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GREEN TAX REFORM, STRUCTURAL UNEMPLOYMENT, AND WELFARE

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THE NEW GERMAN GOVERNMENT HAS DECIDED to reduce the social security tax on labor income and to compensate the shortfall in government revenue with an energy tax. In short: it has decided on a revenue-neutral green tax reform. Notwithstanding the justified criticism of the many exemptions the decision allows for, this paper explains the rationale of a green tax reform in an underemployed open economy with sticky wages.

We consider an economy that produces an export good with domestic labor and imported energy. The economy is stuck in an unemployment situation that results from an excessive fixed net-of-tax wage rate or from an excessively high labor tax burden. This is typical for nearly all west European economies (see OECD, 1995). Given this initial situation, we study a revenue-neutral green tax reform that substitutes energy taxes for wage taxes in a way that keeps domestic output constant and does not reduce the tax revenue. We show that this reform will reduce unemployment, increase domestic income, and improve domestic welfare.

The driving force behind this result is the technological substitution process that a green tax reform will bring about. The change in the tax-inclusive factor price ratio induces the producers to substitute labor for energy as factors of production. Holding domestic output constant, the green tax reform yields a positive employment "dividend." The reduction in unemployment is welfare-improving since energy, which the country has to buy at its true social opportunity cost, is replaced with labor, whose price is above its social opportunity cost. An improvement in the environment would be a further advantage, but this is not considered in this paper.

THE MODEL

The following section outlines the main features of the more general framework applied in Koskela, Schöb, and Sinn (1998). The knowledge of these features is essential for understanding the effects of a green tax reform in the presence of a labor market imperfection.[1]

There is one representative firm in the economy that produces a single output Y, using an imported resource R, which we call energy, and domestic labor L as inputs. The domestic output is exported, all private and public consumption goods as well as the resource R are imported.

The firm's wage and energy costs are defined gross of ad-valorem labor and energy tax rates t_w and t_q such that $\tilde{w} = \tilde{w}(1 + t_w)$ and $\tilde{q} = (1 + t_q)q$, where w is the fixed net-of-tax wage rate and q is the world price of the resource, which cannot be influenced by the country's demand. Domestic workers receive the net-of-tax wage rate, foreign resource owners receive the net-of-tax world resource price. Profits, which are equal to the surplus of sales revenues over factor costs, accrue to domestic firm owners. Tax revenues are used by the government for the provision of public goods.

In this paper, we focus on the impact of a revenue-neutral green tax reform, which substitutes energy for wage taxes in a way that leaves domestic output unaffected. We elaborate the effects such a green tax reform will have on employment, domestic income, and domestic welfare. The notion of employment is straightforward. Domestic income consists of net-of-tax wage income, profits, and tax revenues. Welfare depends on domestic income, which can be used for the purchase of private and public consumption goods, and on the amount of leisure. Each household either supplies one unit of labor or enjoys leisure. Involuntary unemployment is introduced in the model by assuming that, at the given net-of-tax wage rate, labor demand falls short of labor supply and that the labor market is unable to adjust the wage rate so that the labor market is in equilibrium.[2]

LABOR TAX SYSTEM VERSUS GREEN TAX SYSTEM

We provide an illustration of the effects that a green tax reform, which substitutes energy for wage taxes but leaves output constant, has on employ-

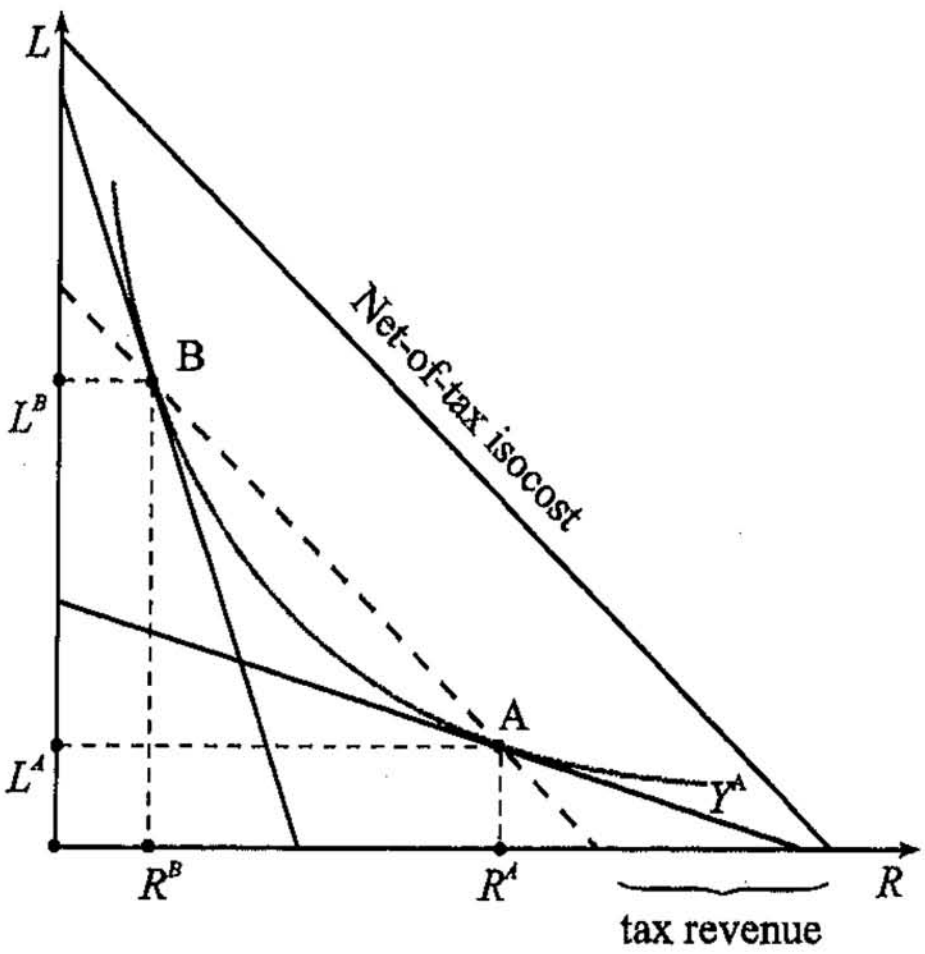
ment, domestic income, and welfare. As mentioned in the introduction, European tax systems are characterized by high taxes on labor and low ones on energy, $t_w > t_q$.[3] We call such tax systems "labor tax systems." In Figure 1, point A illustrates the equilibrium resulting from a labor tax system.

Our analysis focuses on a discretionary green tax reform that moves the economy from the initial labor-tax system to a new tax system that generates the same domestic output as the initial one. Figure 1 illustrates such a reform. The figure contains an isoquant, which represents the initial output level Y^A, and various isocost lines. In general, the slope of an isoquant equals the negative of the ratio of marginal factor productivities, and the slope of an isocost equals the negative of the factor price ratio. A cost minimum prevails where an isocost touches the isoquant. Let the slope of the isocost through A reflect the initial tax-inclusive factor price ratio $-\tilde{q}/\tilde{w} = -(1+t_q^A)\,q/(1+t_w^A)w$. Since A is a point of tangency between the isocost and the isoquant, it characterizes a cost minimum. Assume that the production function is linear homogeneous. Then, given the net-of-tax factor prices and the initial factor tax rates, there are many such cost minima on a ray from the origin through A, all of which have the same unit production cost. As the firm faces a downward sloping output demand curve, it will set an output price that maximizes profits. There is only one cost minimum where profits are maximized, and we assume that A is that cost minimum.

The isocost through A reflects the factor cost including the factor taxes. The diagram also shows the corresponding net-of-tax isocost curve. This curve is defined as the geometrical locus of factor combinations that would be attainable at a given expense if there were no taxes. The net-of-tax isocost curve is flatter than the tax-inclusive isocost because the labor tax rate exceeds the energy tax rate, and it is in a more outward position because positive tax rates imply that the factor inputs are smaller at given cost.

The horizontal distance between A and the net-of-tax isocost equals the government's tax revenue in terms of energy input. The broken parallel to the net-of-tax isocost through A therefore defines the geometrical locus of potential

Figure 1: **Labor-Tax System Versus Green Tax System**



equilibria, where the tax revenue is the same as in the initial labor-tax system A. We assume that the isoquant is well-behaved in the sense that it does not touch the axes and is strictly concave. Furthermore, linear homogeneity guarantees that along the isoquant the total factor cost and the unit cost of production are constant.[4] Thus, it is possible, with an appropriate choice of the tax rates t_w and t_q, to transpose the economy gradually from A to B along the isoquant, keeping domestic output, total production cost, and unit production cost constant while preserving the conditions for a cost minimum. As the unit production cost does not change when we move along the isoquant, the firm has no incentive to change the output price. Hence, all points on the isoquant would be potential equilibria. Among these equilibria there is one point, B, that also generates the same tax revenue as A because it is located on the broken parallel to the net-of-tax isocost through A. We call the tax system that generates point B a "green tax system" since the isocost through B is steeper than the net-of-tax isocost, which indicates that the energy tax rate exceeds the labor tax rate: $t_q > t_w$.

Employment

The revenue-neutral green tax reform, which substitutes energy taxes for labor taxes, increases employment by the amount $L^B - L^A$. As we assumed that this green tax reform leaves the net-of-tax wage rate constant, labor supply is not affected. Hence, unemployment is reduced by the same amount. The reduction in unemployment is accompanied by a reduction in domestic energy consumption. This result can be summarized as follows.

Proposition 1: A green tax reform that is both revenue-neutral and output-neutral increases the employment of labor and reduces the consumption of energy.

Domestic Income

Domestic income consists of wage income, profits, and tax revenues. The green tax reform increases employment by the amount of $L^B - L^A$. As the net-of-tax wage rate is not affected by the green tax reform, domestic wage income increases by the amount $w(L^B - L^A)$. By contrast, the profit of the firm remains constant. This can be seen by comparing sales revenues and production costs in the two equilibria A and B. Moving along the isoquant from the initial equilibrium A to the new equilibrium B leaves both the total production cost and the per unit production cost constant. The latter implies that the firm will not alter the output price and the quantity produced. Both sales revenue and total production cost therefore remain constant, and so does the profit. Tax revenues are not affected as we have considered a revenue-neutral green tax reform. Hence, domestic income increases by the same amount as domestic wage income does. This result is summarized in Proposition 2.

Proposition 2: A green tax reform that is both revenue-neutral and output-neutral increases domestic income.

Domestic Welfare

Welfare is measured by the difference between domestic income and the disutility from working. As profit and tax revenue remain unchanged in the course of the green tax reform, domestic income is affected only by the increase in wage income due to an increase in employment. In itself, the increase in domestic income improves domestic welfare. However, the higher employment level also implies a reduction in leisure, which in itself reduces welfare. To find the net effect, note that we assumed involuntary unemployment. As involuntary unemployment means that the wage rate is above the marginal cost of leisure, the employment reaction we analyzed clearly indicates a welfare increase. This can be summarized in a third proposition.

Proposition 3: A green tax reform that is both revenue-neutral and output-neutral improves domestic welfare.

The reform may even be Pareto-improving with regard to the whole world. Suppose the world energy price measures the true opportunity cost of energy consumption in terms of withdrawing it from other uses. The domestic wage rate, on the other hand, is above the opportunity cost of labor. Given this asymmetry, the domestic economy will gain from the green-tax reform while no one else in the world loses.

On Marginal Tax Reforms

Thus far, we have considered a jump from a labor tax system to a green tax system by considering the tax reform which leaves output and tax revenues constant. Obviously, however, the movement along the isoquant from A toward B will increase

the tax revenue until the point is reached where the isoquant has the same slope as the net-of-tax isocost curve. This immediately gives

Proposition 4: A marginal output-neutral green tax reform will always increase employment and welfare and, provided the labor tax rate still exceeds the energy tax rate, it will also increase the tax revenue.

CONCLUSIONS

The aim of this paper was to demonstrate why a green tax reform that substitutes an energy tax for a labor tax may be favorable in countries that suffer from persistently high levels of involuntary unemployment. Such a green tax reform will induce a technical substitution in the production process that replaces energy consumption with employment. Since energy is priced at its true domestic opportunity cost, but the price of labor is above its social opportunity cost, the green tax reform will also improve domestic welfare.

This result justifies the policies of the new German government, but it is in sharp contrast to the results derived in the standard models used to analyze the double-dividend hypothesis.[5] In these models, labor markets clear, and so the mobile factor energy should not be taxed. The whole tax burden of energy taxes would fall on labor, and there would be an excess burden that also has to be borne by labor. We have shown that, with involuntary unemployment, this traditional result will no longer hold. It is true that energy is supplied elastically in the world market and should not be taxed if labor is less elastically supplied. However, involuntary unemployment effectively means that labor supply is also perfectly elastic. When both labor and energy are supplied elastically, tax discrimination of labor is not efficient, and when, in addition, the price of labor is above its opportunity cost, even a tax discrimination of energy can be justified.

While the green tax reform does have its merits, it can nevertheless be defended only as a second-best policy measure. Of course, the best policy measure would be a market-clearing wage adjustment. Instead of carrying out a green tax reform it would still be better to reduce wages and compensate the insider workers with company shares, as one of us has recommended elsewhere.[6] Only if, for whatever reason, such a policy move is really not feasible, should an alleviation of the unemployment problem be sought with a green tax reform. With regret we state that the new German government has not even considered the policy alternative.

Our analysis neglects structural differences in the production functions of different sectors. The fear that a green tax reform would hit sectors whose resource input is relatively high cannot be dismissed easily. Certainly, in a more complicated setting with sectors whose energy intensities differ, there will be sectors that shrink and others that grow in situations where our model predicts constant output. Until we analyze the sector problem explicitly, we can only suspect that the gains of the rising sectors will outweigh the losses of the shrinking ones. We believe that strange things would have to happen in a multi-sector model before our results could be stood on their heads.

Notes

[1] Related papers dealing with green tax reforms in economies with imperfect labor markets are, among others, Koskela and Schöb (1996), Bovenberg and van der Ploeg (1996, 1998), and Carraro, Galeotti, and Gallo (1996).

[2] Here, we assume throughout that the net-of-tax wage is constant. See Koskela, Schöb, and Sinn (1998) for its justification in the union bargaining context.

[3] In Germany, for example, we calculate that $t_w = 1.25$ (marginal tax rates including employers' and employees' social security contributions; see OECD 1995, p. 39). With the exception of taxes on gasoline and automotive diesel, where the excise tax exceeds the labor tax rate with values of 2.45 and 1.31, energy taxes for German industry are very low, being in the range of $0 \le t_q \le 0.21$, where the two bounds refer to taxes on coal and light fuel oil (see International Energy Agency, 1997, p. 125f).

[4] This is a direct implication of Euler's theorem.

[5] See, for example, Bovenberg and de Mooij (1994).

[6] Sinn (1998).

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