The use of differential VAT rates to promote changes in consumption and innovation

Summary

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This study deals with the likely impacts of differential VAT rates for specific products with recognised environmental benefits. Applying a reduced VAT rate to environmentally preferable products while taxing the less preferable ones at the standard rate could lead to a relative price reduction for the 'greener' product and thus stimulate the demand for this product. Likewise, increasing the VAT rate on environmentally harmful products that are currently taxed at a reduced rate might also steer demand and supply in a more sustainable direction.
The main research question was how producers, retailers and consumers would change their behaviour in response to the introduction of reduced VAT rates for 'greener' products and to the increase of reduced rates on 'non-green' products to the standard rate. This question has been addressed in various ways: through a literature survey, by reviewing experiences with previous and existing (environmentally motivated) VAT reduction and other subsidy schemes, and by directly contacting stakeholders. Five case studies have been carried out as illustrations and in-depth explorations of the posssible impacts. Interim results of ongoing parallel studies on related subjects have been taken into account.

General considerations

In general terms there are a number of considerations that deserve attention when considering the use of the VAT instrument for environmental purposes and assessing its potential impact. These include the following:

- Reduced VAT rates are usually applied for non-environmental reasons, such as distributional concerns, 'public good' (or 'merit good') arguments, or employment generation. These may either coincide (e.g. public transport) or conflict (e.g. meat, domestic energy) with the environmental motive.
- Application of reduced VAT rates requires a clear and unambiguous distinction between the qualifying 'green' products and their 'non-green' counterparts (e.g. on the basis of energy labelling or eco-labelling criteria).
- Due to continuous (eco-)innovations, products may cease to be the 'greenest' in their class after some time, and thus lose their eligibility for a reduced VAT rate.
- In competitive markets, VAT reduction is likely to be passed through fully to consumers (though this may take some time, especially in capital intensive sectors). Incomplete pass-through (or none at all) can be expected for products with high demand elasticities and if the VAT reduction is perceived as temporary.
- VAT differentiation (if passed through fully) will reduce the price of 'greener' products by some 10 to 15 percent. This may not always be enough to bridge the price gap with the 'less green' alternative. However, in the case of energy efficient products, the payback period will become shorter anyway.
- Data on the impact of relative price changes on the demand for 'green' and 'less green' products (cross price elasticities) are scarce. Moreover, such elasticities should be applied with caution. Demand responses may differ between price increases and decreases, and between large and small price changes.
- For durable goods, the impact of VAT reduction will depend on (changes in) replacement patterns and on the question what happens with the replaced product (is it scrapped or does it remain in use).

- There is evidence for the existence of a 'signalling effect': subsidies and fiscal incentives, if properly communicated, tend to have an impact on consumer demand beyond the purely financial advantage they confer.
- The environmental impact of VAT differentiation should preferably be assessed for the product's whole life cycle, using a 'per unit of service' approach, and taking into account indirect effects.
- The effectiveness of VAT reduction on energy efficient products may be somewhat reduced by behavioral changes (e.g. the 'rebound effect'), but it is unlikely that these will offset the environmental benefits to any considerable extent.
- VAT reduction can stimulate the innovation dynamics in 'green' product markets, including learning curve effects and Porter-type competitive advantages. In this respect, there are no essential differences between VAT reduction and other instruments that that selectively stimulate demand and supply of 'green' products.
- If some Member States would opt for VAT differentiation whereas others would not, some increase in cross-border purchasing (e.g. of household appliances) is likely to occur, but this will be limited to border areas.
- As with other positive financial incentives, the phenomenon of 'free riding' (the incentive providing a windfall to consumers who were already buying the 'green' product anyway) cannot be avoided. Its size may be reduced, however, by a careful instrument specification and by applying it to products with high price elasticities.
- Expanding the scope of reduced VAT rates obviously implies a loss of public revenues. This may be compensated by a relatively small increase in the standard VAT rate, but other fiscal or budgetary measures are of course possible as well.
- The introduction of differential VAT rates within a product group will probably lead to legal disputes (borderline cases) and some fraud (attempts to sell non-eligible products under the low rate).
- Any change in the VAT regime will have wider economic consequences (on economic activity, employment, income distribution etc). Careful economic analysis can help to avoid unwanted impacts.
- The introduction of multiple VAT rates implies a non-negligible increase in the burden of administrative and compliance costs of the firms concerned.
- There are alternative instruments to VAT differentiation (e.g. direct subsidies, income tax credits) that may achieve similar results. These may avoid some of the VAT related problems (e.g. more freedom to determine the correct size of the incentive), but may also bring new complications (e.g. the need to set up a new administrative scheme, whereas VAT reduction can to a large extent lean on existing fiscal procedures). A comparison of VAT differentiation with other instruments is beyond the scope of this study.

Experiences in some EU Member States

A number of EU Member States already have some experience with using reduced VAT rates to promote environmentally preferred products. For example, from 1993 until 2004 the Czech Republic applied reduced VAT rates to a number of products including renewable energy equipment, biofuels and recycled paper. In Portugal, equipment necessary for the production and use of renewable energy resources is taxed at a 12% VAT rate (instead of 21%). Unfortunately, in both countries there is little evidence available that would allow to determine the impact of VAT reduction separately from the influence of other policy instruments. However, the general impression is that the role of VAT differentiation has been

minor. In the case of Portugal, one of the reasons mentioned is that natural gas and electricity are still taxed at an even lower (5%) VAT rate.
In the UK a reduced VAT rate is applied to the (professional) installation of specific energy-saving materials. The uptake by paying customers (other than social housing and priority groups) has been low. One reason for this may be the fact that, since the installer buys the product for the final customer, the reduced VAT rate may not be clearly visible to the end consumer.

Case study: Central heating boilers

Almost half of the dwellings in Europe has a central heating boiler. The EU market amounts to some 6 to 8 million units per year, with a value of about € 8 billion (excluding the costs of installation). The size of the market (relative to population size) varies by Member State; it is relatively large in the UK, Ireland, the Netherlands and Italy. Until 2014, a moderate grwoth of the boiler market is expected (2% per year).
Condensing boilers (achieving an energy effciciency close to 100%) are obvious 'green' alternatives to traditional, 'atmospheric' boilers (but there are other energy efficient innovations as well, e.g. heat pumps and micro-CHP). The current average market share of condensing boilers is 44%, but differs widely between Member States (Denmark, the UK and the Netherlands having market shares over 80%).
Past experience with subsidy schemes for condensing boilers shows that they have a significant impact in terms of speeding up the growth in market uptake, but also that the share of 'free riders' tends to become high after some time. Reluctance among installers appears to be a main factor causing delays in market penetration.
Data for the Netherlands and the UK show that condensing boilers are on average 21 (NL) to 45 (UK) percent more expensive than traditional boilers (excluding installation costs). Applying the reduced VAT rate to condensing boilers could reduce this difference to 8 and 29 percent, respectively. For a representative household in these countries, this would reduce the payback period of the additional investment through energy savings from 2.2 to 1.2 years. Given past experience, this could lead to a short term increase in market share from 44 to 75% for condensing boilers.
The environmental impact of this increase (if the VAT reduction would be applied in all Member States) is estimated at 17.7 Mton of CO_2 reduction per year, or 4.5% of total CO_2 emissions from individual (gas fired) heating boilers in the EU. VAT revenues from the sales of central heating boilers would decrease by 55% (€ 676 mln).
In Member States where the market share of condensing boilers is already high, the VAT reduction would have a relatively low cost-effectiveness (due to a high rate of 'free riders'). In other Member States, regulatory instruments (such as the requirements of the EPBD directive) may stimulate the demand for condensing boilers and other energy efficient heating systems as well.

Case study: Household appliances ('white goods')

In this case study, four types of household appliances have been selected:
- Refrigerators;
- Washing machines;
- Dishwashers;
- Freezers.

Together, these appliances account for some 40% of household electricity use.
In the EU(-15), the market for refrigerators and washing machines is highly saturated (penetration rate close to 100%) and sales are mainly for replacement. For dishwashers and

freezers the penetration rate is around 50% and these markets show a somewhat higher growth rate. The market for household appliances is dominated by a limited number of large producers; nevertheless there is stiff competition and real sales prices show a decreasing trend.
The rate of innovation in household appliances is high, and this includes a trend towards more energy efficient appliances. For the four product groups, it has taken just 5 to 9 years time for 'A' labelled types to capture a market share of more than 50%, and additional 'super-efficient' classes (A+ and A++) have been introduced for three of them. As with central heating boilers, the market share of energy efficient types differs widely between Member States.
Prices of household appliances show considerable variation. The most energy efficient models are usually (though not always) more expensive than the less efficient ones, but the price difference is not the same in all Member States. As a result, in some countries a reduced VAT rate could (more than) compensate the price difference, whereas in others (for the same appliances) it would not.
Given current appliance prices in the Netherlands, and average EU prices for electricity and water, a low VAT rate (if passed through fully) would reduce the price of 'A+' type refrigerators, freezers and washing machines to a level below that of the 'A' type.[1] For 'A++' type refrigerators and freezers, the payback period of the additional costs (compared to the 'A' type) would be reduced by 2 and 5 years, respectively.
Experience with a Dutch subsidy scheme for energy efficient 'white goods' suggests that a net price reduction between 10 and 20% may accelerate the uptake of these appliances. There is no empirical evidence for a 'relapse' to less efficient types after abolition of the financial incentive.
It is estimated that a VAT reduction would move forward the market penetration of the eligible energy efficient types by 2 to 4 years, increasing their market share by some 15 percentage points. If applied EU wide, the VAT reduction would lead to a decrease in CO_2 emissions from the use of refrigerators, freezers and washing machines by about 3.4 Mton per year. The tax revenue loss would amount to some € 245 million.

Case study: Thermal insulation

Buildings are the largest single energy-using sector, accounting for 40% of Europe's energy consumption. Insulation is a highly cost-effective end-user measure in reducing the emissions of GHGs. Adding thermal insulation to existing buildings in the EU could potentially reduce the CO_2-emissions from heating by 42% (353 million tons per year). The largest potential for improvement lies in central and southern European countries.
Presently reduced VAT rates are in place for energy-saving building materials in the United Kingdom, and for renovation work in the housing sector (which may include thermal insulation) in a number of other Member States. The installation must be done by a professional or approved contractor.
In 2007, the thermal insulation market in Europe was worth € 30 billion. The market has shown considerable growth in the past few years, driven mainly by favourable building regulations and rising energy prices. A small number of large producers supply the materials. The actual product cost is just 10% of the overall market value; the installation service accounts for the largest part.
A reduced rate of VAT on thermal insulation is generally expected to enhance the demand for such products. It is considered to be a strong sales tool, if not a significant price incentive. The measure would apply to almost all housing and a significant share of the non-residential

[1] For dishwashers, no calculations could be done due to lack of data on A+ types.

building stock. Its possible impact is illustrated by the results of a temporary campaign mimicking VAT exemption, which led to an increase in sales of 120%.
However, there are also some potential barriers to the VAT reduction's effectiveness. Indications exist that a reduced VAT rate on insulation products might not be passed through fully by installers to the consumers, although increased competition might force them to do so eventually. Furthermore, the reduced VAT rate may not always be clearly visible to the end consumer since the installer buys the product on his behalf. This is one reason why the uptake in part of the UK market has been low. In addition, capacity constraints and increasing production costs for insulation materials may counteract the price lowering effect of VAT reduction.
Depending on domestic energy prices, the 'payback period' of investments in thermal insulation ranges from 2 to 6 years. A reduced VAT rate would reduce this by a number of months. In addition to the financial incentive, consumer awareness is considered to be a crucial factor determining the investment decision.
The reduced rate of VAT, if applied EU-wide, is roughly estimated lead to 23 to 36 million tonnes of CO_2 reduction per year. VAT revenues would decrease by about € 3 billion.
It can be concluded from this case study that a reduced VAT rate for thermal insulation is a potentially effective instrument, but needs accomapying measures to remove market barriers and failures. It has relatively low administrative costs, but it is not sure that overall it would compare favorably to other types of incentives.

Case study: Domestic energy

Several EU Member States apply reduced VAT rates to energy products such as coal, heating oil, natural gas and electricity. EU wide, the VAT revenue foregone by not applying the standard VAT rate is estimated at € 2 billion for natural gas and € 5 billion for electricity, with the UK accounting for the largest part. These implicit energy subsidies are largely motivated by distributional concerns, although studies show that poorer households benefit less from them compared to richer households. Moreover, a low VAT rate on energy counteracts instruments like carbon/energy taxes and the emissions trading scheme, which have been introduced to reduce energy consumption.
This case study considers two policy options:

- increasing VAT on domestic energy to the standard rate in those Member States where it is currently taxed at a reduced rate;
- lowering VAT to the reduced rate for renewable sourced electricity where it is taxed at the standard rate.

Given existing estimates of the price elasticity of demand for domestic energy, it can be calculated that nearly 20 million tonnes of CO_2 could have been avoided in 2005 if the standard rate had been applied in the 10 Member States using the reduced VAT rates. The impact of the higher energy prices on low-income households could be alleviated by a targeted way of spending the additional VAT revenues, e.g. on energy efficiency programs. Reduced rates of VAT on renewable sourced electricity are likely to reduce or close the price gap with conventional electricity, as it is expected that they would at least partly be passed throuigh to consumers. This would lead to an increased demand for 'green' electricity, but would do less to encourage energy efficiency. The CO_2 reduction that might be achieved by this measure EU-wide is estimated at 2.8 million tonnes.

Case study: Meat and dairy products

Most EU Member States currently apply a reduced VAT rate to food and food products, and some of them even a zero rate. This case study addressed the option of applying the standard

VAT rate to dairy products, meat and meat products, with a possible exemption for organic production.

Meat and dairy production are economically important activities in the EU, with considerable environmental impacts. Food markets are highly competitive, though the food processing industry is dominated by a limited number of large firms, and some market power lies with the retail sector as well. The sales of meat and dairy products show substantial variation between Member States.

Organic agriculture performs environmentally better than conventional farming in a number of respects (though hardly in terms of GHG emissions), and is also advocated for various other reasons (e.g. animal welfare, food quality, health). The organic sector is developing strongly, but still accounts for only about 2% of EU food consumption. There are EU standardisation and certification schemes for organic agriculture, providing a clear and unambiguous means of distinguishing between organic and conventionally produced meat and dairy products.

Organic food is more expensive to produce than conventional food, and therefore sells at a premium to conventional produce. There are wide variations in price premiums between Member States. In countries where general food shops are active in the marketing of organic food, price premiums are usually lower than in countries where organic food shops or direct sales provide the main channels.

VAT measures in the meat and dairy sector are generally expected to be fully passed through to the consumer. The effect of requiring meat and dairy products to be taxed at the standard rate would be to increase their price by between 0% and 21%, depending on their current VAT treatment in different Member States. Adjusting for market size produces a weighted average increase in prices of 12% across the EU. If VAT on organic meat and dairy products was kept at reduced rates, this would help to reduce the price differential between organic and conventional produce, though the price change would not be large enough to close the substantial premium that persists for most meat and dairy products in most Member States.

Demand for meat and dairy products is price inelastic. Overall, evidence suggests price elasticities in the range -0.2 to -0.6 for meat and of -0.2 to -0.4 for dairy products. Based on these elasticities, a 12% price increase would be expected to reduce demand for meat in the EU between 2% and 7%, and for dairy products between 2% and 5%. This could bring about a gross reduction in greenhouse gas emissions of between 9.2 and 27.5 million tonnes CO_2 equivalent for meat and between 3.4 and 6.9 million tonnes CO_2 equivalent for dairy products. Other environmental benefits of reduced consumption would include reductions in eutrophication and acidification, and reduced pressure on land use.

EU evidence suggests a cross price elasticity somewhere between 0.5 and 1.3 for organic meat and dairy products; i.e. a 1% increase in the price of the conventional product increases demand for the organic product by 0.5 to 1.3%. On this basis a 12% increase in the price of conventional produce could boost demand for organic meat and dairy products by between 6% and 16%. This substitution would not be expected to reduce GHG emissions but could bring a variety of benefits in terms of biodiversity, landscape and reductions in water pollution.

A VAT change could be expected to have a range of wider impacts, both positive and negative. It could yield health benefits, particularly if accompanied by educational activity. On the other hand, lower income consumers would probably have difficulty in adjusting their diet in response to a price change and there might be a shift towards cheaper product types. The measure would be unpopular with farmers, many of whom are already struggling to compete in a more competitive market place. There would be strong political resistance to a VAT increase, on the grounds that it is taxing basic needs and amounts to government interference in the dietary and lifestyle choices of individual consumers.

Any such move should be accompanied by a wider awareness raising and educational campaign, promoting the health as well as the environmental benefits of consuming less meat. Given low consumer awareness of the issue, it is likely that the VAT change will be as important in its signalling effect as in its price effect.
This VAT change would also generate significant revenue and represent a tax harmonising measure (though it would introduce differences in VAT treatment of meat and other food products).

Conclusions

The conclusions firstly focus on the three groups of stakeholders that we distinguished (producers/importers, retailers/installers, and consumers). Next, the environmental impact is discussed and some general issues are addressed.

Producers and importers

Current producers of the 'greener', 'low-VAT' products will see their market share growing at the expense of those who are specilized in supplying the 'less green' ones. This implies a shift in market share in favour of the first group, but the latter may also benefit by responding adequately. The most innovative firms will develop new and still 'greener' products, considering the prospect of obtaining a strong market position in the future when the criteria for VAT reduction will be tightened.
The case studies tend to confirm that VAT differentiation is expected to be one of the factors having an impact on innovative activity, though its role will differ by type of product and market.

Retailers and installers

The evidence on the extent to which reduced VAT rates are 'passed through' to the final consumers, and thus lead to proportionally lower product prices, is mixed. Empirical evidence as well as expectations among stakeholders show examples of complete as well as of incomplete 'pass-through'. Lack of competition and the prospect of the VAT reduction being temporary are among the factors precluding full 'pass-through'.
The impact of VAT differentiation is expected to go beyond the financial incentive it provides, as it is expected to be used as a communication and marketing tool. For products which are usually installed by professionals, the effectiveness of a reduced VAT rate can be enhanced by applying the reduced rate not just to the product, but to the installation service as well. In some sectors, conservatism among retailers and installers may be an important obstacle, underlining the need for accompanying promotional measures, specifically targeted at retailers and installers.

Consumers

Consumer response to price changes resulting from VAT differentiation will vary between types of products, depending on elasticity of demand. Full 'pass-through' implies a price change in the order of 10%. For meat, dairy and domestic energy (products with low elasticity of demand) this would lead to a change in demand of (much) less than 10%. On the other hand, evidence shows that in some cases the 'substitution elasticity' between 'green' and 'non-green' products within one product group may be much larger. Data on elasticities are scarce anyway, and they should be treated with caution. In dynamic markets with high innovation rates, the impact of VAT reduction will mainly be to move forward the market penetration of the 'newest and greenest' models.
In many cases, VAT reduction may not be sufficient to bridge the 'price gap' between the 'green' and the 'non-green' product. However, for energy efficient goods it will reduce the

'payback' time and thus make them more attractive. Apart from its financial impact, a reduced VAT rate is expected to play a 'signalling' role by drawing consumers' attention to the eligible products.
As with any subsidy scheme, reduced VAT rates will also benefit those consumers who would have bought the 'green' product anyway ('free riders'). Minimizing 'free riding' in dynamic markets requires a frequent updating of eligibility criteria so that only the 'top of the market' qualifies.
Due to the variety in markets for 'green goods' between EU Member States, a uniform EU wide VAT differentiation might stimulate the growth of the 'green' market in some countries, whereas it would be hardly effective (and bring along a lot of 'free riding) in others. This effect could be mitigated by allowing Member States to choose whether or not they want to apply the VAT differentiation for specific product groups. Alternatively, the criteria for reduced VAT eligibility could be differentiated by Member State, though this would add to the complexity of the scheme.

Environmental impact

VAT differentiation may bring about significant environmental benefits in some product categories. Table S.1 shows some estimates from the case studies for greenhouse gas emissions, but there are of course other environmental benefits as well.

Table S.1:Estimated greenhouse gas emission reductions due to VAT differentiation in selected cases (Mt CO_2 equivalents per year)

Product category	**GHG emission reduction (Mt CO_2-eq. per year)**
Central heating boilers	18
Refrigerators, freezers and washing machines	3
Insulation materials	23 – 36
Domestic energy (applying standard rate)	20
Domestic energy (reduced rate for renewables-based electricity)	3
Meat and dairy (applying standard rate)	12 – 21

These estimates should only be seen as an illustration of the orders of magnitude. A complete analysis should address aspects such as:

- impacts over the product's whole life cycle;
- calculate impacts on a 'per unit of service' basis;
- interactions between the product categories;
- the 'rebound' effect (though this is likely to be small);
- the question what happens with the 'old', 'non-green' product when it is replaced by a 'green' one.

Other considerations

The acceptance of VAT differentiation as an instrument to promote 'greener' products appears to vary widely. A majority of stakeholders consulted in the case studies tends to support reduced VAT rates for 'green' products, if properly designed and accompanied by supporting measures. There seems to be much less support for an increase in VAT rates on domestic energy, meat and dairy products to the standard level (in countries currently applying a reduced rate).
For the product groups considered in the case studies, no major problems are expected with respect to definitions and criteria for VAT differentiation.

Though VAT differentiation implies higher administrative and compliance costs, its advantage over many other targeted subsidy schemes is that the basic administrative structure is already in place.
Introducing reduced VAT rates for ‘greener’ products will lead to lower tax revenues, which can be compensated by a relatively small general increase in VAT rates or by other measures. Furthermore, differential tax rates may create an incentive for tax evasion, implying lower tax revenues and higher costs of checks and inspections. Differences in VAT rates between Member States will induce cross-border sales, affecting national tax revenues, although the impact at the overall EU level may be neutral.
A possible VAT differentiation will be just one among several measures of a sustainable production and consumption policy. Its effectiveness will therefore to a large extent be determined by the other elements of the package. These policies are only partially harmonised at EU level, and this is an additional reason why the impact of environmental VAT differentiation will differ between Member States.