Journal of Economics and Development Vol.13, No.1, April 2011, pp. 5 - 18 ISSN 1859 0020

Vietnam's environment protection tax: Possible impacts and incidence

Nguyen Van Chan
National Economics University, Vietnam
Ian Coxhead
University of Wisconsin-Madison, USA

Abstract

This paper predicts economic and environmental impacts and incidence, in short term and in long tem, of the implementation of Law on Environment Protection Tax (EPT) recently promulgated by the National Assembly and coming into force by the beginning of 2012[1]. The forecasts result from simulation scenarios run on an Applied General Equilibrium (AGE) model for the Vietnamese economy, using General Equilibrium Modeling Software (GEMPACK).

Depending on the different assumptions about factors' mobility, the numerical results of simulations show a relatively large short-run decline in the GDP growth rate, and smaller declines in the long run. In general, following the model results it seems difficult to expect that application of the EPT would directly bring positive economic effects[2]. The benefits of the EPT should be drawn from that the natural environment is improved and therefore the quality of life would be better. The simulation results also emphasize the necessity of government accompanying policies and measures, such as use/ redistribute the EPT revenues in different programs aiming to improve the natural environment and to assist the strongly energy- dependent industries, to help the seriously suffering households. Our further research plan is precisely to run some model simulations on possible impacts of such kind of macro policies.

Keywords: environment protection tax, general equilibrium model, Vietnamese economy, macro- and micro –simulations, Gempack.

1. Introduction

Vietnam has recently adopted its first law on environment protection tax (EVN)[1], and expects to implement it from 1 January 2012. As in other countries, there is considerable uncertainty over the economic impacts of such a tax, and its incidence on households, especially the poor. Environmental taxes, especially when applied to energy products such as coal and gasoline, have far-reaching economic effects. In many cases, reaching the nominal objectives - reduced emissions and solid waste - also requires changes in the structure of production, employment, wages, and prices. The net economic effects of the tax may be positive or negative. In the best cases, environmental taxes both reduce pollution and raise additional tax revenue, allowing government to reduce the rate of some more distorting tax without changing its net budget balance. In other cases, environmental taxes may be passed on to consumers as higher prices on a wide range of goods, thereby reducing real wages and incomes. In low-income economies, there are additional concerns about the incidence of an environmental tax- that is, its effects on income distribution and poverty. Will the poor carry a relatively heavy burden of the tax? These concerns in turn influence the degree of political support for the tax, as well as the process of legislative design and implementation.

In this paper we evaluate the likely impacts of Vietnam's adopted EPT law. Because the law establishes taxes on coal, gasoline and other fossil fuels, its impacts are likely to be felt widely in the economy. Accordingly, we make use of an economy-wide modeling 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 general equilibrium approach facilitates a relatively complete assessment of the impacts and incidence of the EPT. In the paper, we focus on the consequences of the adopted tax system for industrial production and employment, wages and incomes, and household poverty. We make allowances for lack of quantitative knowledge about the operation of a key market - labor - by examining several different specifications of wage and employment adjustments. We also provide some tentative estimates of changes in industrial pollution associated with the EPT. Finally, we discuss some policy and political economy implications of the taxes, and of our contribution to the understanding of their impacts.

2. Previous studies

Environmental taxes are politically controversial, in part because there is much uncertainty over their effects. Economists have also struggled to identify these clearly, whether in theoretical models or in quantitative analyses. Taxes on energy sources, which are the targets of most environmental tax proposals, have far-reading effects in any economy because they have potential to affect costs in a wide range of industries. This in turn means that these taxes are likely also to have economy-wide, or general equilibrium effects on employment, wages, and household incomes as well as macroeconomic variables such as trade and the government budget. There is no way to capture all these phenomena in a "blackboard" model. However, it is possible to obtain important insights from simplified (or "stylized") models (Copeland and Taylor, 2003; Coxhead and Jayasuriya, 2003). These models capture key general equilibrium features such as labor markets and trade and help to generate an agenda for more detailed research with real-world data.

It is worth noting that in developed countries, as concluded in literature review by OECD (1994, 1995), environmental policies to reduce pollution and/or fossil consumption are mostly regressive in terms of income distribution – the burden is essentially borne by lower income households. However, for developing countries, this question on the trade-off between environmental and equity objectives is still open (Yusuf, 2008). As we can see, there have been a number of general equilibrium applications of environmental tax experiments to developing-country data. One set of studies of particular relevance to Vietnam examines the economic and environmental implications of carbon taxes (i.e., taxes on fossil fuel use) in Indonesia (Yusuf, 2008). That study examines the distributional and welfare effects of carbon tax policies and reduced energy subsidies, under a variety of scenarios concerning the use of government revenues earned (or saved) by the reform. In Vietnam, an early paper by El Obeid *et al*. (2002) used a general equilibrium model to examine the effects of trade policy reforms and environmental policy initiatives, focusing on measuring changes in emissions of air and water pollution and solid waste. To our knowledge, however, there has not yet been a thorough study of the likely effects of the current EPT.

3. Methods and data

3.1 The model and data

In this research we use an applied general equilibrium (AGE) model. Such models represent the entire economy in simplified numerical form. They combine baseline information from the national accounts and other sources about the activities of firms, households, enterprises and government with theory-based specifications about market operation, labor, capital and resource supplies, trade balances and other constraints, and the assumed behavior of foreign partners in trade and investment. They thus provide a consistent interface between macroeconomic and microeconomic phenomena, at least in the realm of the real economy.[3]

We use an AGE model of the Vietnamese economy to observe the effects of tax policy shocks on prices and the incomes of producers and consumers, and through their reactions to these changes, to trace effects on the markets for labor, land and capital, consumer choices, and other consequences. Because households have different patterns of asset ownership, income, and expenditure we can also measure effects on income distribution and poverty. The model is based on collaborative research between U.S. and Vietnamese partners and is described more fully in Coxhead, Nguyen et al. (2010). Here, to save space we merely summarize the model's main features.

The model identifies 112 sectors, each producing a single commodity for domestic consumption and intermediate use. A subset of these commodities are also exported, while for a different subset, imports compete with domestic products. There are three aggregate primary factors: land, labor, and capital. Labor is a composite of twelve different types, distinguished by gender, location (urban/rural), and skill (low/medium/high). These categories are based on data in the 2003 Vietnam Social Accounting Matrix (SAM) (Jensen and Tarp, 2007). Labor demands are derived in the usual way from profit-maximizing choices made by a representative firm in each industry. The model posits a nested factor demand structure, with composite factor demand decisions at the top level and demands for each type of labor determined at the next level; these are governed by constant elasticity of substitution (CES) production technology. Similarly, intermediate inputs used in each industry are aggregated into a composite input using CES technology. This implies the possibility of interfuel substitution when tax increases energy prices at different rates - an important feature for the environmental tax study.

The model contains 16 household types, distinguished by location (urban/rural), sex of household head (M/F), and primary income source (farming, self-employment, wage work, unemployed). Households earn income from their ownership of labor, land and capital, and may receive government transfers. They spend it on a wide range of goods and services, both those produced domestically and those imported from abroad. There is also some non-marketed home consumption, mainly of foodstuffs.

For purposes of welfare analysis, we augment this household structure by linking it to the corresponding VHLSS data, which contains information on the incomes and expenditures of some 6,000 households nationwide. This link, from the ‘macro’ model to ‘micro’ data, makes it possible simultaneously to conduct two types of experiments. One type is *macrosimulation*, or experiments in which we examine the effects of a growth or policy shock on macroeconomic aggregates such as GDP, CPI, wages, employment and industry outputs. The other type is *microsimulation*, in which we trace the effects of the same shock(s) to the incomes and expenditures of individual households, or to regional and other aggregates. This enables us to draw conclusions about the effects of the shock on income distribution and poverty, both nationally and for subsets of the population, such as urban and rural households.

3.2 Closure assumptions and solution algorithm

In order to conduct experiments we must make assumptions about the way in which the economy adjusts to any shock, choosing which variables and policy settings are exogenously fixed, and which may endogenously adjust.

In Vietnam, one of the most important macroeconomic markets is that for labor. The labor market is the most important market in the economy from the point of view of household income, income distribution and poverty. While product prices may respond quickly to an economic shock, the labor market is slower to adjust as workers change jobs or migrate between locations. Yet very little is known quantitatively about labor supply, pricing, and mobility in Vietnam (Phan and Coxhead 2010). To allow for our lack of clear knowledge of this important market, we explore several alternative labor market specifications, or *closures*.

Closure 1 is a short-run version. It assumes that employment of labor of each type is demand-determined, and that real wages remain constant. Thus, adjustment to a policy shock assumes labor market slack (unemployment) either prior to or following the shock. In this closure we assume that workers can move between jobs in their current location, but cannot migrate between rural and urban areas.

Closure 2 is longer-run in that it permits migration between rural and urban regions, and allows wages to adjust so as to maintain full employment. If an urban-based industry (e.g., garments and textiles) seeks to expand, it can draw on workers of a given type (e.g., female, medium-skill) from either urban or rural areas. In this closure, migration in response to growth of labor demand in specific industries provides a channel to redistribute the gains of growth, or a contraction, from one part of the economy to others.

Closure 3 is also longer-run, but in contrast to closure 2, it assumes that the supply of unskilled labor is elastic at a given (constant) wage. In this closure, job creation in one location and industry can draw in unskilled workers from other sectors, but also from a pool of unskilled workers who are unemployed or underemployed. As in closure 2, however, we continue to assume full employment of medium and high skill workers, since they are in short supply.

In each closure we assume that half the capital in each industry is fixed (immobile), while the other half is mobile (it can be reallocated across industries or sectors).[4]

We also assume that trade plus international capital flows add to zero with no change in the government's budget deficit. The fixed nominal exchange rate of VND for USD is the model's numéraire price.

The tax revenues accrue to government, which must then decide how to spend the additional income in order to maintain budget balance. The current EPT law specifies that it will be spent on environmental programs, but provides no details on how this is to be achieved. In order to maintain focus on the economic incidence of the taxes themselves, we instead assume that any additional revenue is redistributed to households as a lump-sum transfer, leaving the government's net budget deficit unchanged. In this case, all households will receive an equal percentage increase in transfers. However, since transfers contribute differing shares of initial household income, the impact of an increase in transfers will vary across household types.

The model is implemented using the GEMPACK suite of software (Harrison and Pearson, 1996). Our implementation of the model using this software relies heavily on code from the ORANI-G model (Horridge 2005). The model is implemented in percentage changes of variables relative to a no-tax alternative. Thus, for example, an increase of 0.5% in the CPI means that imposing the tax raises the rate of inflation (the growth rate of the CPI) by 0.5%.

4. The experiment

The core of the EPT is to apply specific taxes on the volume sold of coal, gasoline and other fossil fuels, and pesticides. These taxes are intended to replace fees currently levied at the point of sale. Using current market prices, we convert these fees and specific taxes to their *ad valorem* equivalents. Table 1 shows basic data on the main sectors targeted by the EPT. The taxes span a wide range of values. The last column of the table shows the sales tax equivalent of the *median* rate of the adopted EPT for each product line. These are the rates we apply in our simulation experiments.

Table 2 shows the main macroeconomic results[5]. The model predicts that the EPT will reduce GDP growth by -0.8% in the short run, and by between -0.05% and -0.36% in the longer run, depending on the labor market closure. The inflation rate also rises, with the CPI growth rate increasing by 0.4% – 0.7%. The taxes raise government revenues by about 3.5%, or approximately VND 5 – 5.5bn. At the level of aggregate sectors, the tax raises costs and reduces output in manufacturing and services (which include energy-intensive transport services). Agriculture may expand or contract;

Table 1. Environment Protection Tax (EPT) rate (% of base price)

	Value of domestic production (VND bn) (1)	Sales tax revenue (VND bn) (2)	Effective sales tax rate (%) (3)	Domestic base price (VND) (4)	EPT (per liter or ton) (5)	EPT as % of base price (median rate) (6)
Coal	6,762.06	553.90	8.19	450,000	30,000	6.67
Pesticides	3,701.44	208.70	5.64	190,000	5,000	2.63
Gasoline	29,971.73	2,040.37	6.81	15,000	2,000	13.33

Sources: (1), (2): SAM, 2003. (3) = (1)/(2).

(4) VNeconomy.vn : http://tinyurl.com/33cd84f; Vatgia.com: http://tinyurl.com/2v3g8o6 ; petrolimex.c http://tinyurl.com/2upehoa

(5) From the adopted EPT Law

(6) = (5)/(4). This tax rate is computed net of previous per -liter (or per ton) fees.

Table 2. Environment Protection Tax: macroeconomic impacts

Variables	Short-run: fixed wages, flexible employment	Medium-run: Full employment, flexible wages	Medium-run: flexible employment of unskilled workers
CPI, % change	0.73	0.52	0.61
Real GDP, % change	-0.83	-0.05	-0.36
Government tax revenues, % change	3.85	3.84	3.55
Government revenues, change (VND bn)	4.98	5.58	5.32
Output by aggregate sector, % change			
Agriculture	-0.645	0.203	-0.222
Manufacturing	-0.813	-0.191	-0.433
Services	-1.190	-0.237	-0.538
Employment by aggregate sector, % change			
Agriculture	-1.165	0.321	-0.405
Manufacturing	-1.534	-0.307	-0.779
Services	-1.823	-0.355	-0.820

in closure 2 (full employment with flexible wages) agriculture expands to absorb workers displaced from other industries, albeit at a lower wage than in the pre-tax equilibrium. But in the alternative closure 3, where real unskilled wages are inflexible and workers who lose jobs in one industry may not necessarily find alternative employment in others, there is no such positive news. In this scenario agricultural output shrinks by 0.2%, manufacturing industry by 0.4%, and services by 0.5%. In each case, sectoral employment changes follow the pattern of output changes.

Among individual industries, the range of impacts is wide (to save space, we omit complete tables of results; these are available on request). Output changes in agricultural and resource sectors range from -3.5% to +0.5%. In manufacturing, the range is -8.6% to +3.4%, with declines in the majority of industries. In services, the range is -4.7% to +0.8%. The industries directly targeted by the tax are of course seriously affected. In the medium run (closure 2 in our model), domestic output of coal falls by -1.7%, and that of gasoline by -8.6%. Gasoline imports, which of course account for the greater part of domestic supply, fall by -2.9%. Other industries that use these as inputs experiences cost increases, which in most cases they cannot fully pass on to consumers. Transport industries in particular are badly affected, since gasoline and other fuels account for between 40% and 72% of their costs. Their prices rise by 1% (road transport) to 2.5% (water transport), and this raises costs throughout the entire economy. Among the industries that are especially badly hurt are some key natural resources and agricultural export industries. Fishery output falls by -3.4%, and exports from this sector fall by -11.9%. Fish farming contracts -1.3% and exports by -1.3%. Output and exports of processed seafood fall by over -3%; exports of pulp and paper, and of processed rubber, both fall by nearly -4%. In manufacturing, effects are generally smaller but even light industries do not escape; garment exports fall by -0.3% and leather goods by -0.4%.

An important insight from the industry-level results is that some industries experience much greater adjustment pressure than others. In general, energy-intensive industries are most heavily affected, of course. But among these are some industries which, because they supply the domestic market free from international competition, have discretion to raise prices, thereby sharing (i.e., passing on) part of their input cost increase to consumers. Transport services exemplify this type of industry. On the other hand, some industries produce goods for which the price is essentially set in the world market (processed seafood, rubber, and fruit and vegetable products are examples). Faced with higher costs, these industries cannot easily raise their selling prices and so must instead cut production and jobs. Among these are several industries which are large employers, especially of unskilled labor, so their quantity-based adjustment then has relatively large impacts on wages and employment.

We see the consequence of this in the wage and employment data. In the short run (closure 1), real wages remain constant, but in the longer run, wages and other factor incomes are reduced by the taxes (Table 3). In both rural and urban areas, the wages of more skilled workers fall fastest, reflecting the relatively greater decline in activity among more skill-intensive manufacturing and services industries. But the labor market impacts are most pronounced in the longer run when the model allows for unemployment among unskilled workers (closure 3). The loss of unskilled jobs also reduces demand for higher-skilled workers, whose nominal wages fall by almost -3% (implying a real wage fall of about -3.5%, since the CPI rises by 0.6%). Other factor returns also decline in both nominal and real terms. Although our model does not track investment decisions, lower unit prices for

Table 3. Environment Protection Tax: Impact on factor employment and returns

Factors	Short-run: fixed wages, flexible employment*	Medium-run: full employment, flexible wages for all labor	Medium-run: flexible employment of unskilled workers
Labor			
Rural male unskilled	0.73	-0.74	0.61
Rural male medium-skilled	0.73	-1.02	-2.58
Rural male high-skilled	0.73	-1.35	-2.76
Rural female unskilled	0.73	-0.74	0.61
Rural female medium-skilled	0.73	-1.08	-2.61
Rural female high-skilled	0.73	-1.32	-2.74
Urban male unskilled	0.73	-0.74	0.61
Urban male medium-skilled	0.73	-1.02	-2.58
Urban male high-skilled	0.73	-1.35	-2.76
Urban female unskilled	0.73	-0.74	0.61
Urban female medium-skilled	0.73	-1.08	-2.61
Urban female high-skilled	0.73	-1.32	-2.74
Other factors			
Land	-2.31	-1.19	-1.64
Mobile capital	-2.26	-1.12	-1.55
Fixed capital	-2.31	-1.19	-1.64

* Real wages are fixed; nominal wage rates rise at same rate as CPI (see Table 2).

fixed and mobile capital and land send a negative signal to investors that expected investment returns in the medium run will be lower (or more accurately, will rise by less) than expected.

As seen, the taxes increase prices overall due to the pervasive effects of energy costs. Higher prices for consumer goods reduce household purchasing power, or real income. Household incomes are also altered by changes in employment, wages, and returns to land and capital. Table 4 summarizes some key results. This table also highlights the effects on household incomes of increased government transfers due to the EPT revenues. For each closure, the table shows the impacts on households first without the additional transfers, and then with them. The first column in each pair (headed "pre-transfer") shows that the direct impact of the EPT is to reduce real income for almost all household types (unemployed households depend mainly on transfers and are less affected, but as the first column of data reveals, they are very small groups within the total population). The biggest losses are among urban households, as can be seen in the results of the short-run closure. In the longer run, when workers can move between urban and rural areas, there is less difference between rural and urban households of similar types.

Suppose now that government uses the net increase in revenue from EPT to compensate households directly via an equiproportional increase in lump-sum transfers, as discussed above. The columns headed "post-transfer" show the net effects on households. For some groups, including the largest (rural farm

Table 4. Household real consumption (% changes from base)

	Population share (%)	Real consumption (% change)					
		Short-run: fixed wages, flexible employment		Medium-run: Full employment, flexible wages		Medium-run: flexible employment of unskilled workers	
		Pre-transfer	Post-transfer	Pre-transfer	Post-transfer	Pre-transfer	Post-transfer
Rural							
MH self-employed farm	40.4	-0.701	0.157	-0.146	0.908	-0.229	0.750
MH self-employed non-farm	12.2	-1.407	-1.109	-0.800	-0.460	-0.981	-0.651
MH wage-earner	4.2	-0.993	-0.432	-0.663	0.025	-0.742	-0.100
MH not in labor force	5.0	1.375	3.813	2.169	5.196	1.815	4.634
FH self-employed farm	5.4	-0.454	0.626	0.120	1.452	0.001	1.239
FH self-employed non-farm	2.6	-1.372	-1.122	-0.863	-0.571	-0.841	-0.574
FH wage-earner	0.6	-0.713	0.146	-0.362	0.698	-0.493	0.497
FH not in labor force	3.7	-0.030	0.592	0.710	1.445	0.387	1.093
Urban							
MH self-employed farm	3.1	-0.588	0.367	-0.160	1.033	-0.066	1.024
MH self-employed non-farm	5.1	-1.869	-1.582	-1.041	-0.738	-1.443	-1.127
MH wage-earner	5.2	-1.374	-0.868	-1.086	-0.496	-1.670	-1.074
MH not in labor force	3.1	1.728	4.991	2.522	6.592	2.184	5.962
FH self-employed farm	0.8	0.612	2.856	1.222	4.020	1.000	3.596
FH self-employed non-farm	3.2	-1.512	-1.041	-0.899	-0.346	-1.185	-0.650
FH wage-earner	1.9	-1.249	-0.705	-0.941	-0.305	-1.490	-0.855
FH not in labor force	3.4	-0.083	0.901	0.631	1.825	0.331	1.458

Note: MH: Male-headed household; FH: female-headed household. Not in labor force: unemployed, retired, invalid.

households) these transfers are sufficient to make up for the loss of purchasing power caused by the taxes, resulting in overall increases in real consumption values. For others, however, the transfers are too small. Urban wage earners and self-employed workers are among the biggest losers overall. In the longer-run closure with flexible unskilled labor supply, urban wages-earners and self-employed workers, making up about 15% of the total population, experience real consumption declines of between -0.65% and -1.12% — even after receiving some compensation in the form of higher transfers.

We also imputed the overall effects of the EPT on poverty, by mapping changes from the simulation model to the VHLSS household database. As is well known, there is more than one way to measure poverty. The simplest— and least accurate— is the headcount measure, which merely counts the number of households with incomes below the national poverty line. A more useful measure for policy purposes is the poverty gap, which computes the monetary value of the distance by which each poor household falls below the poverty line. The poverty gap measure thus shows what it would cost to raise the incomes of all poor households just to the poverty line. Finally, a measure that is more sensitive to the severity of poverty is the squared poverty gap, which, by squaring the poverty gap measure, gives exponentially greater weight to the welfare of households further below the poverty line (Foster *et al*., 1984).

Table 5 shows percentage changes in each of these poverty measures. In the short run, poverty rises sharply by every measure. The headcount poverty rate rises by 3.4%; the poverty gap by 3.8%, and the squared poverty gap by 4.2%, indicating also that the poorest households are also the biggest losers in the short run. In the longer run, changes are generally much smaller as expected, once the labor market has undergone some adjustment. One point in the table is of particular interest: in the longer run, different poverty measures show contrasting results. The headcount measure shows a large decline in urban poverty and a rise in rural poverty, whereas the poverty gap and squared gap measures show rural households less hard-hit than urban households. The large decline in the urban headcount measure merely indicates that there is a larger density

Table 5. Poverty changes in the medium run (percent change from base, after transfers)

	Short-run: fixed wages, flexible employment	Medium-run: Full employment, flexible wages	Medium-run: flexible employment of unskilled workers
Headcount: Total	3.41	0.13	-0.16
Urban	1.87	-2.48	-2.60
Rural	3.68	0.60	0.28
Poverty gap: Total	3.79	-0.12	-0.33
Urban	4.52	-0.43	0.05
Rural	3.68	-0.08	-0.39
Squared poverty gap: Total	4.18	-0.17	-0.48
Urban	6.59	0.44	0.78
Rural	4.07	-0.20	-0.54

Table 6. Estimated changes in aggregate industrial pollution (percent change)

	Short-run: fixed wages, flexible employment	Medium-run: Full employment, flexible wages	Medium-run: flexible employment of unskilled workers
Air pollution	-0.94	-0.32	-0.55
Solid waste	-0.80	-0.30	-0.48
Water pollution	-0.73	-0.33	-0.49
Total emissions	-0.85	-0.31	-0.51

of households clustered close to the poverty line; a small rise in income is sufficient to push them above it. But the gap-based measures show a different story, with small poverty declines overall, concentrated mainly among the rural population. As Table 4 suggests, these results are largely the product of compensating transfers from government based on additional EPT revenues.

Finally, the use of additional data from outside the model gives us an opportunity to make some tentative comments on the environmental impact of the adopted taxes. For this, we apply data from the World Bank's Industrial Pollution Projection System (IPPS), which provides industry-specific estimates of air, water, and solid waste emissions per unit of output produced (Hettige et al, 1994). Full details of the application of this data set to Vietnamese data can be found in Coxhead, Nguyen and associates (2010). In brief, we use IPPS estimates of emissions intensity (pollution relative to the value of production) for each industry, and multiply these by output change predictions from the tax policy simulation. After weighting by each industry's contribution to total pollution of each type, we can compute estimates of the percentage change in emissions of each type associated with the imposition of the EPT. These are shown, for each of the three closures, in Table 6. In the short run, when the change in GDP is sharply negative, there are correspondingly large reductions of -0.73% to -0.94% in air, water and solid waste emissions. In the longer run, when labor market adjustment takes place, the emission reductions follow the same pattern as the GDP changes shown in Table 2. In the full-employment, flexible wage closure, emission reductions are only about -0.3%. With flexible employment of unskilled workers, the reductions are somewhat greater, at about -0.5%. It is important to note, however, that as with the other data reported from these simulation experiments, these numbers represent the extent of reduction in the growth rate of emissions-not reductions in the absolute emissions levels.

5. Summary and discussion

In this paper we have reported the predicted economic and environmental impacts, in the short and longer run, of the recently adopted environment protection taxes (EPT) in Vietnam. Our predictions are based on simulation experiments with an applied general equilibrium model of the Vietnamese economy, using the latest available complete data sets. Our approach has been to simulate the adopted EPT as *ad valorem* sales taxes on three key commodities: coal, gasoline and other fuels, and pesticides. This approach is consistent with the EPT law as we understand it. In order to evaluate the incidence of the taxes on household welfare, we require that additional revenues associated with the new taxes be returned to households in lump-sum form as (increased) government transfers. We perform the tax experiments under three alternative assumptions about labor market operation, representing one short-run and two longer-run scenarios. Outputs from the model show percentage changes in variables such as prices, employment, incomes, poverty and industrial emissions relative to trends that they would have followed in the absence of the taxes.

Predictions from this model indicate a relatively large short-run decline in the GDP growth rate, and smaller declines in the longer run as production plans and labor markets adjust to new incentives. Because these are taxes on energy, an input used in all industries, their effects are pervasive. Transport industries in particular suffer large losses, and energy-dependent, export-oriented industries like fisheries, fish-farming, and seafood processing all experience severe cost increases and associated declines in production, exports and employment. Real wage growth declines, especially for unskilled workers. When we allow for the possibility of slack (or unemployment) in labor markets, there is a substantial reduction in the rate of new job creation.

While the results should be regarded as preliminary in the absence of direct, *ex post* measures of tax incidence, it is our view that they are important to merit careful consideration at policy level. An initial reaction to the simulation results might be to regard the adopted EPT as a costly threat to continued economic growth and development in a lower-income economy. We do not support this conclusion, because other consequences of the taxes, not captured or following concluding thoughts.

First, although we can estimate likely reductions in the growth of industrial emissions, we lack the information necessary to assign valuations of the environmental benefits of the new taxes. These may take the form of reduced abatement costs (that is, costs associated with remediation of pollution, clean-up of water supplies, waste disposal, and so on), and also reduced costs of health and other human welfare. Studies in other developing countries indicate that particulate matter and gaseous emissions from industries and vehicles have large and costly impacts on human health, as well as reducing the productivity of labor. If the environmental taxes reduces emissions growth, they will also deliver benefits in the form of a more healthy and productive workforce. These benefits should be taken into account when evaluating the net gains and losses from an environmental tax proposal. Because we do not, our results understate the gains from the adopted system of EPT.

Second, in the absence of better information, we have assumed that revenue gains from the taxes are returned to consumers in lump-sum form. This is non-distortionary, and so is a useful modeling device for the purpose of evaluating the incidence of the taxes themselves. But it is not by any means the only or the best way to dispose of the additional revenues. The literature on the so-called “double dividend” from environmental taxes identifies improvements in the efficiency of the tax system as a second gain (or “dividend”) beyond the environmental benefits themselves (Bovenberg and Goulder 1996; Coxhead 2000). Distortionary taxes reduce social welfare; therefore, if revenue gains from environmental taxes (which themselves reduce distortions, by helping to correct pollution externalities) are used in budget-neutral fashion to reduce the rate of more distortionary taxes such as import tariffs or factor income taxes, then social welfare improves. Once again, because we have not sought out such possibilities, our experiments underestimate the potential social gains from an environmental tax.[6]

Third, environmental tax revenues could also be used, in principle, to offset cost increases experienced by energy-intensive industries. Our experiments show that tradable industries in particular suffer contractions and job losses because they are unable to pass on tax-related cost increases to buyers in world markets. To minimize the impact on these industries, and therefore on national employment and export competitiveness, the government could consider using environmental tax receipts to compensate them, for example by means of a corporate tax rebate proportionate to their input cost increases. This revenue-recycling strategy is more narrowly targeted than that discussed in the previous paragraph, and as such bears some risks (for rent-seeking and corrupt practices) along with its potential gains. On the other hand, its potential for beneficial impacts on employment and export revenues may well justify such risks. ■

Notes:

The authors thank Ms. Le Dong Tam for research assistance, and the Hanoi office of the Ford Foundation for funding the development of the model used in this paper. Comments are welcome. Address correspondence to nvchan@cfvg.org and coxhead@wisc.edu.

1. Precisely the Law on Environment Protection Tax (N°57/2010/QH12) has been approved by the National Assembly of Vietnam, 12th Legislature, 8th Session, November 15, 2010 and will be effective from January 1st, 2012.

2. See Section 5 for more details and discussions.

3. For recent surveys of AGE Models applied to the Vietnamese economy, see Coxhead, Nguyen et al., 2010; and Abbott et al., 2009.

4. The Vietnam SAM provides no guidance on fixed and mobile capital, and our 50-50 division is merely an ad hoc assumption. Quantifying the mobility of capital at industry level is the subject of ongoing research. However, the model results are not very sensitive to the exact percentage split between mobile and fixed capital.

5. A complete file of simulation results, along with details of the model and database, is available from the authors.

6. We are exploring these possibilities in ongoing research with the model.

References:

Abbott, P., J. Bentzen, and F. Tarp, 2009, 'Trade and development: lessons from Vietnam's past trade agreements', *World Development* 37(2).

Bovenberg, L., and L. Goulder, 1996, 'Optimal environmental policies in the presence of other taxes: general equilibrium analyses', *American Economic Review*, 986 (4) September, pp. 985-1000.

Copeland, B. R. and M. S. Taylor, 2003, *Trade and the Environment: Theory and Evidence*, Princeton, NJ: Princeton University Press.

Coxhead, I. 2000, ‘Trade and tax policy reform and the environment in developing economies: is a ‘double dividend’ possible?’, FEEM Working Papers No. 88.2000, Milan.

Coxhead, I., and S. Jayasuriya. 2003, *The Open Economy and the Environment: Development, Trade and Resources in Asia*, Chelthenham, UK, and Northampton, MA, USA: Edward Elgar.

Coxhead, I., Nguyen Van Chan, and associates. 2010, ‘A general equilibrium model for the study of globalization, poverty and the environment in Vietnam’, University of Wisconsin-Madison and National Economics University, Hanoi, Vietnam, Accessible at <http://www.aae.wisc.edu/coxhead/papers/VNCGE-ModelDescription.pdf>

El Obeid, A., D. Van der Mensbrugghe, and S. Dessus, 2002, ‘Outward Orientation, Growth, and the Environment in Vietnam’, Ch. 9 in J. Beghin, D. Roland-Holst, and D. van der Mensbrugghe, eds: *Trade and the Environment in General Equilibrium: Evidence from Developing Economies* (Boston: Kluwer Academic Publishers).

Foster, J., J. Greer and E. Thorbecke, 1984, ‘A class of decomposable poverty measures’, *Econometrica* 52(3): 761-66.

Harrison, W. J., and Pearson, K. R. 1996’, ‘Computing solutions for large general equilibrium models using GEMPACK’, *Computational Economics* 9: 83–127.

Hettige, H., P. Martin, M. Singh, and D. Wheeler. 1994, ‘IPPS: The Industrial Pollution Projection System’, Unpublished document, World Bank.

Horridge, M. 2005, ‘ORANI-G: A generic single-country computable general equilibrium model’, *Edition prepared for the Practical GE Modelling Course, February 7–11, 2005*, Centre of Policy Studies and Impact Project, Monash University, Australia.

Jensen, H. T. and F. Tarp, 2007, ‘ A Vietnam Social Accounting Matrix (SAM) for the year 2003’, Department of Economics, University of Copenhagen (mimeo).

OECD. 1994, *The Distributive Effects of Economic Instruments for Environmental Policy*, OECD, Paris.

OECD. 1995, *Climate Change, Economic Instruments and Income Distribution*, OECD, Paris.

Phan, Diep, and I. Coxhead. 2010, ‘Interprovincial migration and inequality during Vietnam’s transition’, *Journal of Development Economics* 91(1), January: 100-112.

Yusuf, A.A. 2008, ‘The Distributional impact of environmental policy: the case of carbon tax and energy pricing reform in Indonesia’, Singapore: Environment and Economy Program for Southeast Asia, Research report No. 2008-RR1.