uncertainty as to the realization of xs, while θs are deterministic and known with certainty from the beginning.

Given our hypothesis of symmetry among sectors, ω_i (and hence L_i) is the same for all i. (19) becomes

$$B = \frac{t}{1-t}\omega_i^{1+\varepsilon}. \tag{28}$$

Individual h post-tax income y_h is given by

$$y_h = B + \frac{1}{1+\varepsilon}\left(\frac{\varepsilon}{1+\varepsilon}\right)^{\varepsilon}(\omega_i x_h)^{1+\varepsilon} \tag{29}$$

We substitute in constraint (17):

$$E[y_h] - R(S[y_H]) - c = \frac{t}{1-t}\omega_i^{1+\varepsilon} + \frac{1}{1+\varepsilon}\omega_i^{1+\varepsilon} - R\left(\frac{1}{1+\varepsilon}\omega_i^{1+\varepsilon}\gamma\right) - c = 0 \tag{30}$$

where $\gamma = (\varepsilon/1+\varepsilon)^{\varepsilon} S[x^{1+\varepsilon}]$.

We have

$$-\frac{\frac{dU_i}{d(1-t)}}{\frac{dU_i}{dH_i}} = \frac{\frac{1}{(1-t)^2}\omega_i^{1+\varepsilon} - \left[\frac{t}{1-t} + \frac{1}{1+\varepsilon}\left(1-\gamma R'\right)\right]\frac{d\omega_i^{1+\varepsilon}}{d(1-t)}}{\left[\frac{t}{1-t} + \frac{1}{1+\varepsilon}\left(1-\gamma R'\right)\right]\frac{d\omega_i^{1+\varepsilon}}{dH_i}} \tag{31}$$

and, multiplying by $(1-t)/H_i$

$$\begin{aligned}\phi_i &= \frac{\frac{1}{(1-t)} - \left[\frac{t}{1-t}(1+\varepsilon) + 1 - \gamma R'\right]\eta_{1-t}}{\left[\frac{t}{1-t}(1+\varepsilon) + 1 - \gamma R'\right]\eta_H} \\ &= \frac{1 - \left[t(1+\varepsilon) + (1-t)\left(1-\gamma R'\right)\right]\eta_{1-t}}{\left[t(1+\varepsilon) + (1-t)\left(1-\gamma R'\right)\right]\eta_H}\end{aligned} \tag{32}$$

Note that, since the right hand side does not depend on i, we can drop the subscript in ϕ_i and refer to this elasticity as ϕ. We rewrite the condition for the optimal tax rate (26) as

$$\varepsilon\eta_{1-t} + \phi = 0 \tag{33}$$

or, after substitution for η_{1-t} and η_H and simplification

$$\left[t(1+\varepsilon) + (1-t)\left(1-\gamma R'\right)\right] = \left[(1-\varepsilon\eta_H)\eta_{1-t}\right]^{-1}. \tag{34}$$

We are ready to state

Proposition 1. *When there are idiosyncratic shocks but no sectoral shocks, increased international integration reduces the optimal tax rate.* □

PROOF. The right hand side of equation (34) decreases as a consequence of international integration, since from (22) and (23) we have

$$\frac{1}{(1-\varepsilon\eta_H^c)\eta_{1-t}^c} = \frac{[1+\varepsilon(1-a)]^2}{1+2\varepsilon(1-a)} > \frac{[1+\varepsilon(1-a/(1-b))]^2}{1+2\varepsilon(1-a/(1-b))} = \frac{1}{(1-\varepsilon\eta_H^o)\eta_{1-t}^o} \tag{35}$$

Note that for given t no other term in equation (32) changes with international integration: w_i does not change because we have assumed that the *equilibrium* allocation of capital among countries does not change and that all sectors are identical. The left hand side of equation (34) is an increasing function of t, as it is clear if we differentiate it

$$\varepsilon + \gamma R' - (1-t)\gamma(dR'/dt) > 0 \tag{36}$$

($(dR'/dt) < 0$ because of convexity of R). This is enough to prove the result. ■

It is worthwhile noting that the optimal t increases as γ (hence as $S[x^{1+\varepsilon}]$) and R' increase: this is not surprising, as the reason for taxation in our model is protection from risk.

What we have obtained is the commonly claimed result that international integration, by making some factors more mobile, reduces the scope for redistribution. Note that this is true even when, as in our model, taxation is imposed only on labour, and the only mobile factor is capital.

We can easily interpret this result: a difference between the closed and the open case is that in the closed case, because of capital immobility, some of the tax burden can be shifted from labour to capital. This is not possible in the open case.

5.2. *Sectoral shocks*

We follow the same procedure to analyse the effect of increased integration when shocks are sectoral. To simplify analysis, we now assume that x_h are fixed, so that we can ignore them: it will be $x_h^{1+\varepsilon}(\varepsilon/(1+\varepsilon))^\varepsilon = 1$. The only source of risk is now the variability of θs. We assume in addition that θs are log-normally distributed, or

$$\log\theta_i \sim N(\mu,\sigma). \tag{37}$$

The uniform transfer is

$$B = \frac{t}{1-t}E[\omega^{1+\varepsilon}]. \tag{38}$$

We consider workers' post-tax income

$$y_h = B + \frac{1}{1+\varepsilon}\omega_i^{1+\varepsilon} = \frac{t}{1-t}E[\omega^{1+\varepsilon}] + \frac{1}{1+\varepsilon}\omega_i^{1+\varepsilon} \tag{39}$$

We substitute in (8) and obtain:

$$E[y_h] - R(S[y_H]) = \left(\frac{t}{1-t} + \frac{1}{1+\varepsilon}\right) E[\omega^{1+\varepsilon}] - R\left(\frac{1}{1+\varepsilon} S[\omega^{1+\varepsilon}]\right) \tag{40}$$

We have

$$-\frac{\dfrac{dU_i}{d(1-t)}}{\dfrac{dU_i}{dH_i}} = \frac{\dfrac{1}{(1-t)^2} E[\omega^{1+\varepsilon}] - \left(\dfrac{t}{1-t} + \dfrac{1}{1+\varepsilon}\right) \dfrac{dE[\omega^{1+\varepsilon}]}{d(1-t)} - \dfrac{1}{1+\varepsilon} \dfrac{dS[\omega^{1+\varepsilon}]}{d(1-t)} R'}{\left(\dfrac{t}{1-t} + \dfrac{1}{1+\varepsilon}\right) \dfrac{dE[\omega^{1+\varepsilon}]}{dH_i} - \dfrac{1}{1+\varepsilon} \dfrac{dS[\omega^{1+\varepsilon}]}{dH_i} R'} \tag{41}$$

and, multiplying by $(1-t)/H_i$, after some manipulation

$$\phi_i = \frac{1 - \left[t(1+\varepsilon) + (1-t)\left(1 - \dfrac{S[\omega^{1+\varepsilon}]}{E[\omega^{1+\varepsilon}]} R'\right)\right] \eta_{1-t}}{\left[t(1+\varepsilon) + (1-t)\left(1 - \dfrac{S[\omega^{1+\varepsilon}]}{E[\omega^{1+\varepsilon}]} R'\right)\right] \eta_H} \tag{42}$$

(note that it is possible to drop the subscript i in ϕ_i). The optimality condition (33) can be written as

$$t(1+\varepsilon) + (1-t)\left(1 - \frac{S[\omega^{1+\varepsilon}]}{E[\omega^{1+\varepsilon}]} R'\right) = [\eta_{1-t}(1 - \varepsilon\eta_H)]^{-1} \tag{43}$$

In the case of sectoral shocks, the analysis of the effect of international integration is more complicated than in the case of idiosyncratic shocks, since capital mobility affects $S[\omega^{1+\varepsilon}]/E[\omega^{1+\varepsilon}]$ and R' as well.

In order to determine $S[\omega^{1+\varepsilon}]/E[\omega^{1+\varepsilon}]$ in the closed and open case, we use equations (20) and (21); passing for analytical convenience to the logarithm, we have

$$S[\log \omega^{1+\varepsilon}] = S[(1+\varepsilon)\log \omega] = \frac{1+\varepsilon}{1+\varepsilon(1-a)} \sigma \tag{44}$$

for the closed case, and

$$S[\log \omega^{1+\varepsilon}] = \frac{1+\varepsilon}{1+\varepsilon(1-a/(1-b))} \sigma \tag{45}$$

for the open case, where $\sigma = S[\log \theta]$.

We recall the relation between the moments of the lognormal and those of the corresponding normal distribution:

$$\frac{S[e^X]}{E[e^X]} = \frac{\exp\left\{\mu_X + \sigma_X^2/2\right\} \sqrt{\exp\left\{\sigma_X^2\right\} - 1}}{\exp\left\{\mu_X + \sigma_X^2/2\right\}} = \sqrt{\exp\left\{\sigma_X^2\right\} - 1} \tag{46}$$

where μ_X and σ_X^2 are mean and variance of X. This means that in the closed case

$$\frac{S[\omega^{1+\varepsilon}]}{E[\omega^{1+\varepsilon}]} = \sqrt{\exp\left\{S[\log\omega^{1+\varepsilon}]^2\right\}-1} = \sqrt{\exp\left\{\left(\frac{1+\varepsilon}{1+\varepsilon(1-a)}\right)^2\sigma^2\right\}-1} \tag{47}$$

and in the open case

$$\frac{S[\omega^{1+\varepsilon}]}{E[\omega^{1+\varepsilon}]} = \sqrt{\exp\left\{\left(\frac{1+\varepsilon}{1-b+\varepsilon(1-a-b)}\right)^2\sigma^2\right\}-1} \tag{48}$$

Therefore, international integration increases both $S[\omega^{1+\varepsilon}]/E[\omega^{1+\varepsilon}]$ and R' (the latter is an increasing function of $S[\omega^{1+\varepsilon}]$). We can conclude that, for high enough values of σ and R'', international integration can decrease the right hand side less than it decreases the left hand side for given level of taxation. In this case, optimality is restored through an increase in t (note that an higher t decreases R', so that the left hand side is an increasing function of t in this case as well). We summarise this in

Proposition 2. *When there are sector-specific shocks, increased international integration may increase the optimal tax rate. In particular, this will more likely happen for high values of σ, and with rapidly increasing R'.* □

We note that as ε approaches zero (labour supply is inelastic) condition (43) collapses to

$$\frac{t}{1-t} = \frac{S[\omega^{1+\varepsilon}]}{E[\omega^{1+\varepsilon}]}R' \tag{49}$$

so that only the insurance effect is at work, and any increase in variance unambiguously requires an increase in the tax rate.

6. Concluding remarks

In this paper we have shown that the commonly claimed conclusion that international integration calls for less social protection is not well grounded when one considers that social protection, and redistribution in general, can encourage specific investments in human capital.

Our model, though quite stylised, captures at the same time the (conventional) distortionary effect of taxation as well as its incentive effect on investments in specific human capital. We have analyses the two effects in a context of integrated product markets and increasingly integrated capital markets. We have shown that there is no a priori reason to believe that either effect is stronger than the other, so there might be situations (values of parameters) when, contrary to conventional wisdom, increased integration requires more redistribution among workers.

In our opinion, the debate on taxes and international integration to date, while focusing on the distortionary effect of taxation, has not devoted enough attention to the fact that human capital investments are specific and insurance market are not usually able to provide adequate protection for this kind of investment, so that taxation, redistribution, and the welfare state in general, play the role of insurer. This paper is intended as a contribution to reestablish a more balanced view of the matter.

By stressing the role played by specific investments, and by assuming an extreme degree of specificity, we have not taken into account the possibility of choice among different mixes of specific and generic skills[14]. However, we don't expect that an explicit introduction of different degrees of specificity changes our main conclusion: without well functioning insurance markets, uncertainty would affect relatively more those sector where technology requires more specific skills, and this would result in a biased outcome, with workers overinvesting in generic skill and underinvesting in specific skills[15]. Redistribution can help reducing this bias.

Future research should check if our conclusions are still valid once some of the restrictive hypotheses we have adopted, such as that of perfect symmetry among factors, are removed. In addition, the model could be made more realistic by considering a richer set of tax instrument, removing the restriction that there is just a linear tax on labour, and by abandoning the hypothesis of perfectly a competitive labour market.

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[14] It could be argued that international integration calls for a move to more generic skills, rather than more protection of existing specific skills. However, it seems unlikely that the optimal response can be simply to rely only on generic/multipurpose skills, due to diminishing returns and incresing costs from standardisation of tasks. About standardisation and social protection as substitute instruments to cope with an uncertain environment, see D'Antoni and Pagano (2002).

[15] Indeed, this kind of effect is captured at least in part by our model, as long as we can reinterpret the choice not to invest as a choice to invest in generic skills.

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