ELSEVIER
www.elsevier.com/locate/worlddev

World Development Vol. 51, pp. 119–131, 2013

0305-750X/$ - see front matter

http://dx.doi.org/10.1016/j.worlddev.2013.05.013

Are Carbon Taxes Good for the Poor? A General Equilibrium Analysis for Vietnam

IAN COXHEAD
University of Wisconsin-Madison, USA

ANAN WATTANAKULJARUS
National Institute of Development Administration, Bangkok, Thailand

and

CHAN V. NGUYEN *
National Economics University, Hanoi, Viet Nam

Summary. — We evaluate effects of an environmental tax using a general equilibrium model linked to a household database. The burden of the tax, applied mainly to energy, is passed forward by non-tradable industries and backward by tradable industries facing fixed world prices. The tax is thus equivalent to a real exchange rate appreciation, and since export industries are labor-intensive, reduces employment, and increases poverty, especially when labor supply is responsive to wages. The use of revenues to increase transfers to households can offset poverty increases, but does not create jobs; thus the tax will likely conflict with other development policy objectives.

Key words — carbon tax, environmental tax, poverty, labor market, general equilibrium, Vietnam

1. INTRODUCTION

In December 2012 the Government of Vietnam implemented its first law on environmental taxation. [1] The law mandated new taxes on coal, gasoline and other fossil fuels, pesticides, and some other products. As such it bears a strong similarity to carbon taxes being implemented or debated in other countries. Such taxes have far-reaching economic effects, so as in other countries, there is considerable uncertainty over their economic implications. It is likely that reaching their nominal objectives—reduced growth rates of emissions from carbon-based fuels—will also require changes in the structure of production, employment, wages, and prices, and that these changes in turn will affect the levels and distribution of household incomes. In trade-dependent low-income economies like Vietnam, therefore, the effort to reduce emissions raises additional concerns at points where it intersects with other primary targets of development policy. Do energy taxes alter the competitiveness of industries producing exports and import substitutes? Do they alter prospects for employment growth? What effects do they have on poverty? If adverse effects are sufficiently large, policymakers may be compelled to choose among development policy priorities.

In this paper we evaluate the likely economic impacts and incidence of Vietnam's environmental tax law. The scope of the law ensures that its impacts will be felt throughout the economy. Accordingly, we adopt a general equilibrium approach, taking account of known economic linkages among production activities, employment, wages, household incomes, consumer expenditures, trade, government revenues, and other important macroeconomic variables. This methodology facilitates a relatively complete assessment of the impacts and incidence of the tax. We quantify the consequences of the tax for production, employment, and wages—and consequently for household income and poverty. This in turn requires a discussion of some important parameters about which relatively little is known. Among these are elasticities of labor supply. The environmental tax affects real wages through a number of channels, and the effect of real wage changes on labor supply determines aggregate employment effects as well as contributing to distributional and poverty outcomes. Our examination of the labor supply issue is threaded throughout the paper.

Environmental policy issues in Vietnam have received limited prior attention from a general equilibrium perspective. El Obeid, Van der Mensbrugghe, and Dessus (2002, chap. 9) used a small general equilibrium model to examine the structural effects of trade policy reforms and environmental policy initiatives, focusing on measuring changes in emissions of air and water pollution and solid waste, but did not explore welfare and distributional questions. In a concurrent study Willenbockel (2011), using a smaller version of the database that we do, explores structural impacts of the environmental tax law. His study includes a helpful exploration of the longer-run issue of tax-induced substitution among energy sources as well as careful predictions of environmental outcomes. We complement this approach by focusing on welfare issues arising from the incidence of the tax as transmitted through factor

* The authors thank Le Dong Tam, Kim Tran Dung, and Kim Pho Chi for research assistance, The Ford Foundation and the Graduate School of the University of Wisconsin-Madison for financial support, and conference/seminar participants at the University of Waikato, the National Institute of Development Administration (Bangkok), the Midwest International Economic Development Conference, Madison, WI, and two anonymous reviewers for helpful comments on earlier drafts. Address for correspondence: coxhead@wisc.edu. Final revision accepted: May 15, 2013.

markets and alternative fiscal mechanisms, and map results to a complete household survey database. In doing so, as noted above, we draw attention to incipient tradeoffs among development policy goals.

The remainder of the paper proceeds as follows. In Section 2 we review relevant tax incidence concepts and theory. Section 3 introduces the model and its main datasets. We describe the environmental tax simulation experiment in Section 4, and discuss the results in Section 5. In a final section we draw some conclusions and identify areas for future research.

2. TAX INCIDENCE IN AN OPEN ECONOMY

The economic incidence of a tax differs from its statutory (direct) incidence. Those on whom the statutory burden falls pass the cost of the tax on, through markets, to consumers and the suppliers of labor and other factors (Atkinson & Stiglitz, 1980). The extent to which tax burden is passed forward (to consumers) or backward (to factor owners) depends on behavioral and technological responses to the tax—for example the elasticity of consumer demand for a product, or the extent to which a less highly taxed input to production may be substituted for a more highly taxed one. In general, tax burden is redistributed according to relative magnitudes of relevant elasticities of demand or supply. The less elastic is demand by purchasers of a taxed item, the more likely it is that the tax will be passed forward. In the event that demand is elastic, the burden will instead be passed backward to factors. In that case, the distribution of the burden among factors will depend, in part, on relative values of their supply elasticities. The values of such parameters are thus crucial to the economic incidence of a tax. [2] Moreover, so long as agents are heterogeneous in terms of the services that they supply to factor markets, the conditions under which they supply them (e.g., reservation wages), and/or the preferences they exhibit as consumers, then the shifting of the tax burden has consequences for income distribution in addition to its impacts on aggregate welfare.

These general observations come into sharp focus in small open economies, where the differences between domestic and foreign markets become important to overall tax incidence. Suppose (for simplicity) that the supply of an exportable good produced by homogeneous domestic firms is inelastic, so demand (D) is the main determinant of its price. Denoting foreign and home markets by f and h, respectively, we have $D = D^f(p_f) + D^h(p_h)$, with $\partial D^i/\partial p_i < 0$, $i = f, h$. Using the total differential to find the change in total demand,

$$dD = \frac{\partial D^f}{\partial p_f} dp_f + \frac{\partial D^h}{\partial p_h} dp_h.$$

If we multiply and divide the first right-hand side term by $D^f p_f$ and the second by $D^h p_h$ then divide the whole by D, we have

$$\widehat{D} = \frac{dD}{D} = \varepsilon_f \theta_f \hat{p}_f + \varepsilon_h (1 - \theta_f) \hat{p}_h,$$

where a "hat" denotes the proportional change in a variable; $\varepsilon_i = (\partial D^i/\partial p_i)/(p_i/D^i)$ is the absolute value of the demand elasticity in the ith market, and θ_f is the foreign share in total demand. The change in total demand is a weighted sum of price changes in each market, where the weights are price elasticities and market shares. More intuitively, if we suppose that the good in question has close substitutes in both markets so that price changes are correlated, we can write $\hat{p}_f = \hat{p}_h = \hat{p}$, which (after more rearranging) yields

$$\frac{\hat{p}}{\widehat{D}} = \frac{1}{(\varepsilon_f - \varepsilon_h)\theta_f + \varepsilon_h}.$$

The change in the price of a good with respect to demand growth will be equal to $1/\varepsilon_h$ when there are no foreign sales, and $1/(\varepsilon_f - \varepsilon_h)$ when there are no domestic sales. In the small country case foreign demand is elastic, and therefore $\varepsilon_f > \varepsilon_h$. In industries whose output is sold primarily to the world market, price is unresponsive to demand shocks and the tax burden cannot be passed forward. In contrast, for industries producing non-traded or little-traded goods and services, demand is less elastic and prices are more responsive. These conditions apply particularly to suppliers of domestic services such as transportation, storage and trade, which are inputs to all other productive activities and have few substitutes. If the law of one price holds, then any tax affecting costs in these intermediate services will be passed forward until it reaches the border (that is, domestic industries competing directly with foreign producers), at which point it will 'bounce back' onto factors of production. This is easily seen by recalling that under constant returns to scale and competitive markets, price is equal to unit cost. Given a vector of primary factors $\mathbf{x}$ with prices $\mathbf{w}$ and an intermediate input z with tax-inclusive price $q(\pi) = q(1 + \pi)$, unit cost is $p = \mathbf{w}'\mathbf{x} + q(\pi)z$. Choose units of z such that $q = 1$. Then in proportional change form the zero-profit condition is:

$$\hat{p} = \sum_i \phi_i \hat{w}_i + \phi_z \hat{\pi},$$

in which the ϕ are cost shares and $\sum_i \phi_i + \phi_z = 1$. When the rate of the tax increases, p must rise, and/or some w_i must fall to maintain zero pure profits. If p is constrained from increasing by limit prices set in world markets, the burden of adjustment falls instead on factors. In its turn, the distribution of this loss among factors will be strongly influenced by their relative supply elasticities. We return to this point below.

If non-traded industries can pass the tax burden forward while those competing at the border cannot, then in the macroeconomy, a tax on a widely used input such as energy has effects analogous to those of a real exchange rate appreciation. It reduces the relative profitability of producing tradable goods and services, and so diminishes the country's competitiveness in world markets. This point is strikingly absent from standard carbon tax models, which omit or minimize the role of international trade (Fullerton & Heutel, 2007; Metcalf, 2008). The loss of tradable sector competitiveness opens (or widens) a balance of trade deficit, with a matching excess of domestic aggregate expenditure over income. For given international capital flows, [3] the elimination of these deficits requires a combination of expenditure reductions and a fall in the relative level of domestic prices so as to depreciate the real exchange rate. Among tradable industries, higher costs and lower profits cause tax burden to be passed back in the form of lower factor prices, and ultimately to household incomes. These are likely to be important components of the adjustment to a new equilibrium. Accordingly, the shifting incidence of the tax affects not only the structure of production and trade, but also factor prices and employment, and ultimately the distribution of household income and welfare.

(a) *Environmental taxes*

Environmental taxes are politically controversial, in part due to doubts over their efficacy, and in part because there is much uncertainty over their economic incidence. Economists have also struggled to identify incidence, whether in theoretical models or in quantitative analyses. Taxes on energy sources have inherently general equilibrium effects; stylized models have been used to explore structural issues (Copeland