55th AARES National Conference
Melbourne, 8-11 February 2011

A Tax Mix Change to Reduce Greenhouse Gas Emissions

John Freebairn
The University of Melbourne
(email: j.freebairn@unimelb.edu.au)

1. Introduction

Placing a price on greenhouse gas emissions, either through a tax or a tradable permit scheme, is a cost effective way to internalise the external pollution cost. From a government perspective, the policy intervention represents an increase in the aggregate indirect tax burden and it provides a windfall revenue gain. Most of the additional indirect tax is passed forward to consumers as higher prices. As well as increasing the relative prices of greenhouse gas intensive products and production processes, placing a price on carbon increases the average cost of living. The consumer price effects are regressive, they aggravate the distortions caused by current income and consumption taxes to work and save by households, and they provide incentives for employees and investors to seek compensating increases in nominal wages and interest rates. Returning the indirect tax revenue windfall to households as reductions in income taxation, and increases in social security payments, as a component of a policy package which is approximately aggregate revenue neutral and vertical distribution equity neutral largely can eliminate the undesired effects. Presenting a tax mix change package also may improve political acceptance of an explicit price on carbon.

Most of the debate on policy design so far in Australia to place a price on greenhouse gas emissions has proposed to return only some of the revenue windfall gain to households. For example, Garnaut (2008) and the government proposed Carbon Pollution Reduction Scheme (CPRS) (Department of Climate Change, 2008) propose to return about a half of the revenue to households, and then only as compensation to low income households. Even though the final economic incidence of the relative price increases likely will be regressive, middle and high income households also will experience increases in their cost of living. Another option for seeking compensation for the cost increase is through higher wages, nominal interest rates and returns on other savings. Drawing on a related policy story, the ANTS tax reform package of 2000, which involved a net increase in indirect taxation (of the GST less replacement of the WST and some state indirect taxes), used the revenue gain, and more, to compensate all households for the estimated higher cost of living through reductions in income tax and increases in social security payments. As well as for reasons of equity, the ANTS tax mix change package was advanced successfully to discount the one-off increase in costs of living in wage negotiations and interest rates and to avoid the risk of initiating an inflationary wage-price spiral (The Treasury, 2003). Adverse second round effects of an explicit price on carbon aggravate distortions associated with current taxes. This effect has been the focus of discussions about environmental taxation and the double dividend (Parry, et al., 1998, Bovenberg and Goulder, 2002, and Bovenberg, et al., 2008). Designing a tax mix change package to minimise unintended second round tax efficiency losses is an important neglected topic.

All proposals to date include a gradual reduction in the aggregate pollution quantity over the next forty years with rising carbon prices. The assertion in Garnaut (2008) and implicit assumption in Treasury modelling (The Treasury, 2008) that the net government revenue windfall and increase in the cost of living will be a one-off effect is valid only if the elasticity of the marginal abatement cost function is unity. Available evidence to be presented supports an inelastic function. Then, projected increases in the price of carbon will result in increases over time in the revenue gain and in the average cost of living. This in turn points to a policy strategy of a sequence of tax mix change packages.

The rest of the paper is as follows. Section 2 describes the operation of a carbon tax and an emissions trading scheme, and then the processes and magnitude of pass forward of the charge for greenhouse gas pollution to consumers as changes in relative prices and an increase in the average cost of living. In a once only average price increase context, Sections 3, 4 and 5 provide the case to use the indirect tax revenue windfall to fund reductions in income taxation to achieve, respectively, distributional equity, minimise further existing taxation distortions, and maintain macroeconomic stability. Section 6 presents the arguments for a sequence of tax mix change packages as the price on carbon rises over time. Conclusions are provided in a final section.

2. Placing a Price on Carbon

About 70 per cent of Australian greenhouse gas pollution comes from the combustion of fossil fuels in the production of electricity, other stationary energy, and for transport (Department of Climate Change, 2006). The other major pollution source is agriculture, and here because of difficulties and costs of measurement, no country, including Australia, has proposed imposing a direct charge on greenhouse gas emissions.

The aim of placing a price on carbon is to internalise the external costs of the pollution which, with a high probability, contributes to the external costs of climate change in the future. An emissions or carbon tax imposes a direct cost on pollution, and the market response determines the quantity reduction of pollution. A cap-and-trade or tradable permit scheme, such as the proposed CPRS or the European ETS, sets the quantity pollution reduction, and the market determines the price for the newly created scarce property right to pollute. Under conditions of perfect knowledge and certainty, the two options have the same price and quantity outcomes. In the realistic context of imperfect knowledge and evolving economic circumstances the two options have different outcomes and properties, and different pros and cons (see, for example, Kolstad, 2009). While clearly important issues, the arguments discussed here are not materially affected by the exact mechanism chosen to impose a price on carbon. The Department of Climate Change (2008) report that about 1000 businesses would bear the initial burden, or statutory incidence, of a price on carbon.

Consider next the economic incidence of a price on carbon on the combustion of fossil fuels. For reasons of simplicity and low transaction costs, the use of petroleum products is measured up-steam at the production and import of refined product stage, building on the existing petroleum products excise. In effect, this is a consumption base. Given that Australia is a price taker in a large global market for petroleum products, the extra cost of a price on carbon would be fully passed forward as higher prices to domestic business and household buyers. Studies of tax incidence of excise by ABS (2007) and Warren, et al. (2005), and ACCC inquiries into the pricing of petroleum products, support the full pass-through logic for petroleum products. The electricity generation industry is a non-traded industry, with a carbon price having a consumption base. Because electricity is a non-storable product facing variable demand over the day and across seasons, and because it uses different generation technologies in terms of carbon and pollution intensity, levels of and mixture of fixed and variable costs and ease of adjusting production quantity, the extent to which higher production costs are passed forward to buyers as higher prices is uncertain. If the most pollution intensive fuel coal was always the marginal producer, costs of a price on carbon on coal-fired electricity would be fully passed forward, and non-coal generators would make net gains. Coal provides 84 per cent, and gas 9 per cent, of generated electricity. This suggests that for most of the time coal is the marginal supplier and that close to 100 per cent of a carbon price at proposed levels of $20-40 per tonne of CO2-e would be passed through to buyers as higher prices. Even though Europe is far less dependent on fossil fuels for its electricity than Australia, less than 60 per cent, Sijm et al., (2006) estimate that between 60 and 100 per cent of the market price of tradable permits was passed forward as higher electricity prices. In 2006-07, 30 per cent of refined petroleum products and 23 per cent of electricity was directly consumed by households.

The majority of both petroleum products and electricity are used as intermediate inputs by all other industries. A price on carbon is passed forward as an increase in the cost of these intermediate inputs. For these other businesses, the tax base in effect is a production base falling on exports and excluding imports. If there is a global agreement, a production base rather than a consumption base means most of the extra production cost can be passed on to buyers. Models with a fully pass forward framework used to estimate price changes with the 2000 ANTS changes in indirect taxation with a consumption base were very close to actual outcomes (see, for example, The Treasury, 2003, and Valadkhani, 2005).

But, if Australia places a price on carbon before most of the countries from whom it imports and to who it exports, producers in the Australian trade exposed industries will be unable to pass on all of the higher costs of electricity and petroleum product inputs. However, some of the cost increase will be passed on because of product heterogeneity, especially with respect to import substitutes, and because of less than perfectly elastic export demands. Also, balance of payment equilibrium conditions mean that a fall in exports and a rise in imports will induce a currency depreciation, although Daley and Edis (2010) estimate these effects will be small, with the effect of another round of higher average prices for domestic buyers.

Modelling undertaken by the Garnaut Review (Garnaut, 2008) and Treasury (The Treasury, 2008) estimate that a carbon tax or tradable permit price of around $20 a tonne of CO2-e initially levied on petroleum refineries and importers, electricity generators and manufacturers of iron and steel and cement would be passed forward to buyers, and through other businesses, and ultimately to households resulting in an increase in the CPI of about a percentage point. The paper turns next to the economic arguments for using the revenue windfall from the increase in indirect taxation to fund compensation to households for the increase in their average cost of living.

3. Distributional Equity

Available evidence is that the increase in aggregate indirect taxation associated with a price on carbon will be regressive in its effects (for Australia, Cornwall and Creedy, 1996, and The Treasury, 2008, and for the US, Metcalf, 2009). Household energy outlays, particularly on electricity, gas and petroleum products, and on other products with high shares of energy inputs, including food, represent a higher share of expenditures for households at the lower end of the income distribution. In addition, The Treasury (2008) argue that on average lower income households also have lesser substitution options, or more inelastic demands, for the relatively energy intensive products than is the case for higher income households. At least for annual cross section data observations, lower income households on average have much lower if not negative saving rates when compared with middle income and especially high income households (ABS, 2006). Of course, within each category of household the magnitude of the expenditure cost increase of the explicit cost placed on pollution varies from the average with differences in individual preference functions and constraints. One aim of a tax mix change package is to use the revenue windfall from the emissions trading scheme or carbon tax to fund reductions in other taxes on households so that their overall effective consumption capacity or purchasing power approximately is maintained.

Refunding the indirect tax revenue windfall as lower other taxes on households might take one of several options. One option is to lower the rate of the broad based GST. The GST option has the advantage that it uses consumption rather than income for the tax reduction, and this automatically provides a relatively neutral tax aggregate tax burden for households with different savings propensities. On the other hand, a lower GST as a flat rate consumption tax provides roughly equal tax reductions for high and low consumption households, and it would not fully compensate the regressive effects of the charge on greenhouse gas pollution. A second option is to reduce income tax rates in such a way as to roughly maintain the average aggregate income plus indirect tax rate. This option was followed with the introduction of a GST in New Zealand in1985 and in Australia in 2000. In principle, the regressive effects of the new charge on greenhouse gas pollution and differences in savings rates can be incorporated in a modified tax mix change from more indirect taxation and less income taxation which as a package is approximately both revenue neutral and distributional neutral.

Consider the increase in indirect tax and a reduction in personal income tax package. Let P denote the current proportionate average indirect tax burden associated with the GST, excise taxes, stamp duties, and so forth. Along with the literature on the economic incidence of indirect taxes, it is assumed that all indirect taxes are passed forward to households as higher prices. Let r be the average income tax rate levied on taxable income Y, and S is after income tax saved (which can be negative or positive). The indirect tax falls on $(Y(1-r)-S)$. Note that P', r and S in most cases will vary by income level, and other circumstances. Effective real spending power before the tax mix change is given by

$$((1-r)Y-S)/(1+P) \tag{1}$$

With the addition of the charge for greenhouse gas pollution, the average indirect tax rises to $P' > P$. For a new average income tax rate r', and assuming no behaviour response in the sense of changes in Y or S, effective real spending power is given by

$$((1-r')Y-S)/(1+P') \tag{2}$$

Equating (1) and (2), the lower average income tax rate for the distributional neutral tax mix change package can be derived as

$$r' = r - ((P'-P)/(1+P))(1-r-S/Y) \tag{3}$$

From (3) the required reduction in the average income tax rate, $r - r'$, will be greater the larger the effective indirect tax and average price increase, the smaller the current average income tax rate, and the smaller the saving rate. The income tax rate reduction will be larger the greater the dis-saving rate. Overall, the required reductions in the average income tax rate will result in a more progressive income tax rate schedule.

More specifically, consider the details of a tax mix change package for the Australian income transfer system. In the case of social security payments automatically indexed to the CPI, which includes most of the family payments and allowances for the unemployed and sick, so long as the CPI base closely represents the purchase patterns of these recipients compensation is automatic, although with a six month lag. For other social security payments indexed to a measure of wages, which includes most of the pensions for the aged, those with a disability and single parents with young children, and assuming no independent wage response to the increase in indirect taxes, a special compensating increase in the pension rate would be required to retain distributional equity.

Australia has a progressive personal income tax rate schedule with a substantial zero rate threshold, including the effect of the low income tax rate offset (LITO) for individuals of working age and the senior Australian tax offset (SATO) for those of retirement age. Consider first a required shift in the tax free threshold from a to a'. For an increase in the proportionate indirect tax rate of $P' - P = \Delta P$, the new threshold should equate the increase in the indirect tax collected of $\Delta P\ (a' - S)$ with the reduction in income tax collected of $(a' - a)\ t$, where t is the first non-zero marginal tax rate, and S is as above aggregate saving (which may be positive or negative). Solving for aggregate tax revenue neutrality, and by implication real purchasing power neutrality, the new income tax free threshold is

$$a' = (at - \Delta P\ S) / (t - \Delta P) \qquad (4)$$

The tax free threshold is pushed higher the greater the extra indirect tax burden placed on households by the explicit charge on pollution, the lower the sum saved, and the lower the first non-zero marginal tax rate. Note that all households with a taxable income below the new threshold a' will be losers. This group is likely to include some self funded retirees and part time employees. Adjustment of the marginal tax rate at each personal income tax bracket to retain effective purchasing capacity requires equating the current marginal income tax rate, t, with the sum of the lower marginal income tax rate, t', and the additional indirect tax paid per dollar of income, $t' + ((1 - t') - s)\ \Delta P$, where $s = S/Y$ is the marginal saving rate (which again may be negative or positive). Solving, the marginal income tax rate becomes

$$t' = (t - (1 - s)\ \Delta P) / (1 - \Delta P) \qquad (5)$$

The marginal income tax rate reduction t' – t will be greater the larger the increase in the average consumer price with the pollution charge, the smaller the saving rate or the larger the dis-saving rate, and the smaller the initial marginal income tax rate.

An illustration of an approximate revenue neutral and neutral vertical equity distribution package for contemporary Australia involving a higher indirect tax burden associated with an explicit price on carbon and a lower personal income tax rate schedule is given in Table 1. The current personal income tax rate schedule for 2010-11 has an effective tax free threshold of $15,000 with LITO, and then six non-zero marginal tax rate brackets. It is a progressive rate schedule with a rising average tax rate. Suppose a carbon tax of about $25 a tonne of CO2-e fully passed forward resulting in a regressive pattern of average price increases of two per cent for low income individuals (< $30,000 a year), 1.5 per cent for middle income individuals ($30,000 to $80,000 a year) and one per cent for high income individuals (> $80,000 a year). For simplicity assume all disposable income is spent so that S in (4) and s in (5) equal zero. Formula (4) and (5) are used to calculate the modified income rate schedule in the second column.

Table 1: Illustration of a Tax Mix Change Package Personal Income Tax Rate Schedule

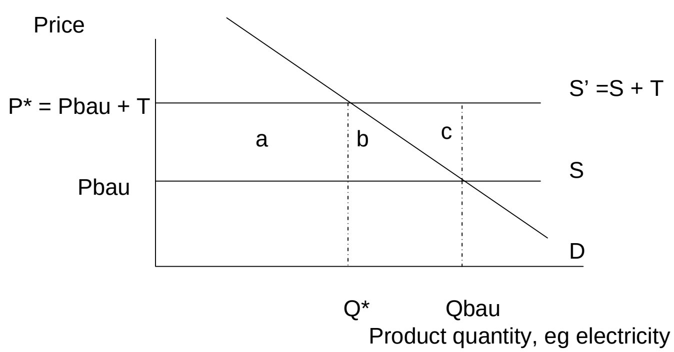
Current Effective Income Tax Rate Schedule		Revenue and Distributional Neutral Package	
Taxable income in $000's / year	Marginal tax rate in %	Taxable income in $000's / year	Marginal tax rate in %
0 – 15	0	0 – 17.3	0
15 - 30	15	17.3 – 30	13.27
30 - 37	19	30 – 37	17.78
37 - 67.5	34	37 – 67.5	32.99
67.5 - 80	30	67.5 – 80	28.93
80 – 180	37	80 – 180	36.36
> 180	45	. 180	44.44

Current is for 2010 – 11 from Swan and Tanner (2009, page 5.24).
Package assumes carbon price raises average cost of living, or ΔP, by 0.02 for income up to $30,000, then 0.015 for income up to $80,000, and 0.01 for greater than $80,000, and apply (4) and (5) of text with S and s equal to zero.

The modified package income tax rate schedule collects less revenue to offset the increase in indirect taxation, and it is more progressive to offset the regressive explicit price placed on greenhouse gas emissions. Specifically, the tax free threshold is raised by $2,300, and the marginal tax rates are reduced by about 1.7 percentage points in the second tax bracket down to just over 0.5 percentage points in the top income bracket.

Another way to consider the design of a tax mix change package and its redistributional effects is via a partial equilibrium model of the market for one of the pollution intensive goods or services as shown in Figure 1. In the initial state, supply, S, is assumed perfectly elastic and with demand, D, consumption is Qbau and price Pbau.

Figure 1



The price on greenhouse gas pollution, or increase in indirect tax, at rate T is fully passed on with a new equilibrium at Q* and P*. The windfall indirect tax revenue gain is area 'a'. Given that the CPI is a base period quantity or Laspeyres index, those given CPI compensation, including social security benefits with automatic indexation to the CPI and income tax reductions using ΔP set equal to ΔCPI in (4) and (5), receive area ‘a + b +c’. Note that they are over-compensated by area ‘c’, and there is a net budget cost of area ‘b + c’. The over-compensation is greater the greater the extent to which households substitute pollution-intensive products for pollution extensive products. An aggregate tax revenue neutral package would leave consumers with a net loss of area ‘b’; but they would gain from lower costs of adaptation to a smaller level of climate change not shown in this diagram.

The proposed household compensation package will still reduce greenhouse gas pollution. The return of the extra indirect tax revenue to households would offset most of the income effects of the price on carbon to reduce greenhouse gas pollution. But, the effect will be small because the income elasticity for emissions-intensive products is inelastic and the gain in real income is small. Importantly, the substitution effects of higher relative prices of greenhouse gas intensive products remain to provide incentives and rewards to substitute greenhouse extensive products and production processes for greenhouse intensive products and processes.

This section has shown that there are very strong limitations to design a tax mix change package involving a price on carbon, effectively an increase in indirect taxation, with the revenue windfall funding reductions in personal income taxation and social security increases which is approximately aggregate revenue neutral and maintains vertical equity. Arguably, the Garnaut (2008) and CPRS (Department of Climate Change, 2008) proposals fail the design constraints. First, they propose to reallocate only a half of the indirect tax revenue windfall to households. Second, middle and higher income households also need compensation, although a lesser share as a per cent of income. Third, the CPRS proposal to provide more than CPI indexation to social security recipients would over-compensate many. In reality an approximate revenue neutral package will result in some winners and losers.

4. Tax Efficiency Arguments

Existing taxes distort factor supply, product choice and business organisation decisions and incur efficiency costs. Placing a price on carbon as an increase in indirect taxation with no changes in existing taxes can compound the distortions and efficiency costs of the existing taxes. Using the revenue windfall from the price on carbon to reduce existing distorting taxes can offset this compounding effect. Then, a tax mix change package can reap the efficiency dividend of correcting the external cost market failure without aggravating distortions caused by existing taxes.

Taxation in Australia in aggregate takes about 30 per cent of GDP. The most important revenue sources are a progressive rate income tax at 59 per cent of all revenue, the GST with 12 per cent, and other indirect taxes 13 per cent. Existing taxes place a wedge, T, between the buyer side and seller side of factor and product markets. With the tax distortion smaller quantities are bought and sold.

In the absence of market failures, the tax-induced quantity reduction involves an efficiency loss. For an individual factor market, such as for labour, the efficiency cost or deadweight loss of a tax wedge T can be expressed as

$$DWL = 0.5\ \Delta Q\ T = 0.5\ [(\varepsilon\ \eta) / (\varepsilon + \eta)]\ NW\ t^2 \qquad (6)$$

where, ΔQ is the change in quantity, T is the tax wedge, ε is the (absolute value) elasticity of demand, η is the elasticity of supply, NW is the market wage bill or income for employment of N and a wage of W per unit employment, and $t = T/W$ is the tax rate. Note that the efficiency cost rises with the square of the tax rate and with the elasticities of labour demand and supply.

Available estimates of the efficiency costs of Australian taxation, as for other countries, indicate that they are large. Of course, there is a range of estimates, and the actual magnitudes vary with specific models and key elasticities used. The Henry Review of Taxation (Henry, et al., 2010, page 13) reported estimates of the marginal cost of another dollar of taxation revenue for different taxes based on a computable general equilibrium model. The marginal efficiency cost approximately is the derivative of (6) with respect to the tax rate t divided by the derivative of tax revenue, tNW, with respect to the tax rate t. Some of the estimates for the marginal efficiency cost of different taxes are 43 cents per dollar of tax revenue for corporate income tax, 25 cents for labour income tax, and eight cents for land tax.

How does the introduction of a price on carbon compound existing tax distortions? Consider the example of labour and distortions to work (and purchase of market goods and services) versus leisure (and home production) decisions. In (6) the tax wedge T includes both an income tax component, t_y, and an indirect tax component, t_i. Both sets of tax reduce the goods and services an employee can purchase, or the real wage, from the market for a period of work, and favour substitution to non-taxed leisure (and home production). Assume for simplicity that all after income tax income is spent, the tax wedge can be expressed as

$$T = W[\, t_y + (1 - t_y)\, t_i] \quad (7)$$

As argued in section 2 above, most of a price on carbon, as an additional cost of production, will be passed forward to households as higher prices than otherwise. Suppose initially that 100 per cent is passed forward. Effectively, the indirect tax burden is increased to $t_i' = t_i + \Delta t_i$, where Δt_i is the pass through price increase effect of the carbon price expressed as an increase in the indirect tax rate equivalent to an increase in the average cost of living. As a result, T in (7) also increases, and so does the efficiency cost of existing income and indirect tax distortions to the labour market via (6). This is the compounding of distortions, or the tax interaction effect, of an environmental tax. As argued by Bovenberg and Goulder (2002) and other critics of the double dividend hypothesis, this additional efficiency loss can be as great as, or greater than, the efficiency gain from placing a price on carbon to reduce the market failure external cost of greenhouse gas emissions pollution.

However, government can use the revenue windfall of the carbon tax or returns from the auctioning of tradable permits to fund a reduction in existing income or other indirect taxes. An approximate revenue neutral reduction in the income tax rate, Δt_y, which leaves T in (7) unchanged can be derived as

$$\Delta t_y = - [(1 - ty)\, \Delta ti] \,/\, [1 - (ti + \Delta ti)] \quad (8)$$

To illustrate, for a current marginal income tax rate $t_y = 0.3$ and indirect tax rate $t_i = 0.1$, and the net average consumer price increase of $0.01 = \Delta t_i$ for about a $20/tonne CO_2-e carbon price, the income rate would be reduced to 0.292, or just under a percentage point.

The existence of a double dividend with taxes to correct environmental externalities, such as a carbon price, depends on the magnitude of the price pass through effect, and some other assumptions (Bovenberg and Goulder, 2002, and Bento and Jacobsen, 2007). If the price pass through is 100 per cent, as assumed above, and if the relatively higher priced carbon intensive products are either independent of leisure or a substitute, the preceding analysis rules out a double dividend and requires use of the revenue windfall for compensating reductions in rates of existing taxes with high marginal costs. Since a policy of placing a price on carbon is a long run policy, the appropriate context is the long run. Here the elasticity of supply of almost all labour and capital inputs to individual industries in most of the services and manufacturing sectors will be close to infinite.

The opportunity for a double dividend will arise for that part of a price on carbon which is passed back as lower rents on natural resources, including land and mineral and energy deposits, which are geographically fixed in supply. For this component of the carbon price, the extra indirect tax redistributes some of the rent income, but with no change in output or adverse effects on efficiency. In addition, Bento and Jacobsen (2007) argue that the lower income effect of the fall in after tax rents will increase labour supply. In the event of a global agreement to place a harmonised price on carbon, and recognising that there is a range of more favourably endowed mines and energy sources with very low costs for labour and capital inputs to less endowed mines and energy sources with higher costs for these inputs, some of the economic incidence of a carbon tax will fall on the rents earned on the natural resources. The extent of the split between higher consumer prices and lower after tax rents will depend on the relative elasticities of demand and supply. A double dividend is achieved if the extra tax effectively collected on the economic rent, and over and above that needed to compensate households for the price increase in (8), is recycled to reduce (any) current distorting taxes.

An in-between and more contentious situation arises if some of the final economic incidence of a price on carbon falls on capital income and/or industry specific labour skills earning quasi-rents, and in the short term on sunk capital which effectively is in fixed supply and earning a residual return. Some of a price on carbon will be passed back to these factors as lower after tax returns on quasi-rents and with minimal changes in quantity decisions. But, in the relevant long run context of a sustained and long term price on carbon, this situation is of limited relevance.

Overall, to the extent that carbon prices are passed forward to consumers and raise the cost of living, they compound relative high efficiency distortions caused by existing taxes. Using a share of the revenue windfall gain from the effective increase in indirect taxation to reduce existing tax rates causing distortions in an approximate revenue neutral package can counter these unintended second round efficiency losses.

5. Macroeconomic Stability

A related argument for compensating households through the income tax system with the revenue windfall of a carbon price is to avoid initiating an inflation cycle with its associated adverse effects on macroeconomic outcomes. The rise in living costs associated with the price increase driven by the increase in the aggregate level of indirect taxation reduces the purchasing power of owners of both labour and capital for given wage rates and returns on capital. One option is for workers to seek compensating increases in market wage rates to restore real wages and for owners of capital to seek increases in nominal interest rates to restore real interest rates and required rates of return on other forms of wealth. If successful, these compensating increases in remuneration at the same time raise production costs. In turn, businesses seek compensation for higher production costs with higher product prices. One can envisage the net increase in indirect taxation associated with a carbon tax or an emissions trading scheme initiating a vicious price-wage inflationary spiral. Further, with a path of rising prices over time on greenhouse gas pollution, the impetus to inflation will be a recurring one.

Using the increase in indirect taxation revenue windfall to compensate households can break the impetus to inflation. Here, a tax mix change package along the lines of the tax mix change packages associated with the introduction of the GST in New Zealand in 1985, and a further increase in 2010, and the Australian ANTS package of 2000 is envisaged. Descriptions of, and evaluations of, the effects of the earlier schemes are in Stephens (1989), The Treasury (2003) and Valadkhani (2005). These packages involved net increases in indirect taxes, compensating reductions in income taxation, and policy initiatives including jaw boning and prices surveillance that argued that the estimated one-off price increase associated with the increase in indirect taxation should be discounted in wage negotiations and interest rates. It is important that the income tax reductions be directed not only at those on low incomes, as argued by

Garnaut (2008) and the government White Paper (Department of Climate Change, 2008), and that they apply to capital income as well as to labour income as discussed in Metcalf (2009). Bringing capital income as well as labour income into consideration may also support taking a longer time period than a year into consideration, and in particular down-playing concerns about differences in saving rates across different socio-economic groups and of different saving rates within a particular group. In practice these packages were successful with there being one-off blips in consumer price indices for the net increase in indirect taxation and smooth paths for nominal wages and interest rates.

An alternative and more direct compensation package would use the revenue windfall from the price on carbon to reduce other indirect taxes, such as the GST or payroll tax. This option has the advantage of directly offsetting the increase in the average price level for households and reduces the need for government jawboning to discount general price increases in setting wages and interest rates. But, as noted in section 3 above, the reduction in other indirect taxes option is less effective in restoring vertical equity relative to the option of increasing social security payments and reducing income taxation.

Current Australian proposals for placing a price on carbon, including Garnaut (2008) and the CPRS (Department of Climate Change, 2008), do not effectively confront the issue of macroeconomic stability, although Garnaut recognises the issue. Too small a share of the windfall indirect tax revenue is targeted for compensation of households, and none for those on higher incomes. Nor is there serious discussion, such as with the ANTS package, to promote a tax mix change package as a valid argument for discounting the pass through consumer price increase effects of a price on carbon in the negotiation of increases in wages and interest rates.

6. A Sequence of Tax Mix Change Packages

Available policy statements and model analyses of policy options to reduce greenhouse gas emissions and the likely costs of climate change anticipate a path of higher per unit pollution charges for at least the next fifty years. Then, unlike the ANTS tax reform package of 2000 with a one-off adjustment to a one-off (so far) increase in indirect taxation, current proposals for policy interventions to place a price on greenhouse gas emissions are likely to require a sequence of packages over time. Each package would return most of the increase of the revenue from the sale of tradable permits or a carbon tax as an additional payment to households for reasons of equity, to reduce aggravating existing tax distortions and for macroeconomic stability.

The price per unit of pollution will rise over time either as the aggregate permit quota falls or explicitly with a time path of rising tax rates to achieve the same effect. For example, the proposed CPRS envisages reducing aggregate economy emissions below 2000 levels by between 5 and 25 per cent by 2020 and by 60 per cent by 2050. With expected growth in both per capita incomes and population (Swan, 2010), the reductions in pollution per capita and per dollar of GDP are even larger. Garnaut (2008) and the Treasury (2008) in their modelling to meet the CPRS type quotas use a real annual growth rate of permit prices of four per cent. Other models, for example, Stern (2006), Nordhaus (2008) and Metcalf (2009), either explicitly or as a consequence of their specified models also project a path of rising costs per unit of greenhouse gas emissions.

As the price of carbon rises over time, the prices of consumer goods intensive in greenhouse gas emissions, both directly and indirectly via energy inputs, also will rise. If there were to be no substitution in the production processes and with close to constant returns production technology, most of the extra input costs of the pollution charge will be passed forward to consumers. The share passed forward for non-traded goods and services is unlikely to fall. Further, if Australia places a price on carbon before some other countries, and many of these countries in due course join a global trend to carbon pricing, compensation to Australian EITE can be phased out, as proposed, and consumer prices of trade exposed goods and services, as well of non-traded products, also increase to reflect their direct and indirect carbon content. To the extent that the pollution charges induce changes in production processes which are more cost effective than paying the extra costs of the initial technology, for example substituting gas fired for coal fired electricity or investment in more energy efficient machinery and buildings, households will be partly insulated from the full pass forward of the increase in indirect taxation. Even so, as the cost per unit of pollution increases over time, prices of carbon intensive goods and services to households will continue to rise while those of carbon extensive goods and services will change very little.

Discussing the implications for inflation of placing a price on carbon, both Garnaut(2008) and the Treasury (2008) contend that there will be only a one-off blip to inflation even though the price of permits are projected to increase at around four per cent real per year. Garnaut (2008, page 568) states
"The introduction of carbon pricing will generate a once-and-for-all increase in the general price level."
and the Treasury (The Treasury, 2008, page xv) evaluating the CPRS projects
"… a one-off rise in the price level of around 1 – 1.5 per cent is expected, with minimal implications for ongoing inflation."
These claims require that the price elasticity of the marginal abatement cost function just equal unity. Then, a higher price on carbon reduces pollution to such an extent that the revenue windfall remains constant, and if extra costs are fully passed forward the net increase in consumer outlays or costs of living will be unaffected by a rising carbon price. On the other hand, if the elasticity of the marginal abatement cost function is inelastic for price increases projected over the next few decades, higher prices will result in increases in government windfall revenue, higher average costs of living. In turn, the higher cost of living and further aggravation of distortionary costs of existing taxes provide justifiable arguments for using the revenue windfall to augment the compensating reductions in income tax and increases in social security payments for households: and vice-versa for an elastic function.

To illustrate, the effects of higher consumer prices for greenhouse gas intensive products on household expenditure can be assessed with a simple model. Suppose just one good is greenhouse gas intensive, good one, and faces a higher price, dP_1, while the prices of the other greenhouse gas extensive goods for j= 2, 3, …,n do not change. For household expenditure, $E = \sum P_i Q_i$, taking the total differential, the effect of dP_1 on expenditure can be expressed as

$$dE = [1 + e_{11} + \sum e_{j1}(w_j/w_1)]\ Q_1\ dP_1 \qquad (9)$$

where, e_{i1} is the price elasticity of demand for product i with respect to the price of product 1, and the w_i represent the share of product i in total expenditure. Consider some special cases of (9). The CPI with a base of initial period weights implicitly assumes the elasticity terms e_{j1} equal zero, and so consumer outlay unambiguously rises, and by Q_1 dP_1. If the cross price elasticities are zero, then a rise in P_1 results in an increase in expenditure if the own price elasticity is inelastic and a fall if it is elastic. In the more likely case that some of the other products are substitutes for product one, the larger the degree of substitutability the larger e_{j1}, and then expenditure E may fall even when the own price elasticity is elastic.

Most estimates of the own price elasticities of demand for the greenhouse intensive products electricity, gas, petroleum products and food are inelastic. For example, Breunig and Gisz (2009) estimate the long run demand own price elasticity for petrol at around -0.2 to -0.3 as found in other studies, and Owen (2007) reports estimates of the demand for electricity over the range -0.15 to -0.5. With no close substitutes, the cross elasticities with other household purchased goods and services also are small.

Estimates of the elasticity of demand for the marginal abatement cost function from modelling by the Treasury for Australia and used by Garnaut for permit prices and pollution reduction over the 2020 to 2050 period (the Treasury, 2008, Table 6.1 for prices and Table 6.8 for quantities) indicate values around -0.5 for the three models used. Metcalf (2009) for the US estimates that a carbon tax rising from US$15/tonne of CO2-e in 2015 by 4 per cent real per year to US$60/tonne of CO2-e in 2050 would generate revenue doubling as a share of GDP from 0.66 per cent to 1.15 per cent.

Granted the uncertainty about future outcomes, the effects of anticipated increases in the permit price or carbon tax on the average cost of living and the government indirect tax revenue collected would be among the monitored outcomes. If increases in the average costs of living are realised, a sound tax mix change policy package would anticipate renegotiating every few years an explicit recycling of most of the additional indirect tax revenue windfall gain to households as additional compensating reductions in income taxation and increases in social security benefits.

7. Conclusions

There are compelling economic and political arguments for using a tax mix change package as a comprehensive policy to place an explicit and transparent price on carbon. Recycling the windfall revenue gain from the effective increase in indirect taxation to households is necessary to: restore the status quo equity of the aggregate tax burden; avoid compounding distortions and efficiency costs of existing taxes while reaping the efficiency gain of reducing pollution; and, avoid initiating an inflationary spiral. Such a package will require most of the revenue windfall, and at least all of that passed forward to households as higher prices. The compensation has to extend across all citizens. Increases in social security payments and reductions in income taxation, albeit with a more progressive rate schedule, approximately maintain vertical equity, but there will be some winners and losers if revenue neutrality is imposed.

Projected increases in the carbon price, together with the likely inelasticity of the marginal abatement cost function, will generate over time an increase in government indirect taxation revenue. Then, with the benefit of forthcoming information every few years a new tax mix change package to recycle to households the additional revenue windfall will be required.

References

ABS (2006), Household Expenditure Survey, Australia: Summary of Results, Catalogue 6530.0, Canberra.

Bento, A. and Jacobsen, M. (2007), "Ricardian Rents, Environmental Policy and the "Double Dividend Hypothesis'", Journal of Environmental Economics and Management, 53, 17-31.

Bovenberg, A, Goulder, L. and Jacobsen, M (2008), "Costs of Alternative Environmental Policy Instruments in the Presence of Industry Compensation Requirements", Journal of Public Economics, 92(5-6), 1236-1253.

Bovenberg, A and Goulder, L. (2002), "Environmental Taxation and Regulation" in A. Auerbach and M. Feldstein (eds.), Handbook of Public Economics, Vol 3., Elsevier, Amsterdam, 1471-1548.

Breunig, R. and Gisz, C. (2009), "An Exploration of Australian Petrol Demand: Unobserved Habits, Irreversibility and Some Updated Estimates", Economic Record, 85(268), 73-91.

Cornwall, A. and Creedy, J. (1996), "Carbon Taxes, Prices and Inequality in Australia", Fiscal Studies, 17(3), 21-38.

Daley, J. and Edis, T. (2010), Restructuring the Australian Economy to Emit Less Carbon, Grattan Institute Report 2010-2, Melbourne, April. Available at htpp://www.grattan.edu.au

Department of Climate Change (2006), National Greenhouse Inventory, Canberra.

Department of Climate Change (2008), Carbon Pollution Reduction Scheme: Australia's Low Pollution Future (White Paper), Commonwealth of Australia, Canberra.

Garnaut, R. (2008), The Garnaut Climate Change Review, Cambridge University Press, Cambridge.

Henry, K., Harmer, J., Piggott, J., Ridout, H. and Smith, G. (2010), Australia's Future Tax System, Report to the Treasurer, Canberra.

Kolstad, C. (2009), Environmental Economics, International Edition, Oxford, Oxford University Press.

Metcalf, G. (2009), "Designing a Carbon Tax to Reduce U.S. Greenhouse Gas Emissions", Review of Environmental Economics and Policy, 3(1), 63-83.

Nordhaus, W. (2008), A Question of Balance: Weighing the Options on Global Warming Policies, Yale University Press, New Haven.

Owens, A. (2007), Report of the Owen Inquiry into Electricity Supply in NSW, New South Wales Government, Sydney.

Parry, I., Williams, R. and Goulder, L. (1998), "When Can Carbon Abatement Policies Increase Welfare? The Fundamental Role of distorted Factor Markets", Journal of Environmental Economics and Management, 37, 52-84.

Stephens, R. (1989), "New Zealand Tax Reform", in J. Head (Ed.), Australian Tax Reform in Retrospect and Prospect, Australian Tax Research Foundation, Sydney.

Stern, N. (2006), Stern Review: Report on the Economics of Climate Change, Cambridge University Press, Cambridge.

Swan, W. and Tanner, L. (2009), Budget Strategy and Outlook" Budget Paper No.1. Commonwealth of Australia, Canberra.

Swan, W. (2010), Australia to 2050: Future Challenges, Treasurer of the Commonwealth of Australia, Canberra.

The Treasury (2003), "Preliminary Assessment of a New Tax System", Economic Roundup, Autumn.

The Treasury (2008), Australia's Low Pollution Future: The Economics of Climate Change Mitigation, Commonwealth of Australia, Canberra.

Valadkhani, A. (2005), "Goods and Services Tax Effectson Goods and Services Included in the CPI Basket", Economic Record, 81 Special Issue, S104-S114.