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Energy Tax Reform in Time of Crisis
The Case of Energy-Dependent and Open Economies

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Abstract

Many arguments against higher energy taxes and environmental pricing assume that a unilateral reform will necessary harm the production costs and the purchasing power of households, and therefore, in the aftermath of the crisis, exacerbate the economic downturn. This paper considers the most extreme arguments which assume that no substitution possibilities away from energy are available in the short to medium run. Unemployment is due to non-clearing wages in the labour market and a shortage of demand in the product market. Under such circumstances, however, a tax shift from labour to energy can increase employment if external trade is sufficiently sensitive to production costs and if the reform succeeds in shifting the tax burden away from production costs to the final consumers' incomes. When external trade is less sensitive to production costs, what matters the most is the domestic market. In that case, the effect is positive only if wages adjust to compensate the higher final energy bills of consumers, and thus, maintain the level of internal demand.

Key words

Energy Policy; Tax Reform; General Equilibrium; Employment

JEL codes

D50; H20; Q43

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La réforme fiscale énergétique en temps de crise
Cas des économies ouvertes à forte dépendance énergétique

Résumé

Beaucoup d'argumentaires contre la tarification des biens environnementaux et la hausse de la fiscalité énergétique supposent qu'une réforme unilatérale pénalisera nécessairement les coûts de production et le pouvoir d'achat des ménages, et donc que ces mesures s'opposeront à la reprise économique après la crise. Cet article considère les argumentaires les plus extrêmes qui supposent qu'il n'existe pratiquement pas d'alternatives à la consommation d'énergie fossile à court et moyen terme. Nous supposons que l'ajustement des salaires ne permet pas de supprimer le chômage involontaire sur le marché du travail et que le manque de débouchés sur le marché des biens aggrave le chômage. Dans ces circonstances, pourtant, et lorsque le commerce extérieur est suffisamment sensible aux coûts de production, une substitution partielle de prélèvements obligatoires sur le travail par une hausse de la fiscalité énergétique peut favoriser l'emploi. Ce résultat est obtenu lorsque la réforme transfère la charge fiscale vers les revenus des consommateurs finaux et allège les coûts de production. Lorsque le commerce extérieur est moins sensible aux coûts de production, c'est le marché domestique qui compte. L'effet est positif seulement si les salaires s'ajustent pour compenser la hausse de la facture énergétique des consommateurs et maintenir la demande intérieure.

Mots clefs

Politique énergétique; Réforme fiscale; Equilibre général; Emploi

Codes JEL

D50; H20; Q43

1. Introduction

Economists recommend an increase in the relative price of energy for a number of long term objectives: to manage the balance between energy supply and demand, to internalise the costs of local pollutions, to finance new infrastructures, to reflect the future costs of climate damages and fossil-fuel depletion. Higher energy prices can be implemented by public authorities through the management of energy taxes or administered energy prices.

In policy discussions, however, this recommendation is often rejected for short term reasons. If not compensated, higher energy prices will adversely affect the economy. It will harm the production costs and the profitability of domestic producers. In particular, if their foreign competitors do not face the same legislation. It will also harm the purchasing power of households who have to heat their homes and drive to work. The most vulnerable will bear disproportionately the costs of higher prices and lower production and employment.

At the same time, higher energy taxes generate new public revenues. A large body of literature has analysed how to recycle these revenues to reconcile environmental, distributive and economic objectives[1]. For many countries, a simultaneous reduction in labour taxes is found to be the best solution for overall production and consumption (see Goulder, 2013 for a recent exposition of the argument). This may not be sufficient, however, to reach an equitable distribution (see for instance Proost and Regemorter, 1995; Jacobs and de Mooij, 2015). But additional redistributive mechanisms can be designed (*cf.* for example Chiroleu-Assouline and Fodha, 2014; Kaplow, 2012; Combet et al., 2010).

The literature remains inconclusive, however, regarding the *net macroeconomic consequences* of a tax substitution between energy and labour. Would the labour tax cuts succeed in compensating the adverse effects of higher energy tax? Is it a possible outcome that this tax substitution alleviates unemployment in the short to medium run, e. g. even when substitution possibilities away from energy are not yet available?[2] We address these questions here by investigating the macroeconomic conditions under which a net gain can be achieved. A good macroeconomic performance is needed to limit the need for

[1] One can refer both to the 'double dividend' literature (for a review see Goulder, 1995, Ligthart, 1998, Bovenberg, 1999) and to the optimal taxation literature (see in particular the seminal paper of Sandmo, 1975, and Cremer et al., 1998).

[2] In the double dividend literature, this question referred to the existence of 'strong' double dividend (Goulder, 1995).

redistribution. We will take an aggregate view of the problem and leave the important distributional issues for other examinations. Considering that no substitution possibilities away from energy are available may sound strange since the first objective of the tax reform is precisely to induce such substitutions. However, we found relevant to consider the very short term arguments that make higher energy taxes politically infeasible.

The early literature on the 'double dividend' has first underlined a mechanism through which the reduction in labour tax does not succeed in compensating the adverse effects of higher energy prices (Bovenberg and de Mooij, 1994). Higher energy taxes increase the cost of leaving of households. In response, they may either reduce their supply of labor or ask for higher wages. The energy tax thus works as an 'implicit' tax on labour. This mechanism contributes to offset the positive effect of lowering the 'explicit' tax on labour. If the energy tax base erodes more than the labour tax base, a higher (implicit or explicit) tax burden on labour income is required to raise the same revenues. As a result, total employment shrinks.

Latter analyses have put forward a number of circumstances under which the previous mechanism (the 'tax interaction effect') does not offset the positive effects of lowering the labour tax (the 'revenue-recycling effect'). By introducing some heterogeneity in the analysis (various production factors, sources of incomes and economic agents), they have provided some explanations as to why the energy taxation would not lead either to higher production costs (in particular, higher wages) or to lower labour supply and employment[3].

Assumptions about the functioning of the labour market are crucial. In a walrasian view of the labour market, unemployed workers can either decide not to work because their real wage is too low (voluntary unemployment), or to bid their wage down until they find a job. In this case, the energy tax is always an implicit tax on wages and production. In an economy with involuntary unemployment, however, there is excess supply of labour. Working less is not an option for workers, even if the higher energy tax reduces their purchasing power. They can only ask for higher wages in the bargaining process with their employers. The extent to which they actually succeed in increasing their nominal wage (and preserve their

[3] In our aggregate view of the problem we will not consider these heterogeneities explicitly. We shall keep in mind, however, that a general microeconomic condition is required for the aggregate level of employment to increase: Some economic agents must support the costs of higher energy prices without obtaining higher incomes. This is the case if the tax burden is shifted towards those unemployed (Koskela and Schöb, 1999), or employed in the informal labour market (Bovenberg and Van Der Ploeg, 1998), those who own a fixed capital factor (Bento and Jacobsen, 2007), or privately-retained scarcity rents (Fullerton and Metcalf, 2001), or natural resources owners, maybe those living abroad, in the oil/gas exporting countries (Franks et al., 2015).

real purchasing power) depends on the particular theory of unemployment considered (efficiency-wage theories, contracting models, insiders-outsiders, search and matching theories). Most of the literature on environmental tax reform have assumed a search model or a wage bargaining model between employers and workers (see Bovenberg and van der Ploeg, 1996, Carraro et al., 1996, Koskela et al., 1998, Koskela and Schöb, 1999). These studies have confirmed that the reform can boost employment if workers cannot (or only slightly) increase their nominal after-tax wage (see in particular Koskela et al., 1998). This outcome is obtained if the fiscal substitution reduces options available outside the labour market, in particular, the real unemployment compensations (Koskela and Schöb, 1999) and the real earnings from the informal economy (Bovenberg and Van Der Ploeg, 1998).

In contrast to these studies, we consider that unemployment may also be caused outside the labour market, by the existence of excess supply in the product market[4]. In open economy, a shortage of demand may be worsened either by a decline in real incomes (domestic demand) or by a deterioration of the trade balance (external trade). Under these circumstances, assumptions about the reactions of wages and trade interact. Holmlund and Kolm (2000) have analyzed such interactions assuming a wage bargaining model and the existence of a tradable sector. They have found that the tax reform can boost employment by reallocating employment away from the tradable sector with high wages, towards the non-tradable sector with lower wages. Here, we do not assume a particular theory of non-clearing wages. We simply assume that the aggregate level of domestic wages responds negatively to the aggregate level of employment. We take this response as exogenous, however, and test the sensitivity of the result to a wide range of wage-setting behaviours[5].

Under such assumptions, it is not clear whether a tax shift from labour to an imported energy can boost employment. A unilateral reform has an ambiguous net effect on aggregate demand since higher energy taxation affects both the purchasing power of households and the domestic costs of production. On the one hand, an incomplete nominal wage adjustment may not be enough to preserve the real after tax wages and the

[4] Shortage of demand is one manifestation of the slow recovery since the Great Depression (Stiglitz, 2011).

[5] This macroeconomic formulation of the wage-setting behaviour is broadly consistent with the microeconomic theories of involuntary unemployment (see Lindbeck, 1993). Note, however, that in our analysis it is the response of *domestic* wages that is exogenous (see section 2). Therefore, both the *real* wage and the level of employment are endogenous variables. The *real* wage is equal to the *domestic* wage divided by the consumer prices, and the consumer prices are endogenous. As we do not account for money supply in the analysis, we speak about *domestic* wage rather than *nominal* wage. The domestic wage is expressed in foreign wage unit (foreign prices are fixed and exogenous, *numéraire* in the analysis).

purchasing power of households for non-energy products. This may depress domestic demand. However, on the other hand, the labour costs are lowered if the labour tax cuts exceed the increase in after tax wages. This latter effect may improve the trade balance.

We analyze this question using a simple macroeconomic model. Drastic simplifications are made to keep the problem as simple as possible. We consider an aggregated representation of a small open economy with one imported energy, a fixed level of final energy consumptions, and one non-energy product in competition with a foreign product. In production, we assume constant technology, immobile and fixed capital, and fixed energy needs by output. We use this model to analyse the sensitivity of the evaluation to our two exogenous parameters: the responses of domestic wages and external trade.

Following Guesnerie (1977) and Ahmad and Stern (1984), we start from a given initial state (that may be sub-optimal) and we consider the implications of a direction of tax reform. We examine the effects of the tax shift under the respect of a public budget constraint and a trade balance constraint. A key result is that the tax reform affects effective demand by modifying the relative positioning of the country with respect to the international market and the domestic market. The qualitative result is sensitive to the exogenous responses of domestic wages and external trade for non-energy products. If external trade is sufficiently sensitive to production costs (the Marshall-Lerner condition holds), the reform boosts employment by shifting the tax burden away from production costs to consumers' incomes. When trade is less sensitive to production costs, what matters the most is the domestic market. The effect is positive if wages adjust to compensate the higher final energy bills of consumers, and thus, maintain the level of internal demand.

The rest of the paper is structured as followed. Section 2 presents our stylised model of energy-dependent and open-economy. Section 3 describes the properties of the general equilibrium under different combinations of behavioural assumptions (e.g. the reactions of net wages and external trade). Section 4 analyses the implied consequences of a marginal tax shift from labour to energy on the domestic price and aggregate production. Section 5 examines in more detail the general equilibrium mechanism involved. Section 7 summarizes the results on the sensitivity of the evaluation to the responses of domestic wages and external trade, and Section 8 to the characteristics of the initial economic situation.

2. A Model of Energy-Dependent and Open Economy

We consider an economy constrained by international competition, energy dependency and unemployment. This economy has no substitution possibilities away from energy. All energy needs are imported, and productive systems produce only one aggregate quantity $\boldsymbol{Y}$ of non-energy goods and services. This domestic product is exhausted by household consumption ***C***, public consumption ***G***, and net trade $\boldsymbol{X}$ (exports minus imports).

$$\boldsymbol{Y} = \boldsymbol{C} + \boldsymbol{G} + \boldsymbol{X} \qquad (1)$$

Investment and capital depreciation are omitted, as we take for given the state of productive capacities, infrastructure, and equipment in the short-mid run. The model thus mimics an extreme case of energy dependency (e. g. of industrialized economies on fossil fuels). The current state of techniques determines the quantities of energy and labour required to produce one unit of domestic product. For any small change we will consider, we assume an extreme case where those two technical coefficients (e and l) will remain unchanged and constant returns to scale in production[6].

As we will discuss the inclusion of the country into the globalised economy, let us take as our *numéraire* price the world price of non-energy products p^* (with the normalisation p^*=1). The domestic price of production is set by producers to cover the costs of energy and labour. These costs include the net costs of resources and the compulsory levies paid in accordance with the existing structure of a tax system. A unit of labour is provided at the nominal wage ***w***, a unit of energy at a constant import price p_E^*. A rate of payroll taxation τ_L apply to the net labour income, and an energy tax τ_E is paid for each unit consumed.

$$\boldsymbol{p} = \left(1+\tau_L\right) \boldsymbol{w}\, l + \left(p_E^* + \tau_E\right) e \qquad (2)$$

Households use their labour incomes to buy energy and the quantity ***C*** of other products. Like producers, they are dependent on energy: they must cover a constant level of energy needs E. Like producers, they pay the uniform energy tax τ_E for each unit consumed.

[6] As noted above this capture an extreme assumption about energy dependence present in policy discussions. This assumption will magnify the basic mechanism analysed below. Technical change in response to change in relative prices will be taken into account in future extensions.

$$\boldsymbol{w}\, l\, \boldsymbol{Y} = \boldsymbol{p}\, \boldsymbol{C} + \left(p_E^* + \tau_E\right) E \qquad (3)$$

Public administrations use all tax revenues to finance the level of public consumption ***G***.

$$\tau_L\, \boldsymbol{w}\, l\, \boldsymbol{Y} + \tau_E\left(E + e.\boldsymbol{Y}\right) = \boldsymbol{p}\, \boldsymbol{G} \qquad (4)$$

Only two assumptions on the functioning of markets are needed to determine the behaviour of the economy and the level of production and employment:

1. The setting of wage ***w***
2. The adjustment of net trade ***X***

In the more general case, the functioning of the economy is defined by any function $\boldsymbol{w}(.)$ and $\boldsymbol{X}(.)$, taking as potential arguments all other variables and parameters. Different theories or beliefs about the functioning of the labour market and the regime of international competition could be 'embodied' in this aggregate formulation. In what follows, we only restrict our analysis to the following relations between variables:

A. The level of domestic wage ***w*** responds positively to the level of production ***Y*** (or negatively to the rate of unemployment ***z***)

$$\boldsymbol{w} = \boldsymbol{w}\underset{(+)}{\left(\boldsymbol{Y}\right)} \qquad (5)$$

Domestic wages only relate to the level of production or to the rate of unemployment. The rate of unemployment is simply proportional to the level of production, given the exogenous levels of total active population L and labour intensity of production l:

$$\boldsymbol{z} = 1 - \frac{l\,\boldsymbol{Y}}{L} \qquad (6)$$

Recall that our *numéraire* is the foreign price p^*. Therefore, domestic wages are fully indexed to foreign prices (and by extension to foreign labour costs) when one assumes that they are insensitive to movements in production and unemployment. On the opposite, domestic wages are largely autonomous from foreign economic conditions when they are fully responsive to domestic production.

Note that we have said nothing about the *real* wage. The *real* wage is in principle equal to the domestic wage $\boldsymbol{w}$ divided by a consumer price index. In what follows, we do not compute such consumer price index. A price index should aggregate prices for energy $[1+\tau_E]\, p_E{}^*$ and for non-energy consumptions purchased in the country $\boldsymbol{p}$ and abroad p^*.[7]

B. Net external trade of non-energy products $\boldsymbol{X}$ responds negatively to the domestic price of production $\boldsymbol{p}$

$$\boldsymbol{X} = \underset{(-)}{X}(\boldsymbol{p}) \tag{7}$$

Trade of non-energy goods and services in the globalized product market is somewhat function of the terms of trade for those goods and services ($\boldsymbol{p}$ / $e\, p^*$). We assume a fix exchange rate *e*. Thus, the world price p^* being our *numéraire*, net trade $\boldsymbol{X}$ responds only to the domestic costs of production $\boldsymbol{p}$.

This response of the net trade of non-energy products to variations in the domestic price of production will affect the trade balance in monetary terms ($\boldsymbol{p\,X}$). We shall consider two different cases. In a first case, the 'Marshall-Lerner condition holds', and any variation (for instance, an increase) in the exchange rate will induce an opposite variation in the trade balance (in this case, a decrease). However, we will also consider the case where 'the Marshall-Lerner condition does not hold', and any increase in the domestic price leads to an increase in the balance of trade. This second case corresponds to countries with important non-price comparative advantages and strong relative power on international markets.

This formulation is nevertheless general enough to describe a wide range of beliefs about the macroeconomic behaviours of wages and trade. The existence of such competing beliefs play an important role in present debates about tax policies (we can think, for instance, of the number of arguments which are based on different assumptions about the degree of 'wage flexibility' and the importance of the 'cost-competitiveness' for trade).

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[7] A more general log linear formulation of the wage setting function will be: $\boldsymbol{w} - \gamma\, \boldsymbol{p_C} = \boldsymbol{w}\underset{(+)}{(\boldsymbol{Y})} = \varepsilon_w\, \boldsymbol{Y}$, where $\boldsymbol{p_C}$ stands for a simplified function of the consumer price index $\boldsymbol{p_C} = \theta \boldsymbol{p} + (1-\theta)\left(p_E^* + \tau_E\right)$, γ for a nominal wage rigidity parameter, and ε_w for a real wage rigidity parameter. The case considered in this paper corresponds to $\gamma = 0$: there is no perfect indexation on the consumer price index. In this case, in particular, higher energy prices are not fully transmitted into higher nominal wages. In the longer run, this nominal wage parameter may shift progressively from 0 to 1 (perfect indexation of wages on consumer prices).

In this framework, no special assumption of optimal adjustment is made. The current state of the economy may be sub-optimal[8]. The current level of wages may not be the one that maximises demand in the product market. The current level of domestic price may not be the one that maximises net exports. The tax structure can either worsen or improve the initial state of the economy, distorting or correcting the system of market prices.

3. General Equilibrium

The previous model has seven equations and seven variables (in bold letters): $\boldsymbol{p}, \boldsymbol{w}, \boldsymbol{z}$ or $\boldsymbol{Y}, \boldsymbol{C}, \boldsymbol{G}, \boldsymbol{X}$. At any general equilibrium, equations (1) to (4) imply the respect of the accounting identity of the current account (here, equivalent to the overall balance of trade), where $\boldsymbol{M_E}$ stands for the total volumes of energy imports.

$$\boldsymbol{p}\,\boldsymbol{X} = p_E^*\left(e\,\boldsymbol{Y} + E\right) = p_E^*\,\boldsymbol{M}_E \qquad (8)$$

There is no possibility of current account deficit as we have assumed that all production incomes are distributed among domestic agents (households and the government). This implies that the overall value of trade flows is balance (energy and non-energy goods). Therefore, the net trade of non-energy goods $\boldsymbol{X}$ must finance the energy bill of the dependent economy[9]. In the international energy market, we assume no restriction in the international supply of energy ($\boldsymbol{M_E}$ is not upper bounded) and no impact of the level of the domestic energy demand on the import price of energy (p_E* is exogenous).

A general equilibrium can be described by the crossing of two curves. A *price curve* resulting from equations (2) and (4), and a *production curve* from equations (1) and (3), or from the balance of trade (equation 10)[10]. Therefore, the level of domestic production and

[8] In this paper, we do not provide a theoretical explanation of the initial sub-optimality of the system. A usual argument for explaining a too high level of energy dependence is that past and current market prices of energy do not correctly reflect the future depletion of resources, and the time required for reducing this dependence. While a sub-optimal real wages adjustment is usually explained, in game theory, by the existence of negative social interactions, frictions and bargaining in the labour market.

[9] Note that this formalisation could as well be applied to the description of a net importing economy (e.g. $\boldsymbol{X} < 0$). In that case, the country should also export some of its energy, or natural resources, to control its external trade balance.

[10] Indeed, the equation of the balance of trade is equivalent to equation 12 minus $\frac{L(1-z)}{l}$ times equation 11.

the domestic price of production are determined together (***p***, ***Y***), or alternatively, as production and employment are proportional, the levels of price and unemployment (***p***, ***z***).

Price curve

$$\boldsymbol{p} \;=\; \frac{1}{1-\boldsymbol{g}(\boldsymbol{Y},\boldsymbol{p})}\left[\; w(\boldsymbol{Y})\,l \;+\; p_E^{*}\,e \;-\; \frac{\tau_E\,E}{\boldsymbol{Y}} \;\right] \tag{9}$$

Demand curve

$$\boldsymbol{Y} \;=\; \frac{1}{1-\boldsymbol{g}(\boldsymbol{Y},\boldsymbol{p})}\left[\; \frac{w(\boldsymbol{Y})\,l\,\boldsymbol{Y}}{\boldsymbol{p}} \;-\; \frac{\left(p_E^{*}+\tau_E\right)E}{\boldsymbol{p}} \;+\; \boldsymbol{X}(\boldsymbol{p}) \;\right] \tag{10}$$

$$\boldsymbol{Y} \;=\; \frac{1}{p_E^{*}.e}\;\left[\; \boldsymbol{p}.\boldsymbol{X}(\boldsymbol{p}) \;-\; p_E^{*}\,E \;\right] \tag{10-bis}$$

with:
$$\boldsymbol{g}(\boldsymbol{p},\boldsymbol{Y}) = \frac{\boldsymbol{G}(\boldsymbol{p},\boldsymbol{Y},\tau_E,\tau_L)}{\boldsymbol{Y}} \tag{11}$$

As regard the public finance, we may either take the structure of the tax system (τ_L, τ_E) as given or the level of public consumption ***G***. In the latter case, public administrations follow a budgeting routine or pursue an objective of public good provision. Accordingly, the level of public consumption is adjusted to the levels of price and production. This budgetary rule takes the form of a new constraint, the function $\boldsymbol{g(p,Y)}$. If no public deficit is allowed, one of the tax rates must adjust to balance the public budget. For any level of energy taxation τ_E, the level of labour taxation τ_L and the size of public consumption ***g*** are determined together. In other words, for any level of public goods requirement, or 'weight of the state', the impact of the tax structure on the general equilibria can be characterized only by looking at equations (9) and (10) or (10-bis).

The existence and properties of the general equilibrium then depend on the behavioural assumptions chosen and the slopes of the two curves. The derivation of the system (9-10-bis) gives the variations of the equilibrium quantities along the two curves in the (Y, p) plan.

$$\left(\frac{\partial \boldsymbol{p}}{\partial \boldsymbol{Y}}\right)_{\textit{Price Curve}} = \frac{1}{Y(1-\mathrm{g})}\left(l\,w\,\varepsilon_w + \frac{\tau_E\,E}{Y}\right)$$

$$\left(\frac{\partial \boldsymbol{p}}{\partial \boldsymbol{Y}}\right)_{\textit{Demand Curve}} = \frac{p_E^*\,e}{X\left(1-\varepsilon_X\right)}$$

The local responses of wages and trade being given by the corresponding elasticities:

$$\varepsilon_w = +\frac{Y}{w}\;\frac{\partial \boldsymbol{w}}{\partial \boldsymbol{Y}}$$

$$\varepsilon_X = -\frac{p}{X}\;\frac{\partial \boldsymbol{X}}{\partial \boldsymbol{p}}$$

The assumption of positive correlation between wages and production (negative with unemployment) implies that the price curve is always upward sloping, whereas the slope of the demand curve changes with the value of the trade elasticity. A geometrical representation of four different cases is given in Figure 1.

Case 1: **The Marshall-Lerner condition holds for non-energy goods ($\varepsilon_X > 1$)**. The demand curve is downward sloping. At 'too high' level of production ($Y>Y_0$), the wage-setting ambitions, as expressed by the price curve, are too strong, and the price is too high to be consistent with the equilibrium of the trade balance. The labour costs must decrease up to the point where the wage-setting ambitions no longer create a trade deficit. This holds whatever is the assumption regarding the response of wages (the value of elasticity ε_W).

Case 2: **A price variation does not affect the balance of trade for non-energy goods ($\varepsilon_X = 1$)**. The slope of the demand curve is locally vertical. Any price variation induces a net trade variation of non-energy goods (***X***) that leaves unchanged the trade balance in value (***p X***). Starting from a balanced current account, the initial level of production and energy imports are the only ones that leave the current account in equilibrium. The level of price is independently determined by the wage-setting ambitions (expressed by the price curve).

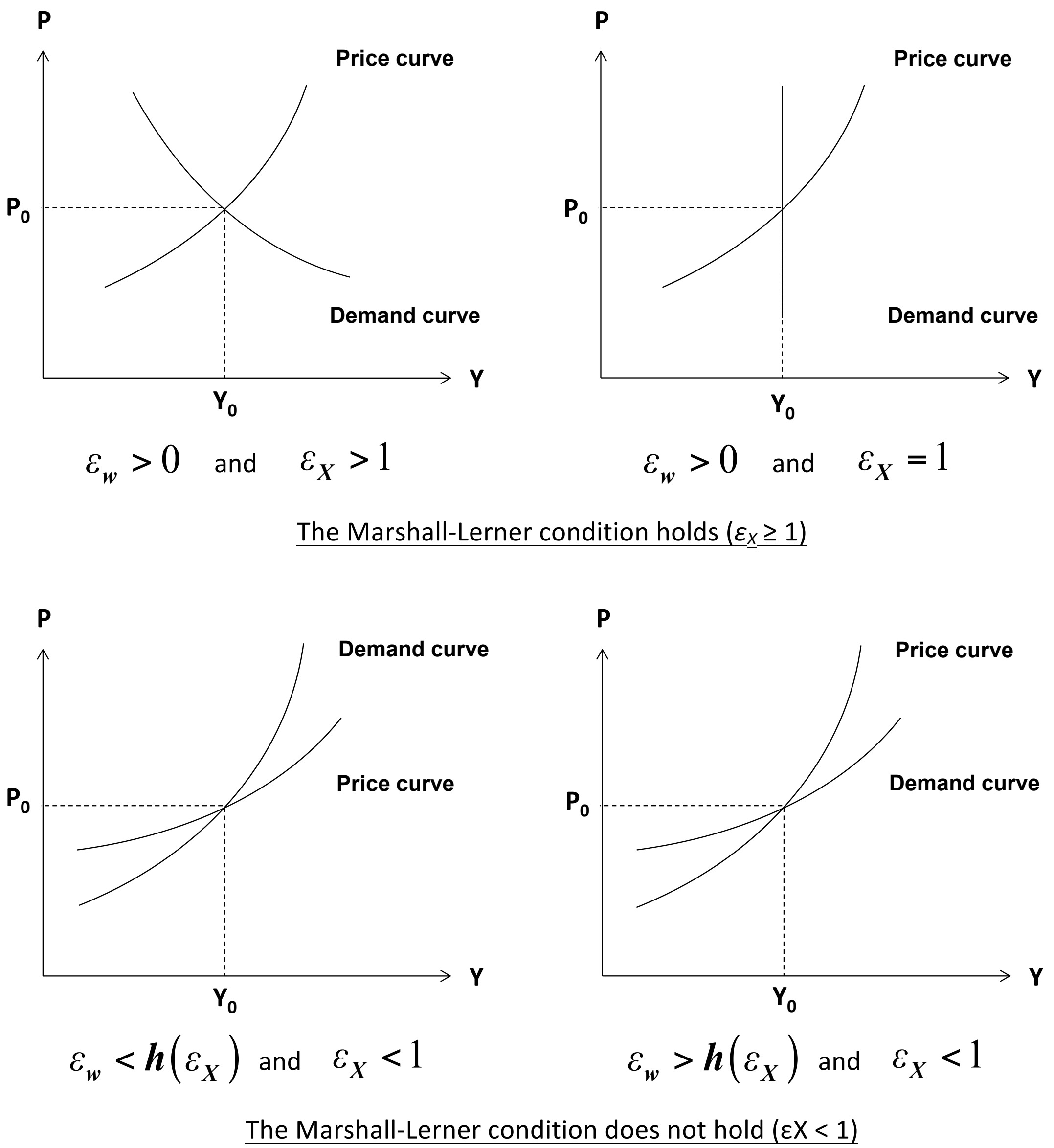


Figure 1 **Determination of domestic price and production**

Case 3: **The Marshall-Lerner condition does not hold for non-energy goods ($\varepsilon_X < 1$).** If the country has important non-price comparative advantages and strong relative power on international markets, the demand curve is upward sloping as well. The general equilibrium properties then depend on the relative slopes of the two curves, which depend in turn on the relative values of trade and wages elasticities. Equality between the two expressions of the slopes gives a limit condition which links those values and delineates two sub-cases:

$$\overline{\varepsilon_w} = \boldsymbol{h}(\varepsilon_X) = \frac{1}{l\,w}\left[\frac{Y\,(1-\mathrm{g})\,p_E^*\,e}{X\,(1-\varepsilon_X)} - \frac{\tau_E\,E}{Y}\right]$$

Sub-case 3-a: **The Marshall-Lerner condition does not hold ($\varepsilon_X < 1$) and the autonomy of domestic wages with respect to foreign prices is 'rather weak' ($\varepsilon_w < h(\varepsilon_x)$)**. In this case, the demand curve is steeper than the price curve. At 'too high' level of production ($Y>Y_0$), the wage-setting are too weak to be consistent with the equilibrium of the trade balance. However, any further increase in wage and price would create an even higher trade surplus in value ($\boldsymbol{p\,X}$). Wage and price must decrease along with production up to the point where the wage-setting ambitions match with the equilibrium of the trade balance.

Sub-case 3-b: **The Marshall-Lerner condition does not hold ($\varepsilon_X < 1$) and the autonomy of domestic wages with respect to foreign prices is 'rather strong' ($\varepsilon_w > h(\varepsilon_x)$)**. The price curve is steeper than the demand curve. At 'too high' level of production ($Y>Y_0$), the wage-setting ambitions are too strong to be consistent with a balanced current account. However, this time, this high wage level induces a trade surplus. Wage and price must decrease along with production to restore consistency between the wage ambitions and a balanced trade.

When the two curves are parallel ($\varepsilon_w = h(\varepsilon_x)$), there may be either a local disappearance of the general equilibrium or a local multiplicity of equilibria. For a given a level of production, if the price curve is above, the price level consistent with the wage elasticity will induce a trade surplus. This surplus could only be resorbed by importing more energy and by producing more (and therefore, a different level of production). The reverse occurs if the price curve is below: a trade deficit, lower energy imports, and lower production. In both cases, there is inconsistency between the wage-setting behaviour and the equilibrium of the trade balance. If the two curves locally superimposed on each other, there is several possible values for price and output consistent with a balanced trade and the process of wage formation. Thus, for those particular values of elasticities, a more global analysis is required[11].

[11] A non-marginal analysis would require at least an upper bound for $\boldsymbol{Y}$ to reflect some limited level of production capacities. It would also be necessary to completely specify the behavioural functions for trade $\boldsymbol{X}(.)$ and domestic wages $\boldsymbol{w}(.)$.

4. Marginal tax reform

Starting from a given initial tax structure (τ_L, τ_E), we now consider a small increase in energy tax $d\tau_E$ and its effect on the economic system ($\boldsymbol{p}$, $\boldsymbol{Y}$). If we take as given the public budget constraint g ($\boldsymbol{p}$, $\boldsymbol{Y}$), the labour tax τ_L must adjust to meet the budgetary objective. The marginal reform is equivalent to an increase in the relative taxation of labour and energy.

In this paper, we will only consider one particular budgetary constraint. Public administrations require a certain level of resources to finance some public activities. However, instead of taking constant the level of real public consumption $\boldsymbol{G}$ whatever the economic conditions are, we assume this consumption level to remain proportional to the size of the whole economy. Formally, the ratio $\boldsymbol{G}$ to $\boldsymbol{Y}$ is constant and equal to its initial value g. As we shall see, this assumption has the advantage of being neutral for the relative impact of the reform on household demand and net exports. It is a way to isolate the consequences of the relative pricing of energy and labour from the consequences of different adjustment of the 'weight of the state' (the relative shares of public and private resources and expenditures)[12]. This is nevertheless a difference from the assumption made in the 'double dividend literature' since the paper of Bovenberg and de Mooij (1994). However, considering $\boldsymbol{G}$ as constant adds some complications. Maintaining this level of consumption requires an adjustment of public expenditures that works as an additional adjustment policy[13].

The two direct economic impacts of a relative high level of energy taxation τ_E appear clearly in equations 9 and 10/10-bis. 1) On the one hand, higher energy taxation tends to *reduce the tax burden on production costs*. Equation 9 shows that this tax burden is alleviated by the amount of energy tax paid by households ($\tau_E \ E$) and apportioned between units of domestic production ($\boldsymbol{Y}$). Although producers pay higher energy tax, this new burden is fully offset by the recycling-option (lower labour tax). 2) On the other hand, relative high energy taxation tends to *weight on the purchasing power of households* and to push down domestic consumption (equation 10). This second direct impact also depends on the energy

[12] Although in real policies these two dimensions interact.

[13] $\boldsymbol{g}(\boldsymbol{Y},\boldsymbol{p}) = \boldsymbol{g}(\boldsymbol{Y})$ = G/**Y** where G is a constant. An additional mechanism appears and modifies the slope of the price curve (the term $\frac{1}{\left[Y\left(1-\mathrm{g}\right)\right]^2}\left(w\,l \;+\; p_E^*\,e \;-\; \frac{\tau_E\,E}{Y}\right)$ is added to the derivative of equation 9).

dependence of households, but it may be offset by the adjustment of price, wage and external trade. Under the constraint of a balance of trade in equilibrium, the relative taxation of energy and labour only directly affects the price curve (*cf.* system 9-10-bis). In all cases, an increase in the relative taxation of energy makes the slope of the price curve steeper[14]. The net consequences on equilibrium quantities then depend on the relative slopes of the curves. As described before, we encounter different configurations depending on the assumptions made about the wage and trade reactions. A geometrical representation is given in Figure 2 and the corresponding mathematical computation in appendix.

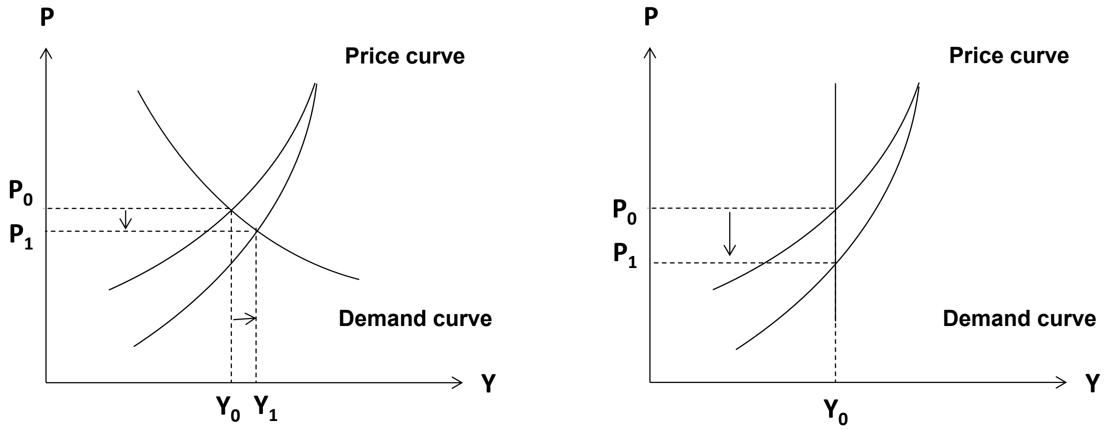
Case 1: **A net production gain if $\varepsilon_X > 1$** (The Marshall-Lerner condition holds). The reform reduces the domestic production price and increases production and employment if net exports vary by more than 1% in response to a variation of 1% in domestic costs and price. This result is insensitive to the assumption made about the response of wages (ε_W).

Case 2: **No variation of production if $\varepsilon_X = 1$**. The reform reduces the domestic production price. However, demand is not affected when net exports exactly vary by 1% in response to a 1% variation of domestic costs (no nominal change in the balance of trade for non-energy goods). This result is insensitive to assumptions on wage behaviour (ε_W).

Sub-case 3-a: **A net production gain if $\varepsilon_W > h(\varepsilon_X)$ and $\varepsilon_X < 1$** (The Marshall-Lerner condition does not hold). For 'rather low' sensitivity of net exports to production price and 'sufficiently high' sensitivity of net wages to domestic employment, the reform decreases the domestic costs of production and increases production and employment.

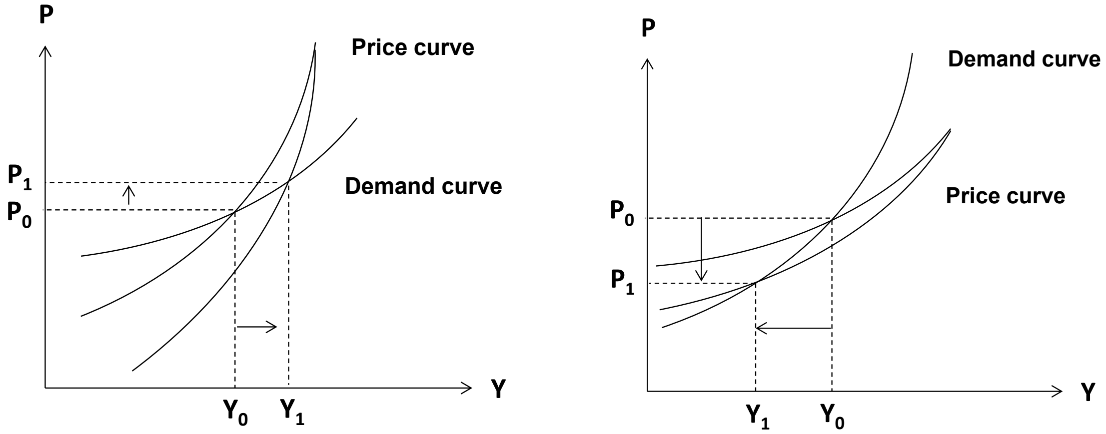
Sub-case 3-b: **A net production loss if $\varepsilon_W < h(\varepsilon_X)$ and $\varepsilon_X < 1$** (The Marshall-Lerner condition does not hold). For 'rather low' sensitivity of net exports to production price and 'sufficiently low' sensitivity of net wages, the reform increases the domestic costs of production and increases production and employment.

[14] The slope of the price curve is increased by $\frac{1}{(1-g)}\frac{\partial \tau_E E}{Y^2}$. The reform has no marginal impact only if the initial energy tax is zero.



$\varepsilon_w > 0$ and $\varepsilon_X > 1$ $\qquad$ $\varepsilon_w > 0$ and $\varepsilon_X = 1$

The Marshall-Lerner condition holds (εX ≥ 1)



$\varepsilon_w > \boldsymbol{h}(\varepsilon_X)$ and $\varepsilon_X < 1$ $\qquad$ $\varepsilon_w < \boldsymbol{h}(\varepsilon_X)$ and $\varepsilon_X < 1$

The Marshall-Lerner condition does not hold (εX < 1)

Figure 2 Consequences of the reform on domestic price and production

5. General equilibrium mechanisms

The underlying mechanisms can be clarified by looking at the signs of the other derivatives. Given the previous examination, this task may be limited to the analysis of the variation of the domestic consumption ***C***. We can easily deduce it from the price variation, a central variable of the system. The variations of the other variables are trivial. Net exports evolve in the opposite direction to price, and wages and production to unemployment.

It is easy to determine the sign of the consumption variation by assuming only a quite acceptable empirical restriction on our problem. Combining the equations of the balance of trade and the supply-use balance in the non-energy product market, and differentiating, it is straightforward to see that (*cf.* mathematical appendix for details):

$$\frac{\boldsymbol{C'}}{\boldsymbol{p'}} = \frac{1-\mathrm{g}}{p_E^* \, e} X \left[1 + \left(\frac{p_E^* \, e}{p\,(1-\mathrm{g})} - 1 \right) \varepsilon_X \right]$$

Therefore, the signs of consumption and price variations are the same if and only if $1 + \left(\frac{p_E^* \, e}{p\,(1-g)} - 1 \right) \varepsilon_X > 0$. Different cases are mathematically possible. Nevertheless, empirical considerations suggest that one may quite well restrict the analysis to the economic cases where $\frac{\boldsymbol{s_E}}{(1-g)} = \frac{p_E^* \, e}{p\,(1-g)} < 1$. Otherwise, the analysis would concern economies characterised by a share s_E of net-of-tax energy costs in total production costs exceptionally high and/or a volume of public expenditures *G* exceptionally high compared to the volume of private expenditures (*C* and *X*). To give an idea of the order of magnitude involved: in France, we observe in 2004 data that the pre-tax energy costs accounted for 0.4% of total costs on average, whereas public consumption and investment accounted for 15% of total production. Therefore, the ratio being equal to 0.005 is far below unity.

Under this restriction, the signs of consumption and price variations are the same if and only if $\frac{1}{\left(1 - \frac{\boldsymbol{s_E}}{(1-g)} \right)} > \varepsilon_X$. This condition is always satisfied if $\varepsilon_X < 1$, because $\frac{\boldsymbol{s_E}}{(1-g)} > 0$

Consequently, the domestic consumption varies in the same direction as the domestic price when $\varepsilon_X < 1$, and in the opposite direction when $\varepsilon_X > 1$.

Table 1 summarises the directions of change of all model variables.

Cases	Domains	dz	dY	dw	dp	dC	dX
1	$\varepsilon_X > 1$	-	+	+	-	+	+
2	$\varepsilon_X = 1$	0	0	0	-	-	+
3a	$\varepsilon_w > h\ (\varepsilon_X)$ & $\varepsilon_X < 1$	-	+	+	+	+	-
3b	$\varepsilon_w < h\ (\varepsilon_X)$ & $\varepsilon_X < 1$	+	-	-	-	-	+

Table 1 **Directions of change of all economic variables for different assumptions about wage and trade reactions**

The general equilibrium mechanisms appear now more clearly.

Case 1: **a net production and employment gain if $\varepsilon_X > 1$**. For economies with high trade exposure - for which 'price-competitiveness' considerations are crucial - the marginal reform benefits all macroeconomic indicators (production, wages, domestic consumption and exports). The positive impact on production costs dominates the negative impact on domestic consumption. Consequently, the reform benefits external trade. The increase in wage incomes and the decrease in price more than compensate the increase in energy bills.

Case 2: **no change in production and employment if $\varepsilon_X = 1$.** The trade balance for non-energy goods is not affected by the lower tax burden on domestic costs of production. Therefore, the reform does not affect energy imports, production, and wage incomes. However, the purchasing power of domestic agents decreases. The lower price level for non-energy goods does not compensate the higher cost for energy consumption. Nevertheless, in this case, the increase in exportations exactly offsets the lower level of domestic demand.

Case 3a: **a net production and employment gain if $\varepsilon_W > h\ (\varepsilon_X)$ and $\varepsilon_X < 1$**. Economies with low levels of trade exposure and certain levels of wage autonomy benefit from the marginal reform. An increase in domestic wages compensates the higher energy bills of domestic agents. The effect on consumption is positive, and this positive effect overcomes the negative impacts of higher wages on domestic costs and external trade.

Case 3b: **a net production and employment loss if $\varepsilon_W < h\ (\varepsilon_X)$ and $\varepsilon_X < 1$**. Economies with low levels of trade exposure does not benefit from the marginal reform if the sensitivity of wage is 'rather low'. This time, the negative effect on the domestic consumption of non-energy products dominates the positive effect on production costs. The reform benefits external trade, however this is not enough to compensate the higher energy bills of domestic agents. In this case, wage incomes do not maintain the purchasing power of households, and the drop in domestic demand exceeds the limited gains from trade.

6. Sensitivity to the behaviour of the economy

Let us now summarize the previous results regarding the sensitivity of the evaluation to assumptions about the uncertain functioning of the economy: the responses of wages and trade (ε_X, ε_W). Different values of elasticities (from zero to infinite) would reflect different contexts or beliefs about the response of the economy. As before, we nevertheless consider that, *ceteris paribus*, higher unemployment goes along with lower relative wage ('wage moderation'), and higher production costs with lower trade surplus for non-energy goods[15].

Figure 2 displays the three different domains on the (ε_X, ε_W) plane for any initial state of the economy. In the domain where the Marshall-Lerner condition for non-energy goods does not hold ($\varepsilon_X <1$), the limit condition $\overline{\varepsilon_w} = \boldsymbol{h}\left(\varepsilon_X\right)$ has been drawn[16]. As noticed above, this condition does not define an optimum for the tax structure (i.e. Y'≠0 along the ***h*** curve). When this relation between trade and wage elasticities holds, the evaluation is locally ambiguous, and it must be extended to a more global analysis. An increase in the relative taxation of energy can either lead to a disappearance of the general equilibrium or a multiplicity of equilibria.

[15] Recall that we consider an energy importing economy that requires a trade surplus to finance its energy imports and balance its external account (see equation 10 above).

[16] Empirical considerations tend to suggest that the value for which the curve cross the abscissa axis is positive. Indeed, $\overline{\varepsilon_w}\left(0\right) = \boldsymbol{h}\left(\varepsilon_X = 0\right) = \frac{1}{l\,w}\left[\frac{\left(C+X\right)p_E^{*}\,e}{X} - \frac{\tau_E\,E}{Y}\right]$ and the value of private demand for non-energy goods and services (C+X) is larger than that of final energy consumption *E* alone.

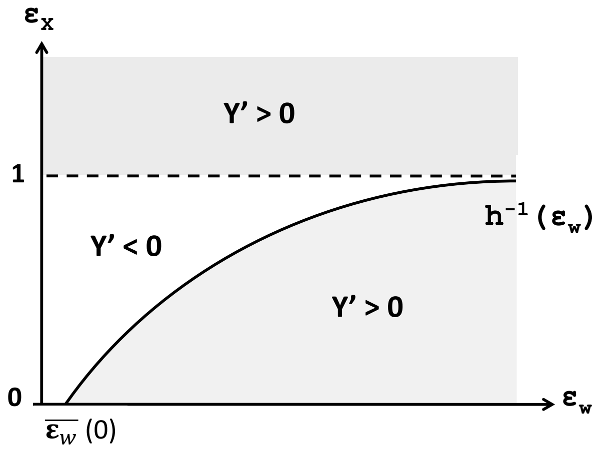


Figure 2 **Net consequences on production**
Sensitivity to the functioning of the economy (ε_X, ε_W)

7. Sensitivity to the initial state of the economy

A relevant issue, when we come to the empirical discussion about the initial state of the economy, is to understand the 'favourable' conditions for which the domain of loss (Y'<0) is narrowed. A narrow domain will limit the range of trade and wage elasticities (ε_X, ε_W) for which the reform implies a loss of production and employment. Note that this analysis does not preclude practitioners from discussing the 'true values' of these elasticities. The reform would actually cause a production loss if the range is narrowed but includes those values.

A simple way to do this is to examine the characteristics of the initial conditions for which the shape of function ***h*** is modified and the domain above is narrowed (see Figure 3).

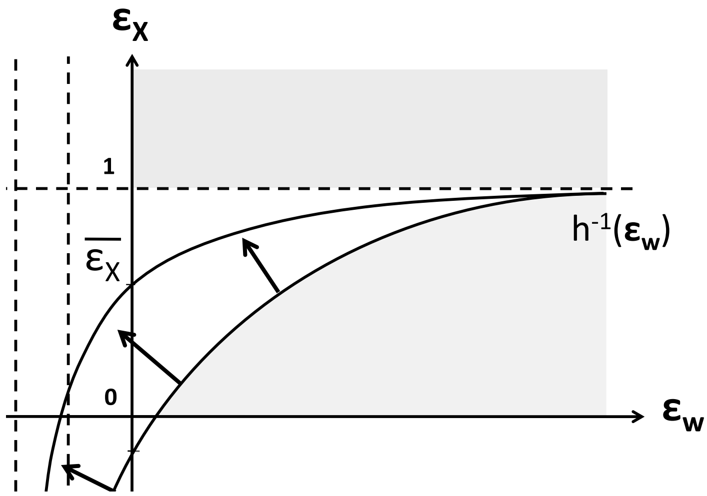


Figure 3 **Initial conditions for a narrow domain of macroeconomic loss**

We see graphically that the second domain is narrowed when the value of $\overline{\varepsilon_X}$ tends to be close to 1, the value of $\overline{\varepsilon_w}$ is low or negative, and the curvature of h^{-1} is pronounced. Looking at the corresponding expressions, we easily determine the favourable conditions.

$$\overline{\varepsilon_w}(0) = \boldsymbol{h}(\varepsilon_X = 0) = \frac{1}{l\,w}\left[\frac{(\mathrm{C}+X)\,p_E^*\,e}{X} - \frac{\tau_E\,E}{Y}\right]$$

$$\overline{\varepsilon_X}(0) = \boldsymbol{h}^{-1}(\varepsilon_w = 0) = 1 - \left(\frac{(\mathrm{C}+X)\,p_E^*\,e}{X}\,\frac{Y}{\tau_E\,E}\right)$$

$$\boldsymbol{h}'(\varepsilon_X) = \frac{1}{l\,w}\,\frac{(\mathrm{C}+X)\,p_E^*\,e}{X}\,\frac{1}{(1-\varepsilon_X)^2}$$

The domain of loss is narrowed when the following economic circumstances prevail:

- The final energy consumption is high (E),
- The intermediate energy consumption in production is low (e),
- The import price of energy is low (p_E*),
- The level of production is low (Y), and unemployment is high,
- The net-of-tax labour costs are low (wages w are low, labour intensity *l* is low),
- Internal demand for domestic goods (C) is high compared to external trade (X),
- The relative taxation of energy compared to labour is initially high (τ_E).

These conditions tend to increase the tax transfer away from production costs. As noticed above, the tax reallocation effect and the sharing of its consequences between a gain of trade and a wage progression determine the net effect of the reform on production and employment. Intuitively, this tax reallocation effect is positive and stronger when the reform ends up by taxing more final consumption than production costs. This is the case, for energy-dependent economies, when the energy consumption of households is high and the energy consumption of producers is low. In this case, the more labour costs (or labour incomes) are initially low (e.g. if unemployment is high and wage development low), the more the additional tax revenue raised on final energy consumption reduces production costs (or increases wages).

The import price of energy p_E* plays a role in a feedback mechanism induced by any initial change in production. An additional quantity of energy is required to produce an additional unit. We see from the accounting identity of the balance of trade (equation 8) that a low import price of energy limits the additional energy bill. Therefore, more production gains are allowed, while the current account remains balanced.

The initial relative level of energy taxation τ_E is involved in another feedback mechanism. Looking at the last term of the price curve (equation 9), we easily understand its positive effect on the tax reallocation mechanism. A first increase in production reduces the amount of tax reduction available for each unit produced. The higher is the initial amount of tax raised on the energy consumption of households, the smaller is this 'dilution' effect.

8. Concluding remarks

The previous analysis has been focusing on the signs of the macroeconomic consequences of a small change in the relative price of energy and labour. A simple macroeconomic model of energy dependent and open economy has been used. This model, however, can represent various sub-optimal situations. Unemployment may be caused both by wage rigidities in the labour market and excess supply in the product market. On the other hand, an extreme case of energy dependent economies has been considered. Energy needs are completely rigid, both in production and final consumption, and imported from abroad. Therefore, the response to changes in the relative price of energy and labour is only determined by two behavioural parameters: the responses of net wages and external trade.

The analysis displays a mechanism from which a tax shift from labour to energy affects employment. The qualitative result is sensitive, however, to wages and external trade reactions. If the external trade for non-energy products is sufficiently sensitive to production costs (the Marshall-Lerner condition holds), the reform increases employment by shifting the tax burden away from production costs to consumers' incomes. When trade is less sensitive to production costs, what matters the most is the domestic market. The effect on employment is positive if wages adjust to compensate the higher final energy bills of consumers, and thus, maintain the level of internal demand.

The main lesson is in line with the theoretical literature on the 'double dividend hypothesis' (Goulder, 1995; Bovenberg, 1999) and more generally the literature on 'second-best optimal taxation in the presence of externalities' (Sandmo, 1975, Cremer et al., 1998): There is no general law about the opportunity of getting a positive net gain in terms of employment. The evaluation depends on the combination of assumptions made about the reactions of wages and trade. However, the present analysis assumes a different set of plausible assumptions: a high level of rigidity in energy needs, different levels of rigidities in domestic wages, and different levels of sensitivity of external trade to the domestic costs of production. Although the primary objective of an energy-environmental tax reform to induce technical change and substitutions away from energy, it remains important to show that the reform does not necessarily depress the economy even during the transition period, when such substitutions are not yet available. This is important to show, indeed, particularly in the aftermath of the crisis, since the opposite argument is often used to oppose and postpone environmental pricing policies and higher energy taxes.

However, a number of extensions must be considered. The previous analysis has assumed a small country and a unilateral fiscal policy. In the case of coordinated climate-energy policies, the fossil energy producing countries may react by adjusting their supply. The international price of energy p_E* would respond to the reform. The price of non-energy goods p* may also respond, since the supply of the country on international markets changes. At longer runs, the reform will induce a technical change and release energy saving potentials. Technical coefficients (l, e) and final energy needs (E) will change. The real and nominal wage rigidities may also be reduced. The way wages will adjust in the long run depends on the theories of unemployment (Malinvaud, 1982; Solow, 1986). Following Malinvaud (1977), it would be enlightening to locate these different theories in the (ε_X, ε_W) space. Other important dimensions are particularly important for policy discussions. The sensitivity of the results to the description of the initial situation shows the need of pushing forward the analysis by looking more closely at the empirics of each specific case (as it is true, in general, for 'second best' policy evaluations outside the perfectly competitive model, Drèze and Stern, 1987). In concrete policy contexts, the fiscal policy will coexist and interact with the budgetary policy and other adjustments of tax rates. Finally, and most importantly, distributional issues have to be included into the analysis. The impacts on production costs and prices P, international trade X and consumption C will vary greatly among agents and productive sectors, depending on the relative energy dependence of producers and consumers (who face different technical, economic and geographical constraints). Second, the development and use of numerical models is required to pursue the analysis by considering non-marginal policies at different future time horizons, while relaxing the oversimplifying assumptions required here to solve analytically the system.

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Mathematical Appendix

Variations of price and production

$$\boldsymbol{p} \;=\; \frac{1}{1-\boldsymbol{g}(\boldsymbol{Y},\boldsymbol{p})}\left[\; w(\boldsymbol{Y})\,l \quad + \quad p_E^*\,e \quad - \quad \frac{\tau_E\,E}{\boldsymbol{Y}} \;\right]$$

$$\boldsymbol{Y} \;=\; \frac{1}{p_E^*\,e}\;\left[\,\boldsymbol{p}\,\boldsymbol{X}(\boldsymbol{p}) \;-\; p_E^*\,E\,\right]$$

Differentiation gives:

$$(1-\mathrm{g})\,\boldsymbol{p}' \;=\; l\,\frac{w}{Y}\,\varepsilon_{\mathrm{W}}\,\boldsymbol{Y}' \;-\; \frac{E}{Y} \;+\; \frac{\tau_E\,E}{Y^2}\,\boldsymbol{Y}'$$

$$p_E^*\,e\,\boldsymbol{Y}' \;=\; \boldsymbol{p}'\,X\,(1-\varepsilon_{\mathrm{X}})$$

Where ***p'*** and ***Y'*** stand for the variations of the equilibrium quantities. We can notice right now a special result.

- If $\varepsilon_W = 1$, then Y'=O and $\boldsymbol{p}' = -\dfrac{E}{(1-\mathrm{g})\,Y} > 0$

After solving the system, we get the expressions of the price and production variations.

$$\boldsymbol{p}' \;=\; p_E^*\,e\,\frac{E}{X\,(1-\varepsilon_{\mathrm{X}})\left(l\,w\,\varepsilon_{\mathrm{W}} + \dfrac{\tau_E\,E}{Y}\right) \;-\; Y\,(1-\mathrm{g})\,p_E^*\,e}$$

$$\boldsymbol{Y}' \;=\; X\,(1-\varepsilon_{\mathrm{X}})\,\frac{E}{X\,(1-\varepsilon_{\mathrm{X}})\left(l\,w\,\varepsilon_{\mathrm{W}} + \dfrac{\tau_E\,E}{Y}\right) \;-\; Y\,(1-\mathrm{g})\,p_E^*\,e}$$

The sign of the denominator depends on the value taken by ε_X.

- If $\varepsilon_X > 1$, the denominator is negative, thus p'<0 and Y'>0.

- If $\varepsilon_X < 1$, the denominator is positive if and only if:

$$\varepsilon_w > \overline{\varepsilon_w}\left(\varepsilon_X\right) = \boldsymbol{h}\left(\varepsilon_X\right) = \frac{1}{l\,w}\left[\frac{Y\left(1-\mathrm{g}\right)p_E^*\,e}{X\left(1-\varepsilon_X\right)} - \frac{\tau_E\,E}{Y}\right]$$

In this case, Y'>0 and p'>0

- If $\varepsilon_X < 1$, the denominator is negative if and only if:

$$\varepsilon_w < \overline{\varepsilon_w}\left(\varepsilon_X\right) = \boldsymbol{h}\left(\varepsilon_X\right)$$

In this case, Y'<0 and p'<0

Variation of consumption

The market balance in quantities for non-energy goods gives:

$$\boldsymbol{Y} = \frac{1}{\left(1-\mathrm{g}\right)}\left[\boldsymbol{C} + \boldsymbol{X}\left(\boldsymbol{p}\right)\right]$$

Combining with equation 11-bis from the balance of trade:

$$\boldsymbol{Y} = \frac{1}{p_E^*\,e}\left[\boldsymbol{p}\,\boldsymbol{X}\left(\boldsymbol{p}\right) - p_E^*\,E\right]$$

We get the following expression of domestic consumption.

$$\boldsymbol{C} = \boldsymbol{X}\left(\boldsymbol{p}\right)\left(\boldsymbol{p}\,\frac{1-\mathrm{g}}{p_E^*\,e} - 1\right) - \frac{1-\mathrm{g}}{e}\,E$$

Differentiation gives:

$$\boldsymbol{C}' = -\frac{X}{p}\,\varepsilon_X\,\boldsymbol{p}'\left(p\,\frac{1-\mathrm{g}}{p_E^*\,e} - 1\right) + X\,\frac{1-\mathrm{g}}{p_E^*\,e}\,\boldsymbol{p}'$$

Where C' and p' stand for the variations of equilibrium quantities.

This is equivalent to:

$$\frac{\boldsymbol{C}'}{\boldsymbol{p}'} = \frac{1-\mathrm{g}}{p_E^*\,e}\,X\left[1 + \left(\frac{p_E^*\,e}{p\left(1-\mathrm{g}\right)} - 1\right)\varepsilon_X\right]$$

Thus, the variation of consumption can be deduced from the previous examination of the variation of price. Under the restriction that $\frac{p_E^* e}{p(1-g)} < 1$ (see the empirical considerations given in section 5), the two variables evolve in the same direction when $\varepsilon_w \leq 1$ and in the opposite direction when $\varepsilon_w > 1$. And therefore,

- If $\varepsilon_X > 1$, then p'<0, and therefore, C'>0.
- If $\varepsilon_X = 1$, then p'<0, and therefore, C'<0.
- If $\varepsilon_X < 1$ and $\varepsilon_w > \overline{\varepsilon_w}(\varepsilon_X) = \boldsymbol{h}(\varepsilon_X)$, then p'>0, and therefore, C'>0.
- If $\varepsilon_X < 1$ and $\varepsilon_w < \overline{\varepsilon_w}(\varepsilon_X) = \boldsymbol{h}(\varepsilon_X)$, then p'<0, and therefore, C'<0.