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A MODEL OF FISCAL STRATEGY TO CLEAN UP CAPITAL AND FREE EMPLOYMENT[1]

Eco links, Employment no subject to tax and eco-taxation on polluting capital

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Abstract : After having reminded of the practical condition to implement sustainability, the eco links economy, this paper proposes a fiscal strategy model for full employment, for environment and for balance of the welfare accounts allowing the public authorities to guide the market towards sustainable technological trajectories with efficiency, equity and the slightest cost in public resources.
Replacing the social welfare cost paid by the employer by an eco-taxation based on polluting capital, the deformation of the production function, caused by a direct tax system favourable to non-polluting capital and to labour, enables the preventive environment and health protection and increases the volume of employment and the consumers' purchasing power in sustainable products. The joint and combined determination of the social security contributions and of the eco-taxation rate on polluting capital can insure the balance of the welfare accounts, maintain the global stability of price and guarantee the budget balance of the fiscal transfer.

Keywords: eco-links; eco-tax; employment; welfare cost; fiscal policy; industrial sustainability

JEL : C61, E62,H22, O23, Q56, Q56

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The quantitative decrease and the qualitative control of flows and stocks of raw material, energy and waste are the practical condition for implementing sustainability (Erkman,1998; Dayan, 2002). They must be accompanied by solidarity with less fortunate people (Dayan, 2002)

The public policy measures to moderate the consumption of materials to prevent pollution and wastes and to protect health while contributing to business competitiveness, balance social accounts and full employment, involve developing a global strategy and, of course, have a cost. To promote sustainable development patterns, we have the task not only to evaluate the arising expenditure, but also to propose ways of financing taking into account the economic situation and the concern for equity

1.The environment: the economics of taxes ?

Of all the economic measures envisaged to enable the moderation in the consumption of materials, including the prevention of pollution and waste, the introduction of an environmental tax affecting polluting products often appears in public policy think tanks. In particular, and among others one, a tax carbon to reduce CO2 emissions.

We cannot do only refer the environmental protection to fight against climate change and the sustainability has not only resulted in environmental view. But especially to tell the truth, it is unclear how, in a perspective where the purchasing power of consumers would be further reduced, budgetary resources of the State would be sought and market does not offer a credible alternative to the dependence on fossil fuels, increased indirect taxation and differential taxation[2] based on the system of penalty/no-claims bonus could be the cause of a "new economy" particularly based on the prevention of pollution and waste. Should we conclude

[2] This system was applied in France since July/2008 for cars. It should cost 300 millions € to the French State. The compensation is not thus made for this year and the system could be applied to others products.

that the economic straitjacket has become little reform and that the features of contemporary economies, cyclical and structural opposed to innovative public policy? The rise in consumer prices of polluting goods should be the result of a long strategy of sustainability dealing to reduce their production and not to a new public action at odds with the economic and social realities and the ethics of sustainability.

The environmental taxation, which emphasizes the monetary penalty and feeding inflation, brings the environmental burden on consumers rather than encouraging true productive innovation. The internalization of social costs of pollution, emissions quotes, pollution rights markets and, more generally, the "polluter payers" principle, may indeed be necessary and create certain effect but remain an illusion if they are not put at the service of an overall strategy for sustainability[3]. Green taxes, either "volunteers" or mandatory, intended to compensate or discourage polluting consumption and to fund remediation activities, not only lead to social and between territories inequities *(the more you can pay, the more you can pollute*) but also to develop a strategy for growth seeking to limit or repair the impacts of human activities and not to prevent them (*the more one gives itself the means to clean up, the more you can pollute*). Indeed, the market directs investment and research towards innovation sectors which improve existing technologies instead of changing the modes of production (Dayan, 2002). This “end of pipe“ approach and incremental trend cannot lead to a sober economy in material nor avoid the excess rules, the vain degradation of the public accounts and the inconvenient transfer of the ecological burden on others countries and the less fortunate people. They are costly, pernicious, unfair and overall inconsistent (Dayan, 2002). Sustainability would be less attractive as a communication exercise[4] and an endless burden for the whole society.

[3] Sustainability opens a new field of science, aesthetics, ethics and cultural : “The link. The linked. The linking”. It requires paying attention to the interrelationships, interactions and interdependencies operating within and between all domains of the world, knowledge and action."*What sustainable development means"* (Dayan, 2003)

[4] Between 1990 and 2006, rich countries have seen the growth of their CO2 emissions by 14,6% .

In fact, on the one hand, there is the urgency of implementing the conditions for sustainable development. On the other hand, there are also imperative need to avoid unemployment, slippages of inflation, public deficits, *"délocalisations"* (relocation, outsourcing offshore) and growing social and geographic inequality. Both necessities are in conflict as the latter takes precedence over the first and that sustainability has only resulted in environmental view. Yet we consider that this opposition is simplistic and that his fate is artificial. Our first axiom is that prevention of threats against the environment should seek relevance and equity of their contents in reshaping the technological links of industrial society. The reshaping should be also able to promote productive performances and purchasing power, sought and measured in terms of sustainable products. This requires industrial technologies worried of increasing the natural resources productivity

2. Economics for sustainability : eco links economy

The eco links economy privileges the rise of global natural resources productivity, the quality of knowledge and the safety of goods rather than labour productivity. This economy reuses by "wall to wall " any waste of a resource for another purpose. It makes clean goods, "from cradle to cradle", in regard to their global cycle of life inside of the chain of the eco links economy. The economic system is set in an ecosystem. This economy can disconnect the creation of wealth from increased borrowing materials from nature and it avoids the produce and the use of pollutants of which the life cycle is neither confined nor waterproof. It requires creating conditions that encourage, "over the fence", timely and strategic cooperation between enterprises in order to arrange appropriate loops concerning their production cycles and to participate in closing the loop of the economic cycle (production, consumption) within their own rivalries. In this sense, the fuzzy concept of sustainable development is precisely defined through that sustainable industrial development (Frosch, Gallopoulos, 1989; Côté, 1995;

Cohen-Rosenthal, 1998; Lowe 1997; Erkman 1998). Economics for sustainability is thus an eco links economy, (Dayan, 2002; Dayan and Dupont, 2007).

By moving the production area closer to re-using of waste area, by giving value to the local physical resources, among which the waste, and local knowhow, eco links economy can offer a better using and an increasing of scale economies for the global economy system and it proposes a strategy for the territorial attractiveness and for *"relocalisation" (*relocation, inshore insourcing) of businesses and jobs.

This new economy provide the competitive means for enterprises by reducing their costs of inputs, transport, environmental rules and waste management but not by the decrease in work force and wage costs and nor by *"délocalisation"*. It ends in the sliding of the world gravity centre of the economic power towards the local management of the global sustainability. It is essentially territorialized.

But worrying about resources productivity is also encouraging employment, development of training and human engineering. One of the conditions for the implementation of eco-links becomes not to restrict hiring but to seek full employment of human potential.

Public policies, which would produce the desired environmental effects by using fiscal policy must associate environmental policy and employment policy. In other words, to produce less costly sustainable goods and thus to protect nature conservation and human health, this tax system should involve jointly both two production factors: capital and labour.

3. Employment no subject to tax and eco-taxation on polluting capital

Imposing capital while discarding labour is not a new idea. In the early eighties, French studies, to measure the impact of tax changes on investment, employment and the choice of

production technique, had reached the following conclusion[5] : it is futile to try to examine tax policies that would not be based on capital imposition, as they have no direct impact on the choice of factors if they maintain a balanced budget. As against, policies based on taxing investment, appear to be effective. Duty noted. Any tax reform being "neutral" (for governments) cannot push the technological choices made by businesses if it is concentrated on indirect tax.

By contrast, impose direct production factors is an incentive to challenge the technological combination through its mechanisms of substitution. The fact is that the latter option has never been implemented. The shifting social contributions to a taxation of capital is probably effective "on paper" but it may actually be thwarted by perverse effects (recession in industries of consumers/capital goods, lower investment rates and reducing growth). The fact remains that, in terms of economic rationality, the only appropriate taxation of production factors, has a real chance to make effective a public policy for environment and employment.

This paper diverges from the previous works on the shifting nature of the tax since it advocates the creation of an eco-tax on polluting capital.

We will assume, for simplicity, that the productive capital is shared - partitioned – into two categories referring to divide "sustainable" / "unsustainable": capital stock of high potential pollutant and capital goods satisfactory in regard to eco-industrial criterion[6]. From this nomenclature, one considers a tax reform based on direct taxation of polluting capital and simultaneous reduction in tax concerning employment. Only the employer taxes would be removed in order to preserve the welfare costs and encourage hiring.

This innovation combines a priori two advantages: directly addressing the harmful factor of production, it can only change the technology mix in terms of economy of raw materials and

[5] Mauritius, Villa,1980; Artus, Sterdyniak, Villa, 1980; Pisany-Ferry, Sterdyniak, Villa,1984

[6] Considering the precise objective of our current study, we disregard paradoxes of this simplistic partition. The provided results are not affected by this limitation.

less use of "polluting" capital. By the play of substitutions, it promotes jobs and increases the intensity of cleaner capital within the productive process.

We go to rigorously justify the theoretical feasibility of such a tax shifting and considers the consequences. To this end, we explore the options which are available to a great Ministry for Sustainability with full taxation power in a social environment marked by a broad consensus on the requirement of sustainability. The Ministry's roadmap has five components: reduction in the use of unsustainable capital, boosting employment, increasing purchasing power measured in sustainable goods, price stability and its corollary: preserving competitiveness and avoiding degradation of budget.

4. The model of fiscal strategy for sustainability

We use a macroeconomic model for micro-economic foundations in which companies determine the quantities of labour, cleaner capital and "polluting" capital minimizing their cost of production assuming that the labour is taxed by social security contributions and where polluting capital are imposed by an eco-tax (concerning pollutants). Under the hypothesis of pure and perfect competitiveness, we get the producer prices and consumer prices by application of the mean VAT rate. The case of a closed economy and of an open economy will be successively considered.

The proposed tax reform is viable if it did not has negatively affect the general price level, and therefore on price competitiveness. It is sustainable if it does not deteriorate the balance. These imperatives guide the joint determination of the rate of social contributions and the rate of eco-taxes through calculation rules that are different depending on whether price stability or stability of the budget deficit is covered and aimed.

We explore the gradual injection scenario of this reform in a nation characterized by high social security contributions and no tax on polluting capital. The dynamics involved are jointly on tax developments controlled by the Ministry of Sustainable Development in order to get a qualitative target of sustainability by reducing the use of polluting capital. At first, one ensures that the

desired effects are achieved in a long time. In a second step, the Ministry is required to get a numerical target for sustainability in the medium term.

4.1. Firms strategy subject to an eco-tax

A national economy is considered here with three components: enterprises, workers/employees and state, respectively paid by three categories of income: profits, wages and taxes. After determining the macroeconomic accounting framework, we are focusing on the strategy of minimizing costs adopted by companies facing a tax on labour, on the one hand, and on polluting capital on the other hand.

4.1.1. Accounting framework

To simplify, there are three types of taxes: payroll taxes on wages, taxes on polluting capital, and indirect taxes on expenditure, proportional to the added value and weighting on consumption, not on investment. The state sets the rate of social contributions[7] , noted *c*, and the tax rate on polluting capital (named "eco-tax"), noted *k*, and the rate of VAT to the value added, noted θ. The stock of polluting the investment on polluting capital, the stock of cleaner capital, the investment in capital and the employment are recorded respectively: K_1, I_1, K_2, I_2 and *N*. Concerning these components, the accounting flows are the followings:

1. Enterprises

$$pQ = s(1+c)N + pI_1 + pI_2 + pkK_1 \qquad \#1$$

The GDP value (output of GDP in volume, *Q*, by the index of producer prices (VAT excluded), *P*, is equal to the wage paid by the firms (product of mean nominal earnings, *s*, to the multiplier index of social contributions and employment), plus investments in polluting

[7] For the sake of accuracy, it would probably be better to separate the social security contributions paid by the employer and those borne by the employee. Only the employer contributions would be removed in order to preserve the welfare costs

capital and in equity capital, as well as taxes owed for the use of polluting capital, which are taxed at the rate *k*.

2. Households

$$sN = P\,C = p\,(1+\theta)\,C \qquad \#2$$

Wages are equal to the consumption value, product consumption by volume, *C*, by the index of selling prices (VAT included), $P = p\,(1+\theta)$. There is no savings in this simple model.

3. State

$$S = p\,\theta\,C + p\,k\,K_1 + s\,c\,N - p\,G \qquad \#3$$

The budget balance *S* is the difference between the total of tax revenues, (direct and indirect) and the government spending *p G*.

4.1.2. Production costs minimization and demand for production factors

Companies choose the factors of production so as to minimize their total cost. Then we seek expressions of demands for factors, of the optimal mix of technologies and of the prices in perfect competition.

The objective function is, noting *r* the interest rate based on capital productive:

$C(K_1, K_2, N) = r\ p\,(1+k)\,K_1 + r\ p\,K_2 + s\,(1+c)\,N$.

The constraint is an objective of volume to produce $\overline{Q}$, it is based on the production function, which summarizes all available technologies. Compared with normal functions of production, its particularity is to combine the gross added value to the use of three inputs, because the capital stock is partitioned into two blocs following an environment criterion. We refer to a Cobb-Douglas to constant yield scale:

$Q = K_1^{\alpha}\,K_2^{\beta}\,N^{\gamma}$ with $0 < \alpha < 1$, $0 < \beta < 1$, $0 < \gamma < 1$, $\alpha + \beta + \gamma = 1$.

The program of the representative firm is therefore:

$$\begin{cases} \min\limits_{(K_1,K_2,N)} r\,p(1+k)K_1 + r\,p\,K_2 + s(1+c)N \\ s.t.\ \ \overline{Q} = K_1^{\alpha} K_2^{\beta} N^{\gamma} \end{cases}$$

Starting from Lagrangian:

$$L(K_1,K_2,N,\lambda) = r\,p(1+k)K_1 + r\,p\,K_2 + s(1+c)N + \lambda(\overline{Q} - K_1^{\alpha} K_2^{\beta} N^{\gamma})$$

We draw the conditions of the first order[8] :

$$r\,p(1+k) = \lambda\alpha\frac{\overline{Q}}{K_1} \qquad \#4$$

$$r\,p = \lambda\beta\frac{\overline{Q}}{K_2} \qquad \#5$$

$$s(1+c) = \lambda\gamma\frac{\overline{Q}}{N} \qquad \#6$$

$$\overline{Q} = K_1^{\alpha}\,K_2^{\beta}\,N^{\gamma} \qquad \#7$$

The technological ratios are obtained by dividing (4) by (5), (4) by (6) and (5) by (6):

Cleaner capital on polluting capital = $\frac{K_2}{K_1} = \frac{\beta}{\alpha}(1+k)$ #8

$$\frac{N}{K_2}\ \frac{\gamma}{\beta}\frac{r\,p}{s(1+c)}$$

Employment on polluting capital = $\frac{N}{K_1} = \frac{\gamma}{\alpha}\frac{r\,p(1+k)}{s(1+c)}$ #9

Employment on cleaner capital = $\frac{N}{K_2} = \frac{\gamma}{\beta}\frac{r\,p}{s(1+c)}$ #10

These three ratios are independent of the level of production and VAT. Social security contributions have a positive effect on both intensity of capitals: capital per worker, $\frac{K_2}{N}$, and polluting capital per worker, $\frac{K_1}{N}$. In other words, any increase in payroll taxes is resulting in

[8] As the objective function is linear and the position-defining coercion equality is concave, the conditions of first order are necessary and sufficient for a overall minima.

a lesser relative use of labour and increased use of cleaner and polluting capitals per worker. The rate of eco-taxation *k* has no effect on cleaner capital intensity $\frac{K_2}{N}$. However, it influences the polluting capital intensity $\frac{K_1}{N}$, and the ratio between polluting capital and cleaner capital $\frac{K_1}{K_2}$ in the direction of a decrease. Thus, an eco-taxation changes the mix of technologies by relative decrease in the use of polluting capital.

These three relationships confirm that it is impossible to distort the mix of technologies in a sustainable industrial development, without imposing polluting capital. In the current tax system, one has *k* = 0, which leads $\frac{K_2}{K_1} = \frac{\beta}{\alpha}$, $\frac{N}{K_1} = \frac{\gamma}{\alpha}\frac{r\,p}{s(1+c)}$, $\frac{N}{K_2} = \frac{\gamma}{\beta}\frac{r\,p}{s(1+c)}$.

Whatever the level of social contributions is, the present ratio between cleaner capital and polluting capital remains unchanged. On the other hand, they clearly show that the shifting of social security contributions towards indirect taxation - by introducing a so called "social" VAT in the political news - has no effect on combining technology, since the rate of VAT is not taken into account in calculating the costs carried out by companies. Naturally, the decline in contributions has a positive effect on employment, but the ratio $\frac{K_2}{K_1}$ is not changed.

It follows from these remarks that a Ministry for sustainable development wishing to lower contributions to boost employment and lay the foundations of sustainable industrial development, can make one stone by creating an eco-tax dealing on polluting capital, which will of course integrated into the rational calculation of firms.

From (7) and ratios (8), (9) and (10) and setting $\Omega = \alpha^{\alpha}\beta^{\beta}\gamma^{\gamma}$, we get expressions of demand for factors:

$$N = \overline{Q}\,\frac{\gamma}{\Omega}(1+k)^{\alpha}(1+c)^{-(\alpha+\beta)}r^{\alpha+\beta}\left(\frac{s}{p}\right)^{-(\alpha+\beta)} \qquad \#11$$

$$K_2 = \overline{Q}\,\frac{\beta}{\Omega}(1+k)^{\alpha}(1+c)^{\gamma} r^{-\gamma}\left(\frac{s}{p}\right)^{\gamma} \qquad \#12$$

$$K_1 = \overline{Q}\,\frac{\alpha}{\Omega}(1+k)^{-(\beta+\gamma)}(1+c)^{\gamma} r^{-\gamma}\left(\frac{s}{p}\right)^{\gamma} \qquad \#13$$

Relations (11) - (13) are consistent with the usual results. The demands for factors positively depend on of the activity. The real wage and social contributions rates have a negative impact on employment, a one positive on applications of capital. The cost of using the capital has a positive impact on employment, a negative one on the demand for capital. We also note that an increase in the rate of eco-tax benefits to employment because we have

$$\frac{\partial N}{\partial k} = \alpha\frac{N}{1+k} > 0,$$

but this effect is less and less important with the increase because of *k* because

$$\frac{\partial^2 N}{\partial k^2} = \alpha(\alpha-1)\frac{N}{(1+k)^2} < 0.$$

In the same way it stimulates demand for equity since

$$\frac{\partial K_2}{\partial k} = \alpha\frac{K_2}{1+k} > 0,$$

with a phenomenon of decay:

$$\frac{\partial^2 K_2}{\partial k^2} = \alpha(\alpha-1)\frac{K_2}{(1+k)^2} < 0.$$

On the other hand, it thwarts the polluting capital since

$$\frac{\partial K_1}{\partial k} = -(\beta+\gamma)\frac{K_1}{1+k} < 0,$$

but this effect is less and less marked because K_1 is convex over *k*:

$$\frac{\partial^2 K_1}{\partial k^2} = (\beta+\gamma)(1+\beta+\gamma)\frac{K_1}{(1+k)^2} > 0.$$

In short, eco-taxation plays effectively its role in deforming the technological combination by changing rationally the demands for factors. And when it does not exist, demand for labour is $N = \overline{Q}\,\frac{\gamma}{\Omega}(1+c)^{-(\alpha+\beta)} r^{\alpha+\beta}\left(\frac{s}{p}\right)^{-(\alpha+\beta)}$, be compared with the expression (11). This tax formula plays more or less a role as a multiplier factor acting on employment : this is because labour is a substitute for polluting capital whose cost is increased by the tax. The gain in terms of employment may be not only quantitative. The emergence of new tasks in a technological system "efficient and limiting polluting capital" is even more likely that, also on the basis of a comparison between the demand for factors in a taxation system without eco-tax and with eco-tax, we find and observe that the taxation of polluting capital has actually a proper divider effect on polluting capital.

4.1.3. Expressions of production prices and selling prices

Based on the demand for inputs (11) - (13) and taking prices and tax rates for short-term parameters, the total cost depends on the quantities produced:

$$C = C(\overline{Q}) = \frac{\overline{Q}\,(1+c)^{\gamma}(1+k)^{\alpha} r^{1-\gamma}\, p^{1-\gamma}\, s^{\gamma}}{\Omega} \qquad \#14$$

In the short term and in case of perfect competition, there is equality of output price and marginal cost, equal to the average cost here, since the production function is referred to constant returns. We conclude the price of production:

$$p = \frac{(1+c)(1+k)^{\alpha/\gamma} r^{\frac{\alpha+\beta}{\gamma}} s}{\Omega^{1/\gamma}} \qquad \#15$$

and the selling price:

$$P = p(1+\theta) = \frac{(1+\theta)(1+c)\,(1+k)^{\alpha/\gamma} r^{\frac{\alpha+\beta}{\gamma}} s}{\Omega^{1/\gamma}} \qquad \#16$$

Thereafter, we admit that workers provide their ability to work in real wages based on their marginal productivity. In this "Keynesian" context, the share of wages in the gross global product, valued at the cost of production, is equal to the elasticity of output with respect to labour input

$$\frac{(1+c)\,s\,N}{p\,\overline{Q}} = \gamma \qquad \#17$$

Similarly, we obtain the following remarkable identities the share of gross profit concerning both cleaner and polluting capital, within the product:

$$\frac{r\,p\,(1+k)\,K_1}{p\,\overline{Q}} = \alpha \qquad \#18$$

$$\frac{r\,p\,K_2}{p\,\overline{Q}} = \beta \qquad \#19$$

4.1.4. The case of an open economy

In open economy, firms choose to factors of production so as to minimize the total cost. The capital goods can be produced domestically or imported, but there is no difference in treatment on the basis of geographical origin: this tax reform taxes the polluting at the rate k, whether domestic or imported, and equity are not taxed. A priori, domestic prices p and foreign prices p_j differ so that the price of duty-free capital, p_K, is a weighted average:

$$p_K = p^u\ p_j^{1-u},$$

where u is the share of capital goods produced nationally among the total capital. The objective function is then: $C(K_1, K_2, N) = r\,p_K\,(1+k)\,K_1 + r\,p_K\,K_2 + s(1+c)\,N$.

Therefore the following program has to be resolved:

$$\begin{cases} \min\limits_{(K_1, K_2, N)} & r\,p_K\,(1+k)\,K_1 + r\,p_K\,K_2 + s(1+c)\,N \\ s.t. & \overline{Q} = K_1^{\alpha} K_2^{\beta} N^{\gamma} \end{cases}$$

As p_K plays the role of *p* in the closed economy model, we get direct expressions of demand for factors and of technological ratios.

Hence the demands for factors:

$$N = \overline{Q}\frac{\gamma}{\Omega}(1+k)^{\alpha}(1+c)^{-(\alpha+\beta)}r^{\alpha+\beta}s^{-(\alpha+\beta)}p^{u(\alpha+\beta)}p_j{}^{(1-u)(\alpha+\beta)} \quad \#20$$

$$K_2 = \overline{Q}\frac{\beta}{\Omega}(1+k)^{\alpha}(1+c)^{\gamma}r^{-\gamma}s^{\gamma}p^{-u\gamma}p_j{}^{-(1-u)\gamma} \quad \#21$$

$$K_1 = \overline{Q}\frac{\alpha}{\Omega}(1+k)^{-(\beta+\gamma)}(1+c)^{\gamma}r^{-\gamma}s^{\gamma}p^{-u\gamma}p_j{}^{-(1-u)\gamma} \quad \#22$$

and the technological ratios:

$$\frac{K_2}{K_1} = \frac{\beta}{\alpha}(1+k) \quad \#23$$

$$\frac{N}{K_1} = \frac{\gamma}{\alpha}\frac{r}{s}p^{u}p_j{}^{1-u}\frac{1+k}{1+c} \quad \#24$$

$$\frac{N}{K_2} = \frac{\gamma}{\beta}\frac{r}{s}p^{u}p_j{}^{1-u}\frac{1}{1+c} \quad \#25$$

The interpretation of these results is exactly the same as in closed economy. In particular, lower social security contributions increases employment, and so are employment/polluting capital ratio and employment/ cleaner capital ratio, while the rise of eco-tax reduces the use of polluting capital, increases the ration cleaner capital/polluting capital and decreases the part of polluting capital within capital intensity.

The output price *p* becomes now:

$$p = \frac{(1+k)^{\frac{\alpha}{1-(1-\gamma)u}}(1+c)^{\frac{\gamma}{1-(1-\gamma)u}}s^{\frac{\gamma}{1-(1-\gamma)u}}r^{\frac{1-\gamma}{1-(1-\gamma)u}}p_j{}^{\frac{(1-\gamma)(1-u)}{1-(1-\gamma)u}}}{\Omega^{\frac{1}{1-(1-\gamma)u}}} \quad \#26$$

The consumer prices VAT excluded, defined by $p_c = p^{v}p_j{}^{1-v}$ where *v* is the share of imported products in consumer products is:

$$p_c = \frac{(1+k)^{\frac{\alpha v}{1-(1-\gamma)u}} (1+c)^{\frac{\gamma v}{1-(1-\gamma)u}} s^{\frac{\gamma v}{1-(1-\gamma)u}} r^{\frac{(1-\gamma)v}{1-(1-\gamma)u}} p_j^{\frac{(1-\gamma)(1-u)+(1-v)}{1-(1-\gamma)u}}}{\Omega^{\frac{v}{1-(1-\gamma)u}}} \quad \#27$$

and the consumer price VAT included is:

$$P_c = \frac{(1+\theta)(1+k)^{\frac{\alpha v}{1-(1-\gamma)u}} (1+c)^{\frac{\gamma v}{1-(1-\gamma)u}} s^{\frac{\gamma v}{1-(1-\gamma)u}} r^{\frac{(1-\gamma)v}{1-(1-\gamma)u}} p_j^{\frac{(1-\gamma)(1-u)+(1-v)}{1-(1-\gamma)u}}}{\Omega^{\frac{v}{1-(1-\gamma)u}}} \quad \#28$$

The remarkable identities (17) - (19) remain valid in open economy.

4.2. Neutrality of tax shifting

We saw that the increase in the VAT rate on polluting products can not affect directly, and in a short time, polluting technologies because it has no impact on applications of the demands for production factors. However, the tax measure consisting in ripping social contributions to an eco-tax on polluting capital, forces companies to revise their methods of production by substituting jobs to polluting capital. This is immediately effective... and sustainable because companies are warnings to integrate, through the way of costs, the environmental approach and boosting the employment in their calculations. But the obvious effectiveness in terms of jobs and ecology should not be upset by contradictory perverse effects such as inflationary slippage, the deterioration of competitiveness, the increase public deficit, or the questioning of financing social spending. Shifting the tax is legitimate if it meets the conditions of neutrality on prices and on the state budget.

4.2.1 Neutrality on prices

The shifting will be called neutral on prices if their level stays unchanged. Formally, the price differential is zero when *c* and *k* vary. Intuitively, it simply noted that the expression $(1+c)(1+k)^{\alpha/\gamma}$ must remain constant in (15) and (16).

For producer prices, we therefore have the rule of neutrality:

$$\alpha \frac{dk}{1+k} + \gamma \frac{dc}{1+c} = 0 \qquad \#29$$

The rule is obviously the same for the selling prices, VAT included, when you leave unchanged the VAT rate : $d\theta = 0$.

Taking into account the remarkable relations (17) and (18), it is rewritten:

$$\frac{r\, p\, K_1}{p\, \overline{Q}} dk + \frac{s\, N}{p\, \overline{Q}} dc = 0 \qquad \#30$$

and it is easily interpreted:

polluting capital × increase in eco tax + labour cost × reduction in social contributions = 0

Neutrality on prices is checked so that, within firms, increasing the cost of polluting capital is strictly offset by reduced labour costs.

4.2.2. Neutrality of the measure for the government

Tax reform poses different problems for governments. Strictly speaking, it will be seen as neutral if it keeps the balance to the same level. The lack of budget neutrality will match, according to the observed deviation, with financial sustainability or the non-sustainability.

If the three modes of taxation coexist, the budget of the state is given by (3). Ex ante, variables of price *p* and *s*, and variable of volumes K_1, *C*, *N* and *G* are constants. In addition, VAT is fixed at the same level as the government knows that its effect on the technology mix is zero. So the balance is not influenced by changes in the rate of social security and eco-tax if the following equality is true:

$$s\, N\, dc + p\, K_1\, dk = 0 \qquad \#31$$

or, taking into account the remarkable relations (17) and (18):

$$\frac{\alpha}{r} \frac{dk}{1+k} + \gamma \frac{dc}{1+c} = 0 \qquad \#32$$

The rule of budget neutrality is not equivalent to the rule (29) of neutrality on prices. Thus, for a decline of 1% of 1 + *c*, the rule of neutrality led to price increase 1 + *k* of γ / α %, while the

rule of budget neutrality leads (γ / α) *r* %. In other words, the new eco tax rate is higher in a framework of price stability than in a situation of fiscal stability[9].

This result opens up important public policy. In the contemporary international capitalism, while inflationary slippage is punished by loss of price competitiveness, loss of markets, growth and employment. The major concern is price stability. Since the government pursues this objective, it must establish an eco-tax following the rule (29), or $\frac{dk}{1+k} = -\frac{\gamma}{\alpha}\frac{dc}{1+c}$.

As the budget balance varies according to short-term $\frac{dS}{p\overline{Q}} = \frac{\alpha}{r}\frac{dk}{1+k} + \gamma\frac{dc}{1+c}$, the rule of price neutrality implies $\frac{dS}{p\overline{Q}} = \gamma\left(1-\frac{1}{r}\right)\frac{dc}{1+c} < 0$.

In other words, the public deficit is reduced. A neutral tax shifting on prices is financially sustainable. Not only tax reform can ensure price stability and the maintenance of price competitiveness, but it also helps to keep spending at the same level - especially social spending - and even to eliminate the public debt or to consider new expenses, such as investment in research and development in new technologies.

4.2.3. The case of an open economy

It is remarkable that the condition of neutrality on prices is the same in case of open economy that in a closed economical system. Indeed, the shifting of contributions to an eco-tax has no effect on output prices if, all things being equal, the product $(1+k)^{\frac{\alpha}{1-(1-\gamma)u}}(1+c)^{\frac{\gamma}{1-(1-\gamma)u}}$ remains constant, which amounts to $(1+k)^{\alpha}(1+c)^{\gamma} =$ constant, or in deriving: $\frac{dk}{1+k} = -\frac{\gamma}{\alpha}\frac{dc}{1+c}$.

This requirement also applies to consumer prices, VAT excluded, and -with VAT constant rate -, for consumer prices.

[9] At least, until the interest rate remains less than 100%.

On the other hand, if the three modes of taxation coexist, the budget of the State reads:

$$S = p_c\,\theta C + p_K\,k\,K_1 + s\,c\,N - p\,G$$

By varying only *k* and *c*, other variables being assumed constant, we always have:

$$s\,N\,dc + p_K\,K_1\,dk = 0$$

Taking into account the remarkable identities and after proper handling, you get exactly the rule established in case of closed economy: $\frac{\alpha}{r}\frac{dk}{1+k} + \gamma\frac{dc}{1+c} = 0$.

Contrary to what intuition suggests[10] there was no difference of interpretation of the effects of a shifting tax on combining technologies on price and the budget balance between the case of a closed economy and an open economy system. The decline in payroll taxes is offset by an increase in eco-tax on polluting capital: this situation is leading domestic firms to revise their demands for factors in accordance with the principles of sustainable industrial development. Their competitiveness is not questioned whether the rule of neutrality price is met, that as their unit cost remains constant. Moreover, the application of this rule mechanically led to an improvement in the budget balance.

4.3. Gradualism with target of environmental sustainability

4.3.1. Shock therapy vs. gradualism

We have all the elements to measure quite precisely the effects of a reform replacing instantly once and for all the tax on social contributions by a new eco-tax on polluting capital. The advantage of this shock therapy is obviously a radical break with the current technological trajectory and to embark without delay on the path of sustainable industrial development.

By starting from a situation where firms are subject to taxation only focused on social contributions (c> 0 and k = 0) and implementing a complete shifting (c '= 0 and k'> 0), the

[10] Intuition underlying number of critical remarks addressed to the proposed tax by shifting APREIS (Dayan, Dupont, 2007).

reform will have no effect on production price and selling price, if the eco-tax is calculated from the rule (29) as follows:

$$k' = (\gamma / \alpha)\ (c / (1 + c)) = ((s N) / (r p K_1))\ c \qquad \# 33$$

The eco tax rate is exactly the old rate of contributions weighted by the relative wage costs, VAT excluded, in the cost of using, VAT excluded, of polluting capital.

By brutal deformation of the combination of technology, the shock therapy will obviously lead firms to revise "in the right direction" their applications factors. In this regard, it is easy to see that the ratio polluting capital / cleaner capital is increased of the amount of the eco-tax, and that the ratio employment / polluting capital is increased by the combined effects of the abolition of fees and by implementation of the eco-tax, and finally that the ratio employment / cleaner capital increases at the rate of social security contributions. In fact, all expected objectives are achieved in a very short time: redefinition of the technology mix in accordance with the requirements of sustainability, boosting employment, price stability and *status quo* on price competitiveness, and additional leeway for government. But this tax shock suffers from two flaws.

The first is that the Ministry of Sustainable Development does not have specific environmental objective: the shifting indeed lowers of weight polluting capital, but is it enough? The second flaw points at its deficit of realism. As a matter of fact, this scenario assumes that firms have the ability to instantly vary their volumes of inputs, namely that the alternative technologies are available without delay and without adjustment costs. It is possible that some productive sectors have such technology, but it is very difficult to admit that this option could be extended at the macroeconomic level. Specifically, periods of adjustment are imperative and injection of the tax reform should be done gradually. The following section explores a scenario therefore undoubtedly closer to the ground : it can be called as gradualist tax reform.

4.3.2 Tax gradualism

The Ministry of Sustainable Development's objective is to enhance environmental quality measured by an index *E*. This index is negatively related to the volume of polluting capital per labourer $\frac{K_1}{N}$: $E = \varphi(K_1 / N)$ with $\varphi'(K_1 / N) < 0$.

Thus, less the current technology mix is a user of polluting capital, more environmental quality improves. Starting from a given state of environmental quality, the goal is to achieve a higher index, defined either by domestic political considerations or by virtue of international conventions. In both cases, a target of intensity in polluting capital is implicitly specified. Of course, the fact of fixing it in the long term gives firms time to adapt.

The Ministry wants to reach the target by imposing the polluting capital K_1. Aware of the many implications about this measure, it also seeks to avoid any slippage inflation to maintain price competitiveness, to revive, at least to maintain the status of employment, and to avoid any increase in the public deficit. Ultimately, the problem is formally seeking the couple (*k*, *c*) which, from a given situation, improves environmental quality by reducing polluting capital, boost employment, respects the rule of neutrality in production prices and does not degrade the budgetary situation.

It is assumed that any date *t* , the Ministry alters the eco-tax based on the difference between the intensity in polluting capital K_1 / N and the intensity of polluting capital desired $(K_1 / N)^d$. A simple rule of intervention is to intervene linearly on the rate of growth of the factor of the eco tax, so long as one gap is found, either :

$$\frac{\dot{k}}{1+k} = h\left(K_1 / N - (K_1 / N)^d\right) \qquad \#34$$

where it is understood that the variables are functions of time *t*, and where the parameter *h*, a constant strictly positive, measures the intensity of the reaction of the Ministry to the difference between the current index and the target.

This behaviour must remain compatible with the rule of neutrality of prices. Consequently, changes in *k* and *c* should check:

$$\frac{\dot{k}}{1+k} = -\frac{\gamma}{\alpha}\frac{\dot{c}}{1+c} \qquad \#35$$

Taking into account the behaviour of minimizing the production costs by firms in this fiscal environment, gives the following changes in the demands for factors concerning labour and polluting capital, from derived equations (20) and (22):

$$\frac{\dot{N}}{N} = \frac{\alpha}{\gamma}\frac{\dot{k}}{1+k} \qquad \#36$$

$$\frac{\dot{K}_1}{K_1} = -\frac{\dot{k}}{1+k} \qquad \#37$$

To lighten the paperwork, let us put $x = K_1 / N$ et $x_d = (K_1 / N)^d$. On the one hand, $\frac{\dot{k}}{1+k} = h(x - x_d)$ and on the other hand, $\frac{\dot{x}}{x} = \frac{\dot{K}_1}{K_1} - \frac{\dot{N}}{N} = \left(-1 - \frac{\alpha}{\gamma}\right)\frac{\dot{k}}{1+k} = \frac{\dot{N}}{N} = \frac{\beta - 1}{\gamma}\frac{\dot{k}}{1+k}$, so that the evolution of polluting capital per labourer *x* is governed by the logistics differential equation: $\dot{x} = \frac{\beta - 1}{\gamma} h\, x(x - x_d)$ #38

As $x > x_d$, that is until the target is not reached, the rate of growth in intensity in polluting capital should reduce pollutant since the ministry increases the eco-tax and companies respond by reducing their demand for polluting capital, while increasing their volume of employment since the contributions are falling at the same time.

The initial condition $x(0) = x_0 < x_d$ is clearly known, the trajectory solution for (38) is:

$$x(t) = \frac{x_0\, x_d}{x_0 + (x_d - x_0)e^{\frac{\beta - 1}{\gamma} h x_d t}} \qquad \#39$$

The trajectory of polluting capital per head is clearly monotone decreasing and converges towards the target, because $x_\infty = x_d$. From (39) and initial values k_0, c_0, $K_1(0)$ and N_0,

you can deduct the paths the rate of eco-tax, the rate of social security contributions, of stock of polluting capital and the stock of employment:

$$k(t) = -1 + (1 + k_0)\left(\frac{x_0 + (x_d - x_0)e^{\frac{\beta-1}{\gamma} h x_d t}}{x_d} \right)^{\frac{\gamma}{1-\beta}} \quad \#40$$

$$c(t) = -1 + (1 + c_0)\left(\frac{x_0 + (x_d - x_0)e^{\frac{\beta-1}{\gamma} h x_d t}}{x_d} \right)^{\frac{-\alpha}{1-\beta}} \quad \#41$$

$$K_1(t) = K_1(0)\left(\frac{x_0 + (x_d - x_0)e^{\frac{\beta-1}{\gamma} h x_d t}}{x_d} \right)^{\frac{\gamma}{1-\beta}} \quad \#42$$

$$N(t) = N_0\left(\frac{x_0 + (x_d - x_0)e^{\frac{\beta-1}{\gamma} h x_d t}}{x_d} \right)^{\frac{\alpha}{1-\beta}} \quad \#43$$

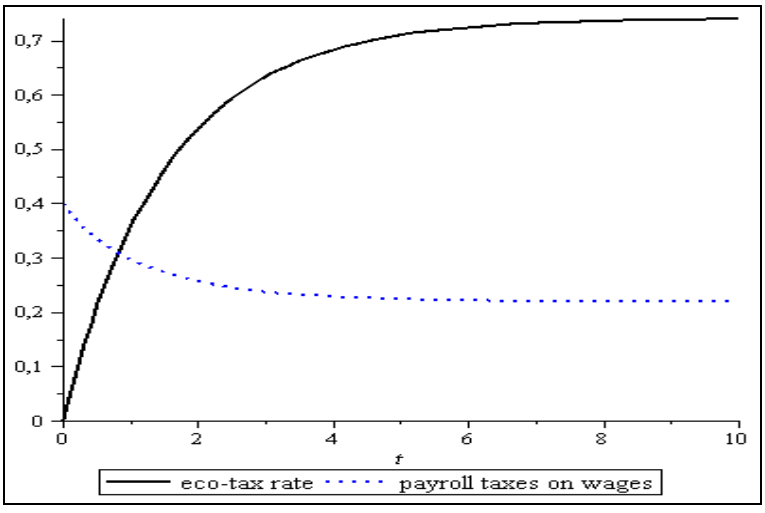
The asymptotical balance, taken as a whole, is stable for all initial conditions economically significant. The rate of eco-tax converges in a monotonous manner toward the level $k_\infty = -1 + (1 + k_0)\left(\frac{x_0}{x_d} \right)^{\frac{\gamma}{1-\beta}}$ higher than the initial rate. The stock of polluting capital decreases and converges to a level far lower than the initial state, either $K_{1\infty} = K_1(0)\left(\frac{x_0}{x_d} \right)^{\frac{\gamma}{1-\beta}}$. Employment is growing so monotonous to the highest asymptotical level $N_\infty = N_0\left(\frac{x_0}{x_d} \right)^{\frac{\alpha}{1-\beta}}$. The evolution of social contribution rate is decreasing but the

asymptotic value obtained can be problematic. Indeed, we have $c_\infty = -1 + (1 + c_0)\left(\frac{x_0}{x_d}\right)^{\frac{-\alpha}{1-\beta}}$.

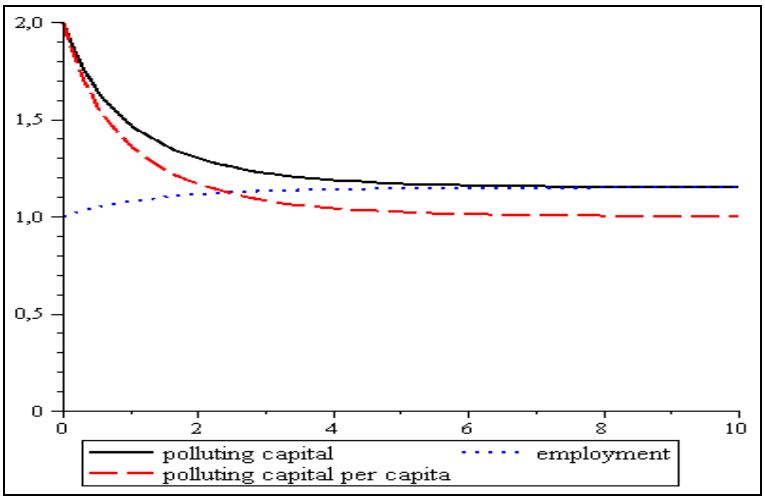
As $\left(\frac{x_0}{x_d}\right)^{\frac{-\alpha}{1-\beta}} < 1$, it follows $-1 + (1 + c_0)\left(\frac{x_0}{x_d}\right)^{\frac{-\alpha}{1-\beta}} < c_0$. This inequality can be checked for a contribution rates asymptotic negative, which is economically excluded. To have also $\lim c(t) \geq 0$, it must be $x_d \geq x_0\left(\frac{1}{1+c_0}\right)^{\frac{1-\beta}{\alpha}}$. In other words, the target should not be too ambitious. In particular, want at a range the elimination of any polluting capital in the production system is utopian.

By way of illustration, Figures #1 and #2 provide paths for a set of parameters characteristic of a nation that starts from a situation marked by the absence of taxation of capital and a high level of social contributions: α=1/6; β=1/6; γ=2/3; h=0.5; x_d =1; x_0 =2; k_0 =0; $K_1(0)$ =2; N_0 =1; c_0 =0.4; p=2; s=1

Fig #1 Dynamics of eco-tax rate and social contributions



Fig#2. Dynamics of polluting capital, employment and polluting capital per capita



It remains to consider the issue of fiscal sustainability. In the event that the Ministry takes the party to keep stable the government spending, and refrain from manipulating the rates of VAT, the budget balance reflects exactly changes in direct tax revenues. In noting these levies R, we have at any time $R = p\,k\,K_1 + s\,c\,N$. Unlike the static reasoning, gradualism has dialectically dynamic effects which could *à priori* appear ambiguous: the continued rise of eco-tax helps to reduce the base represented by polluting capital - a sign that the reform is successful - but the progressive lowering of payroll taxes boost employment and thereby increases the tax base - another sign of a successful reform. Under constraint of neutrality on prices, the gradual shifting is fully effective if tax revenues are not reduced, in other words if the positive budgetary effects tied to the rise of eco-taxes and boosting employment, outweighs the negative effects induced by lower contributions and the base of polluting capital.

At any time, prices remain constant (rule of neutrality on prices), as well as nominal wages to ensure that the purchasing power of wages is maintained.

The evolution of tax revenue is given by:

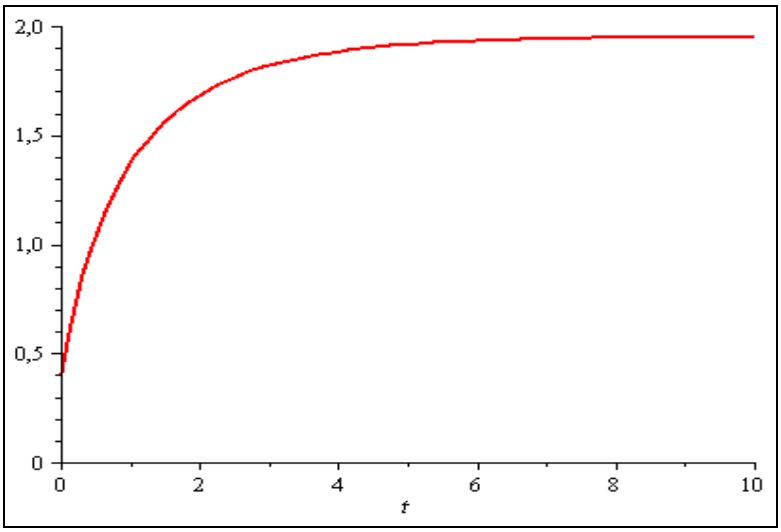
$$\dot{R} = p\left(\dot{k}\,K_1 + k\,\dot{K}_1\right) + s\,(\dot{c}\,N + c\,\dot{N}) \qquad \#44$$

Using (39), (40), (41) and the identities (17) and (18), we have again:

$$\dot{R} = \frac{\dot{k}}{1+k}\frac{\alpha}{\gamma} s N\left(\frac{1+c}{(1+k)r} - 1\right) \qquad \#45$$

Normally, eco-tax checks inequality $k < \frac{1}{r} - 1$, so $\frac{1+c}{(1+k)r} - 1 > 1$, and $\frac{\dot{k}}{1+k} > 0$, $N > 0$ and all parameters are positive, the change in revenue is positive. While the rate of eco-tax remains contented, positive budgetary effects of tax reform outweigh the negative effects as shown in Figure 3 for the parameters given above. However, a rate too high erodes the tax on polluting capital and is combined with a small collection of social contributions to reduce revenues and to increase the public deficit.

Fig#3 Dynamics of tax revenue



The objectives of reducing the intensity in polluting capital, of less use of polluting capital and of boosting employment being met, the gradual shifting of social contributions towards eco-taxation is fully effective under two conditions. First, the target of intensity in capital pollutant on the long range should not be too ambitious otherwise the rate of contributions becomes ... negative. On the one hand, eco-tax should never exceed a threshold - indeed high, thus virtually little binding - beyond which tax revenues decline because of the tax base of

polluting capital would evaporate and social contributions would be very low. That remark prompted to examine further the role of the intensity of the reaction of the Ministry it is seen a gap between the level of polluting capital per current head, and the target sought. A reasonable objective of long term can be obtained by a succession of stages and each intermediate goal will clarify the force of government intervention.

4.4. Gradualism with medium-term target

In the medium term, we consider the period [0, *T*] where *T* is the deadline for a few years, such as 5 to 10 years. The current ratio of polluting capital per capital *x*(*t*), the ratio of long term "reasonable" target x_d, and the intermediate target is $x(T) = x_T$, which of course verifies $x_0 < x_T < x_d$.

The Ministry of Sustainable Development is still acting on the evolution of polluting capital per capita by increasing eco-tax as the long-term target is not reached. The intensity of its reaction h generates adjustment costs, that the Ministry takes to fully charge, for example through public subsidies, not to disrupt the operating accounts of the firms.

These adjustment costs comprise several areas: early scrapping of polluting facilities; acquisitions of new eco-labelled materials, training of manpower to new production techniques, developing new technologies and so on. If the increases of eco-taxes are low, their effects in terms of adjustment will be minimal and limited to a few early scrapped equipments. At a certain level, scrapings are heavier and induce purchases of new equipment and important training programs. Beyond another level, it should also initiate research programs in areas where alternative technologies do not yet exist. These considerations imply that the adjustment costs are convex compared to the intensity *h*, and we note the simple quadratic approximation $C(h) = C\,h^2$, with $C > 0$.

It is clear that the Ministry will seek to minimize the adjustment costs over the period [0, *T*] with coercion of neutrality prices. His program is then:

$$\begin{cases} \min \int_0^T C\,h^2\,dt \\ s.c.\ \ \dfrac{\dot{x}}{x} = Ah(x - x_d) \\ x(0) = x_0 \\ x(T) = x_T > x_d \end{cases}$$

where $C > 0$, $A = \dfrac{1-\beta}{\gamma} > 0$ and the initial and final conditions are given and verified $x_0 < x_T < x_d$.

This problem of optimal control, where h is the variable of command and x is the variable of situation, has for Hamiltonian $H = C\,h^2 - \lambda A h\,x(x - x_d)$.

The optimal command must verify $\dfrac{\partial H}{\partial h} = 0$, $2hC - \lambda A x(x - x_d) = 0$, or:

$$h^* = \frac{A}{2C}\lambda\, x(x - x_d) \qquad \#46$$

As $\dfrac{\partial^2 H}{\partial h^2} = 2C > 0$, there is much in the presence of a minimum.

The canonical system is:

$$\begin{cases} \dfrac{\dot{x}}{x} = -Ah(x - x_d) \\ \dfrac{\dot{\lambda}}{\lambda} = Ah(2x - x_d) \end{cases}$$

The growth rate of the auxiliary variable and the intensity in polluting capital per head are bound by the relationship $\dfrac{\dot{\lambda}}{\lambda} = -\dfrac{\dot{x}}{x}\dfrac{2x - x_d}{x - x_d}$. By injecting the remarkable property in the expression obtained by log derivation from (46), we obtain $\dfrac{\dot{h}^*}{h^*} = \dfrac{\dot{\lambda}}{\lambda} + \dfrac{\dot{x}}{x} + \dfrac{\dot{x}}{x - x_d} = 0$. Thus, the optimal control is constant. It concludes that the ratio of polluting capital per labourer is

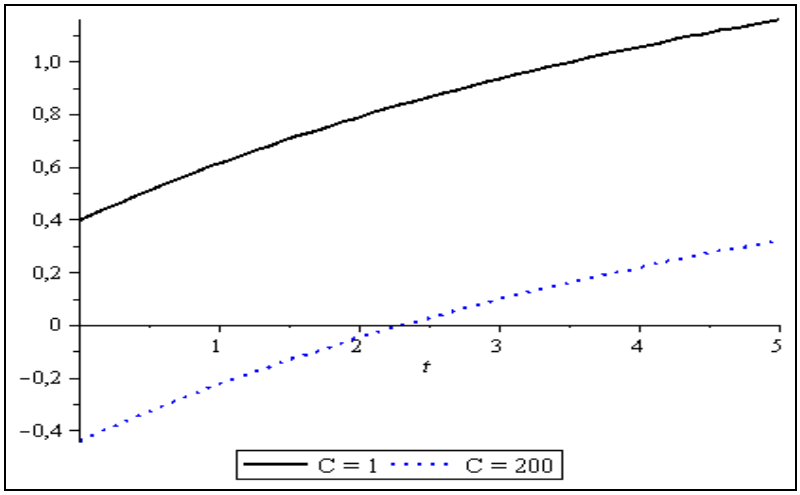
governed by the law of logistic evolution (38). By terminal condition, we calculate the optimal:

$$h^* = -\frac{1}{A x_d T} \ln\left(\frac{x_0}{x_T} \frac{x_d - x_T}{x_d - x_0} \right) \qquad \#47$$

During the period [0, *T*], the results of section 4.3 characterizing the changes in rates and changes in technology mix, remains valid, especially the monotonous reduction of polluting capital and the ratio polluting capital / employment and so, the resumption of employment. However, the evolution of the budget balance is different because, if revenues grow, full support of the adjustment costs by the Ministry of Ecology increases public spending. As before, new tax revenues amounted to $R = p\,k\,K_1 + s\,c\,N$ but we must take account of new spending $C\,h^2$, so the balance specific tax reform is equal to $R - C\,h^2$.

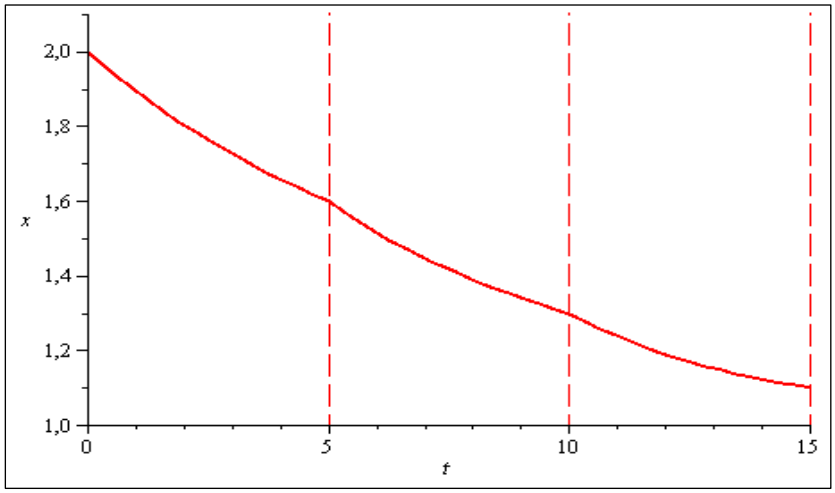
The optimal command remaining constant in time, the change in the balance is still given by $\dot{R}$ which is positive. Graphically, it is as if the curve in Figure 3 is translated downwards by a quantity equal to the constant adjustment costs. The effect is even stronger than the coefficient *C*, characterizing the convexity of the function of cost is high. In Figure 4, built with the parameters of the previous section, the trajectory of budget balance *C* = 1 corresponds to a low convexity of the function of adjustment costs while the path *C* = 200, typical of severe costs, starts with a increased deficit, before finding for a second time the path of surpluses. In all cases, the developments of budget balance are favourable and, indeed, should be even more if we took explicit account lower costs involved in reducing unemployment and overall improving of health public.

Fig #4 Changes in the government balance



Ultimately, the results of the model of optimal control are unambiguous. The best public policy to achieve a given environmental at medium term, consists to react constantly to differences observed between the current intensity of polluting capital per capita and the long term. The choice of intermediate goals defines successions of medium-term strategies of the Ministry and enables to increase in stages the quality of sustainability toward a reasonable and desirable state, by sequential decreases of the ratio of polluting capital per capita (Fig#5) without neither slippage in prices nor in competitiveness of enterprises and with progressive improvement of public finances.

Fig#5 Trajectories of polluting capital controlled per capita



Conclusions

Which comments drew this analysis of a proposed tax revolution? Over the developments, we saw a number of convictions and certainties. If there is a political and social consensus, around the issue of sustainable development, there is no reason that eco-taxation of this nature would be poorly perceived. In this ideal favourable environment, the study of the impact of this tax reform is legitimate, necessary and urgent.

The envisaged tax reform requires a clear definition of what is a good (or service) of production that meets the criterion of sustainable industrial development. It requires a theoretical conceptualization, followed by a heavy statistical work, first to build a nomenclature of the polluting nature and the degree of pollution related to the capital today, then a systemized elaboration concerning accounts.

Once recognized the dichotomy between "sustainable capital" and "polluting capital", it is imperative to determine the current role of them in the macroeconomic production function. The econometrics should be used to calculate the elasticity of these two factors on production. This is crucial because it determines the extent of theoretical and practical results.

In theory, the following results and lessons are provided :

1. The establishment of an eco-tax on polluting capital distorts unambiguous the technological choice of firms wishing to minimize their cost of production. The relative weight of polluting capital declines, while the relative weight of cleaner capital increases, and it is especially true for employment.

2. The demand for labour increases, but under the small model used, it is not possible to determine whether tax reform leads or not to full employment. The occurrence of an over-employment is moreover not excluded.

3. The relative weight of sustainable capital increases in the technology mix. It anticipates that it encourages the emergence and development of innovative sectors.

4. Tax reform fits perfectly into the political fight against inflation. Whatever are the technical and economic characteristics of countries implementing the reform, there are two precise rules for determining the rate of eco-tax on polluting capital that guarantees either price stability or budget neutrality. They are fundamentally underpinned by the high incidence of the substitution phenomenon, causing significant reduction in polluting capital – which becomes very expensive –, and an increasing employment – because it gets much cheaper by the disappearance of social contributions. The objective of price stability is always accompanied by an improvement in the budget balance, guaranteeing the lasting quality or durability of social accounts.

5. By having the necessary authority (regulation powers), a Ministry of Sustainable Development may change direct taxation to reduce the use of polluting capital and to increase employment without inflationary slippage. Two options are possible. Each of them meets the specifications of sustainable industrial development. But compared to the shock therapy, gradualism has two major advantages: it achieves a predefined target of sustainability, it gives companies time to adjust to new technological trajectories. It does not use the ancient weapon of price controls. It helps to think in terms of integrating the transition time required for changing the combination of productive and technological trajectories. Otherwise, companies, liable for eco-taxes, would be reflected in the selling price and would unduly cause a massive transfer of its burden on consumers, within industries where competition on similar and sustainable products does not exist.

6. It is possible to reach a distant target of quality in terms of sustainability in successive stages, equivalent to medium-term periods. For that purpose, tax rates should be determined according to two criteria: first, the gap between the quality found in the early period and the desired quality in the long term; on the other hand, the desired quality whished at the end of the period. To minimize the adjustment costs brought about by the reform, the rules of

engagement must be calculated at the beginning of the period, and then remain unchanged throughout the period.

7. If the advocated reform distorts the combination of technology towards sustainability, sustainable development cannot remain a prisoner of the assumptions of the model developed in this article. For convenience, it is assumed that the "technical ledger" remains fixed, hence the result that the rates of social contributions and eco-taxes are changing technological trajectories into a pre-defined yoke shape and shifting the tax stumbles on limits. De facto, the conclusions of this basic model suggests a more ambitious extensions, which would set the breath of a more powerful dynamism, that should be incentive for firms to break with incremental technological innovations, and to move towards technology of eco-links and eco-routes. In order to formalize it, we should abandon the streamlining of a exogenous technical progress: we should lay on a endogenous major component of development, in considering it as a result of synergies from the combination of labour and non-polluting capital. In fact, sustainability is not an addition of components. The process of its implementation is the development of links and cooperation "over the fence". This makes giving free and full rein to human engineering, to flows of immaterial capital and heritage, and to applied research for true sustainability.

The rule of neutrality on prices has this quality or virtue to loosen under duress the governmental budget and free resources to finance development of the economy of links. Because of the phasing out of polluting technologies - which cannot be total due to the partial substitution of cleaner capital and polluting capital - other fiscal tools should be required but within a context of full employment and reducing social costs generated by insecurity and diseases linked to environmental degradation. These tools should supplement the social accounts whose sampling base could shrink when any part of the social contributions paid by

the employer would be abolished and that the tax rate on polluting capital reaches its economic limits in the field of environmental protection.

While it is not only at the national level that problems of sustainability must be designed. The proposed tax measure takes its full meaning in applying at the widest geographical area possible. But in this area, concern for sustainability is less often cited as economic argument : a national strategy would supposedly doomed to failure because the nation innovative runs the risk of massive relocations by firms in search of raw materials and polluting capital at low cost. In reality, nothing is less certain. The themes of the behaviour of firms, of neutrality on prices and the budget neutrality were systematically taken in open economy. It was shown that the conclusions reached in closed economy are all, without exception, transferred to open economy. That makes sense: the proposed tax reform involves two rates (contributions and eco-tax) controlled by national authorities, the firms located on the territory taken into account in their calculations of production costs, but as the reform is generally painless on prices, the macro economic situation remains the same: price competitiveness is not degraded by eco-taxation and the overall external position has no reason to deteriorate, especially since the sustainability effect creates a dynamic innovation and differentiation in terms of quality, highly competitive for the whole economy.

However, at a less aggregated level, we cannot ignore the sector-based differences that are produced by the significant change in relative prices. Some products much more competitive internationally, will tend to rise sharply on the domestic market. Similarly other products, and it is wanted, which become less competitive, would be less sold. New jobs will be created and other will appear without being immediately turn into jobs in the production of sustainable products in sustainable enterprises. In both cases accompanying strategies must be worked out before the proposed tax shifting.

On a larger scale, this new tax system for sustainability must be integrated within the framework of globalization of economy and developments. States and international institutions must work together to develop standards, regulations and adjustments of global and local sustainability, It is clear that the duty of sustainability justifies the development of environmental and social standards at the international level, and to promote innovative companies investing in environmental technology based on eco-links, introducing a tax on imports dealing on non-renewable materials and polluting goods or services. This tax cannot be taken for a protectionist measure because it obeys to the need for sustainability of the whole humankind. In this case, the implementation of sustainable development, which must be global to be attractive, motivating and achievable, requires cooperative and fair solutions on a global scale. We cannot restrict the development of emerging countries, users of polluting technologies without having simultaneously the rich countries participating in efforts to develop alternative technologies. Northern countries should consider compensation mechanisms for countries of the South, because it is equally clear that countries whose development depends on the extraction of non-renewable materials and export of polluting matters will be heavily affected by all these measures. Therefore, this tax should finance a global fund to finance projects of conversion activities in these countries.

Sustainability is inherently a case of solidarity within the entire world.

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