The political economy of Ecological tax reforms: socio economic frameworks, multiple dividends and resource taxes.

A survey and insights for implementation in the EU and in member states.

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Abstract

The paper summarises the recent literature on ecological tax reforms with the aim of providing a framework for socio economic and policy oriented analyses on the dividends it may bring about. Given the inter disciplinary flavour, we do not discuss the theoretical economic literature, giving priorities to work that can help shaping EU policy. The general framework we depict on ecological tax reform is also meant to draw a picture where to specifically embed the more detailed analyses of EU resource taxes aims and experiences.

1. Background economics of ETR

Ecological tax reform (ETR) is an essential element in long-term sustainable growth/development and it will also help the EU to further strengthen its global leadership in the eco-efficient use of energy and resources. The current competitive advantage of the EU in terms of resource efficiency, especially for carbon (Mazzanti and Musolesi, 2009) is on the one hand dependant on a stronger reaction to past oil crises, and on the other hand on a strategic decision of (northern) EU countries of implementing environmental policy (waste, pollution related) and green fiscal reforms (Scandinavia in early 90's, UK[1]), that have been completed and has supported green investments by private firms. A new emphasis on ETR is needed even in countries that had adopted them significantly, given recent evidence shows how the share of environmental tax revenue on GDP is decreasing (in real terms) in most countries. This may happen if taxes are not implemented in accordance to a pre defined 'escalator' or if inflation of high growth periods erodes the real value[2]. Even in the UK, some taxes (climate change levy) were frozen in the past years and only projected to grow with inflation in the current years since 2007-2008.[3] The current economic stagnation may provide a rationale for increasing such taxes, though we may expect either an increase in diffusion or even a further decrease in diffusion and share of taxation. The political acceptability of environmental taxes is often extremely low and the multiple static and dynamic gains for society are not effectively understood and communicated. Political economy analyses are needed on theoretical and applied grounds (Aidt, 2010). The way revenue recycling is designed and proposed matters in order to enhance the understanding of both economic and environmental values of ETR.

Ecological tax reform represents an umbrella under which market-based instruments can be designed optimally and implemented coherently (From SOER2005: *'Tax reform can contribute to a more sustainable healthy environment. A gradual shift of the tax base away from taxing 'good resources' such as investment and labour, towards taxing 'bad resources' such as pollution and inefficient use of energy, would also help to internalise external costs into service and product prices. This would in turn create more realistic market price signals.')*. Similar conclusions have been reached by the OECD in their many publications on ETR, culminating in 'The Political Economy of Environmentally Related Taxes' (2006). The Council of Ministers have also endorsed ETR in their recent review of the EU Sustainable Development Strategy: *'Member States should consider further steps to shift taxation from labour to resource and energy consumption and/or pollution, to contribute to the EU goals of increasing employment and reducing negative environmental impacts in a cost –effective way.' (Para 23, Review of the SD Strategy, Council of Ministers, 9 June 2006).*

According to Parry (2009) for the US and to Anderson and Ekins (2009) for the EU, the implementation of carbon taxes and/or auctioned permits is a fruitful way to reconcile in this recession environmental and economic performances, where ETR can be shaped on a real 'policy based' target perspective: set up to finance specific EU (competiveness) aims. As debated in the rich discussion on the effects of Environmental Tax Reform (ETR) in the 90's, double and triple dividends *could* emerge (Busquet, 2000).

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[1] For a survey of the 90's experiences see Bosquet (2000).

[2] The Economist has recently presented comparative evidence, and also the Environmental Audit Committee (2009) has focused that the UK, though a supposed and potential leader in environmental policy, especially regarding the introduction of (fiscal) economic instruments, has recently showed a shaky picture after a sort of golden age in the 90's: 'In 1998 and 1999 green taxes as a proportion of all taxation peaked at 9.7%; since when the proportion has fallen almost steadily, although the figure of 7.4% in 2007 was a slight increase from the 7.2% recorded the previous year. During the same period, environmental taxation as a proportion of Gross Domestic Product (GDP) fell from 3.5% (1998) to 2.7% (2007). In all years since 2001 real terms income from environmental taxation has been below that recorded in 1998' (see also chart 1 in that report). Similar evidence can be found in other countries even in northern EU, though evidence is heterogeneous as expected. Overall, the trend is not increasing; most countries show stable or decreasing figures over the last decade with few exceptions. Pure environmental taxes (Italy) may show some increase, but remains at a very quite insignificant share of GDP, and very low in revenue compared to energy taxes. In conclusions, total energy and environmental taxes reduce their share over the past in the EU15 on a general.

[3] The environmental audit committee (2009) states: 'we note that in the past, rates for these taxes have been frozen or subject to below-inflation'.

The environmental externalities of Transport, including accidents, pollution, noise etc., are in fact estimated to be equivalent to 5-8% of the EU GDP. The estimated external costs of Energy and Agriculture are around 1-2% of GDP. Other externalities, such as for industries like chemicals, have yet to be estimated yet they too can be expected to be very large.

In order to start specifying the economic facts behind the implementation of an ETR (and is economic theory, applied and political rationale) we may observe that:

From a **microeconomic point of view**, ETR are designed to tackle external effects. They provide static efficiency by reducing externalities, and dynamic efficiency through continuous stimulus to innovation. Thus net benefits for society are potentially positive in the short term and long term. This links the implementation of ETR to the Porter hypothesis framework: environmental and economic competitive advantages are driven by stricter regulations. It remains true that the priority aims of ETR are to reduce external effects. Induced innovation can then spur economic benefits. Tax revenues are possibly used to effectively increase public goods or reduce distortionary taxes, for the achievement of multiple dividends.

Quite recently, Gimenez and Rodriguez (2010) reanalyze the DD literature with the aim of reshaping and clarifying the meaning of the ETR objective. Though the paper does not offer a complete new framework, it clarifies issues and offers in the end an empirical example of welfare effects on the US economy. They state that it would be desirable to consider a new definition for both dividends which does not create confusion among competing policy objectives, namely reducing the level of an externality and the tax distortions caused by the fiscal system. Accordingly, they affirm it is attractive to have ‘‘a sort of separability in the tax structure, which might be taken to suggest that environmental taxes should be employed first, with the Ramsey taxes being used to fill up the tax revenue requirements’’. Any analysis should integrate the Ramsey and Pigou approaches. They conclude that by deducting the primary costs of the environmental tax from the second dividend and adding them in the first one, this new definition will in any case reinforce the second dividend.

The ETR may be a way, during strong (social) crises, to put *into question the whole (social) 'model of development'*, generally asking for readdressing the growth/development machine towards equity, quality, wisdom, values, more production of public and collective goods. Building upon a social consensus that may derive from its joint economic environmental benefits, quite unrepeatable we believe for the features of the crisis, ETR can be a pillar of a change of values and a structural factor behind an investing society based on sustainable consumption and production. Only a multi tool kit such as the ETR can transform this possibility of achieving multiple targets into economic reality.

The **characteristics of the current economic crisis[4] may be very appealing and favouring a more extended application of ETR**, in both northern and southern EU countries. In fact, if the scale effect is trivially beneficial to the environment in the short run, the ultimate end of environmental policy is to target environmental efficiency and overall productivity of the economy in the long run, even 'taking advantage' of the crisis. A sustainable economy is thus a greener (and fairer) economy that increases its social and economic performances in the broadest meaning. The implementation of extensive ETR policies in this scenario is an effective way to coherently link short term (sustain economic growth trough demand, and other benefits we will comment on) and long run objectives (sustainable economic and environmental growth, where we want to mitigate potential lack of demand, reduce externalities, having prices reflecting

[4] The peak of the crisis was end of 2008 and the all 2009 year. Nevertheless, we can now extend the reasoning to the post crisis, a situation where even if economic growth is recovering, this is happening often at low rates (maybe expect Germany), with weak impact on employment and a key necessity of re-thinking the comparative advances of advanced economies in face of the increasing competitiveness and role of emerging economies (the EU will decrease its weight from 18 to 13% of world GDP in 10 years, emerging economies will likely increase to 30%). ETR may be a way to reconcile environmental and economic performances by spurring competitiveness and innovation as entangled factors, along Porter hypotheses perspectives. Some evidence on the Eu seems to support this assertion (Costantini and Mazzanti, 2011).

relative scarcity of all resources, improve social welfare). ETR can be targeted and tailored to those different but potentially complementary social needs.

For the current implementation of ETR, we should note that this new emphasis on a greener economy, based on public investments and incentives to private investments that should contain a greener content, arises in presence of a deflationary recession, with relatively 'low' resource prices. This is important and quite different from past crises of the 70's characterised by high cost-based inflation that reduced growth through a shrink in production. Being the actual crisis a (lack of) demand economic slump, ETR may address with one arrow different targets and posses an untreatable political and economic appeal. In fact the crisis is that proposed (green) Policy / investment stimulus may operate in association to low/unstable market incentives towards resource efficiency, thus generating less than expected potential benefits.

Thus strong rationale for environmental fiscal policy (green taxes and/or auctioned emission permits) emerge on the basis of the following joint elements: structurally Changing relative prices for higher resource efficiency with a medium long run perspective in mind; Supporting Green investments and Sustainable Consumption to boost current cycle and rebalance future growth/ demand; Great chance for adopting Green (fiscal) 'inflationary' actions (a sort of triple/4 dividend scenario may emerge: environmental benefit, (green) demand, avoid deflation, relief to public budgets under stress).

Given that the opposition to fiscal measures from a political perspective has always mainly been rooted on the inflationary effects[5] (and circumscribed costs accruing to certain parts of society that bear higher production costs, partly transferred to consumers), this economic situation is indeed unrepeatable in terms of political acceptability and macro economic necessity: deflation (EU prices have and are now increasing at around 1.5%, lower than central back long run target; even if strong signals of deflation are not visible, attention is high on those figures; this is the worst of economic evil and would depress investment opportunity through increasing debt as the known Japanese 1990-2000 period taught us), unemployment and recession call for inflationary measures, labour market and training actions, fiscal stimulus to economic growth. Paradoxically, ETR is in the short term motivated by economic rationales, with environmental spillovers, remaining instead clear the core environmental aims in the long run, from which economic objectives should follow. Clinch and Dunne (2006) present clear discussion on Ireland of the difficulties of implementing ETR double dividends reforms when economic growth and inflation re high and unemployment and public budget necessity are low. That is maybe the reason why after the emphasis in the early 90's such reforms were frozen both by theoretical critical arguments and by an unfavourable macroeconomic environment.

From short to Long term facts

Ecological tax reform (ETR), is thus an essential complementary element in the policy tool kit aimed at long-term sustainable growth and development and it will also help the EU to further strengthen its global leadership.[6] It posses in our view both economic appeal to cope with the 'two crises' (economic and environmental) and unrepeatable political appeal in the current situation. The ETR is also a way, during strong (social) crises, to put into question the whole (social) 'model of development', asking for readdressing the growth/development machine towards equity, quality, wisdom, values. We may sum up some key issues in the discussion.

Ecological tax reforms may be emphasised as a specific set of measures to achieve a greener structure of the economy. Further to the usual 'double dividend' (employment + environment) – or even 'triple

[5] Deroubaix and Leveque (2006) in a study of France discuss the political acceptability, finding that resistance is linked to 'fuel revolts' and more likely in periods witnessing high oil prices. This obviously confirms the above statement on the unrepeatable occasion for introducing extensive ETR in the EU in the current recession.

[6] The current competitive advantage of the EU in terms of resource efficiency, especially for carbon is on the one hand dependant on a stronger reaction to past oil crises, and on the other hand on a strategic decision of EU countries of implementing environmental policy and green fiscal reforms (Scandinavia in early 90's, UK), that have been completed and has supported green investments by private firms. For a survey of the 90's experiences see Bosquet (2000).

dividend' (employment + environment + innovation) –, ETR may provide other dividends depending on economic policy priorities.

Fiscal measures help increased production of greener products and private provision of public goods: Most green consumption goods are 'mixed goods', with a 'private' component (e.g. save energy costs) and a 'public' component (emission abatement from less energy). Individual willingness to pay may be not sufficient to pay for higher prices of greener options. A subsidy is thus justified insofar public spillovers and free riding on public good provision. The same argument applies to technological options. Firms need support during a crisis to mitigate credit crunch and increasing risk aversion and uncertainty effects, and to start investments in risky but high benefits new technological options[7].

Unfreeze the ecological tax reforms. A new emphasis on ETR is needed even in countries that had adopted them significantly, given recent evidence shows how the share of environmental tax revenue on GDP is decreasing (in real terms) in most and even unexpected countries, as some figures on total energy and environmental taxes below show. It is true that figures on 'pure' environmental tax revenue may be witness rising trends, but that revenue net of energy and transport tools is nevertheless negligible, around 0.1-0.2% of GDP or even less on average.[8]

The characteristics of the current economic crisis may be very appealing and favouring a more extended application of ETR. Given that the opposition to fiscal measures from a political perspective has always been rooted on the inflationary effects, the current decreasing trend of prices is indeed unrepeatable in terms of political acceptability and macro economic necessity. ETR is in the current short term we experience strongly motivated by 'keynesian oriented' economic rationales, with environmental spillovers remaining the core environmental aims in the long run.

The implementation of extensive ETR policies in this scenario is an effective way to coherently link short term and long run objectives: sustainable economic and environmental growth, reduce externalities, having prices reflecting relative scarcity of all resources, improve social welfare[9]. It is worth noting that a certain degree of decentralisation at national level is needed for tailoring the ETR to 'local' needs. In fact, the tax type and revenue recycling policy, as well as the country specific institutional and economic situations (labour and financial markets, energy sources) affect the kind and intensity of 'dividends' achievement.

Having set the structural price and revenue recycling elements in the short term, **structural price incentives and sustained expectations should provide their main environmental effects in the medium long ru**n, especially regarding the indirect effects operating through the market

The **dynamic efficiency** of such measures, operating though effects on the innovation should in the end emerge: on the basis of changed relative prices and non myopic and stable expectations, investment choices may flow towards the best alternatives in social terms. Private agents choose the options that give the highest net present value over the investment time (15-20 or more years). Technological fixed costs as long as incorrect project evaluation methods (break even instead of net present value) can be the causes of lock in second or third best technological choices deriving from economic instruments dynamic effects on innovation (Del Rio, 2007). The crisis itself and the absence of a strong ETR in the economy could undermine the pre conditions of such important background situation. Only with correct prices and stable expectations future growth can bring together environmental and economic sustainability along the scenario of an overall 'investing society'. Induced technical change is a pre-condition for growth and sustainability

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[8] Similar conclusions have been reached by the OECD in their many publications on ETR, culminating in 'The Political Economy of Environmentally Related Taxes' (2006).

[9] The evidence for ETR can be found in a range of sources including relevant EEA reports such as three reports on environmental taxes and other market based instruments, (1996, 2000, and 2006); and reports on the sustainable use of natural resources (2005a), and on household consumption (2005b).

towards a carbon free society. Carbon taxes and ETR in general is one pillar of such possible transition (Gerlagh and Lise, 2005)[10].

One major 'flaw', in terms of revenue recycling possibilities, may derive from the intrinsic feature of environmental taxes or auctioned permits: the main objective is to reduce the externality, not generating revenue. Thus **the tax base could shrink over time**, leading either to a reduction in the generated revenue or in a necessary but distortion increase in marginal environmental taxes, that does not depend on externality valuation but on the need to preserve fiscal budget neutrality. One way out of this problem for preserving the 'economic dividend' and the efficiency of taxation, may be found in part from a further extension of the resource fiscal base (applying taxes to new resources) and by an endogenous increase in taxation deriving from higher employment levels, spurred by both lower labour takes, but also by an economy structured on productions and sectors with higher value added with respect to the present. This is linked to the goal of linking on the one hand economic and environmental issues, and on the other hand static and dynamic issues within the implementation of ETR. Biased implementation focusing only on some aspects (economic only, environmental effect only, static properties etc..) are likely to be less effective and efficient in the end.

Another flaw is generally linked to a '**tax interaction effect'**: if on the one hand labour cost reduces boosting labour demand, higher product prices lower real wages and may depress labour supply. The net effect depends on this sum of labour market effects, that must be disentangled in low skilled and high skilled effects. Some employment costs may emerge in some parts of the labour market in the end. We should be aware in the long run that labour demand and supply are driven not only by wage levels but also by the value added of production and its complementary technology contents and skill workforce levels, all factors on which the ETR should try to have influence from the beginning by recycling revenue towards education, technology, high value (green) sectors (Goodstein, 2002)[11].

ETR can thus in the long term bring together economic (mainly a labour intensive growth), environmental, public budget aims.

"A 'green' fiscal stimulus can provide an effective boost to the economy, increasing labour demand in a timely fashion, while at the same time building the foundations for sound, sustainable and strong growth in the future' (Grantham research centre on climate change, 2009). We nevertheless note the possible paradox of a labour intensive growth: **low labour productivity**. We have experienced periods of problematic high growth, high productivity, then with low impacts on employment (the 90's) and other with lower growth but higher employment creation (low productivity) as this decade before 2008. Intuitively, the green stimulus and ETR actions could re boost growth, productivity, and employment in a sustainable way. Joint Investments in demand and education and research should make this possible, generating labour productivity being at 'normal' historical levels in the long run equilibrium. A positive or increasing dynamic of labour productivity is indeed needed, mostly if environmental and labour productivity trends are correlated to each other in the long run dynamics. The shortcoming of high productivity, low employment creation, is to be solved by the only way possible: continuous investments and research of value added sectors, and transformation of low value added productions and low skilled people in high values alternatives. This destruction and creation process is to be fuelled by continuous investments (thus the investing sustainable society) to prevent economic and ecological crisis to occur.

Economic performance are actually extensively analysed by use of macro econometric 'general equilibrium' models of Keynesian flavour. Very recently, on the edge of the new emphasis on ETR, climate change and EU competiveness within the current economic crisis, they have provided various estimates of future scenarios deriving from the implementation of (green) recovery packages and environmental policies (Pollitt and Junankar, 2009a,b; Barker et al., 2009).

[10] The study carbon taxes within a model that presents a useful sketch of the economic system (-research-innovation-labour-capital) highlighting flows and stocks.

[11] Khan and Farmer (1999) comment on the various critics that were posed on the possibilities of achieving double dividends, manly passing through distortions in labour supply. The main flaw of such critics in their eyes is an under evaluation of natural resource as a factor of production, and a narrow focus on labour market effects.

In particular, Barker et al (2007, 2009) and Pollitt and Chewpreecha (2009) provide evidence on productivity, competiveness and carbon leakage effects of ETR using a highly disaggregated macro econometric model where medium run forecasts are informed by the effective history of green reforms in the EU, as applied in some countries (Scandinavia, Netherlands, Germany, UK). The outcomes are of some relevancy due the focus on EU and economic/export performances.

An overall conclusion that emerges and can inform current policy making is that the mild (between 0.2-1% of GDP) ETR implementations did not produce and are not expected to produce negative effects on employment, GDP, and of some interest to us, on competitiveness (export performance). The only relatively possible negative outcome is a reduction of productivity, depending on the fact that the circumscribed effect of ETR increases employment more than GDP. As far as the scenario deriving from the hypothesis of reaching the threefold 20% 2020 targets through a revenue neutral EU27 carbon tax, estimates show that the productivity effects are highly heterogeneous across countries, but exports and imports are unaffected, especially under the hypothesis that tax revenues are recycled by fostering investments in efficient machinery[12].

We note that the targets achieved in the short term somewhat differ but to a great extent support and make possible the achievement of long run targets. The definition of partially different but explicitly linked short term and long term targets may help both the overall effectiveness of the action and its political feasibility.

Summary Box – The framing of ETR from short to long run: socio-economic appeal and political feasibility

Short run[13] *economic and political* targets

- Emphasis on macro economic stimulus, equity and employment gains
- Macroeconomic stimulus to green investments and consumption to revive demand and make it greener
- Microeconomic redefinition of relative prices of green/brown consumption options
- Dynamic efficiency: Supporting niche markets for non mature costly (radical) innovations associated to high present value net benefits (with subsidy to be relaxed once they mature)
- Relief to poverty and compensation for regressive energy price increases during the recession[14]
- Inflationary action (avoiding deflation); side effects deriving from the increasing price nature of green taxes, appeal in the current situation
- Labour tax cuts and education investments (active labour policies) focused on low skilled workers

Medium-Long run *economic and political* targets

- Emphasis on core environmental aims, technology and budget relief gains
- changing resource prices according to scarcity and externalities
- extending environmental resource tax base, shrink labour tax base more and more
- inducing technical change though prices or financing specific technological options
- Using green tax revenue (in excess of expenses) to provide relief to budget after fiscal actions in the recession (if needed). Structure the ETR as neutral in the long run using borrowing/saving flexibility ins specific times

[12] At sector level, another fruitful direction for research has actually been in recent years the analysis of NAMEA data. Though some have recently included trade openness, 'policy' analysis, and R&D as additional merged factors to NAMEA (Marin and Mazzanti, 2011), the core value of NAMEA remains the analysis of the sector based income-environment relationship. Our analysis is to this extent highly complementary as evidence to other sector based direction of applied research.

[13] Thinking of the current situation short run can be defined as a period covering 2009-2012 imagining an ETR implemented since 2009-2010.

[14] Though ETR effects on prices may just compensate decrease due to lowering oil prices, with a negligible net effect.

2. From ETR to RTR – the rationale and issues in resource taxation

The section presents a theoretical and empirical survey of works regarding resource tax reforms with a special emphasis on EU potential implementation. We claim that the rationale for investigating resource tax reforms in isolation from ETR in general terms is the different framework.

A framework that is relevantly coherent with a 'political economy' approach, where the analysis of externality generated by extraction (of water, soil, minerals) and related rents cannot be disjointed from reasoning around the distribution of rents capture and the reinvestment of rents. Efficiency reasoning (optimality of rents, optimality of extraction) are entangled with reasoning on effectiveness and distributional impacts (dividends) arising from the dynamic management of resources. The existence of rents as related to property rights on (land) resources make a political economy approach (opposed to a purely economics one) more robust (O'Connor, 1994). A capital based approach to sustainability (weak or strongly defined) is also a key pillar of such framework, enriched by issues of rent distribution and bargaining power of involved stakeholders over resource use (Stern, 1997). Summing up, efficiency and distributional issues (of any kind, rents distribution among stakeholders, possibility of alleviating regressive impacts of resource taxes, etc.. Dresner and Ekins, 2010) should be brought together in a full dynamic scenario where the analyses of the 'use' of the resource (its extraction) and 'the use of rents' the reinvestments and its multiple aims are jointed. This perspective needs to take into account more than one paradigm on sustainability, both centred on natural capital and its services and functions to society but with different flavour (O'Connor, 2007) and different weights attached to efficiency, effectiveness, distribution of value, political bargaining over resource value:

- "Sustainability as non-diminishing aggregate consumption (or societal utility) underpinned by natural capital, as in the neoclassical economics modelling conventions, and
- Sustainability as a complex systems co-evolution engaging four major classes of organizational forms, the economic, biophysical, social and political spheres" (O'Connor, 2007).

The rationale for a resource tax reform (RTR) in the EU embedded in a more general ETR, is highly motivated by the very low level of taxation in most countries on 'land based' resources such as waste, materials, water, and by the consequential low presence of substantial earmarking of revenues. Both pillars (higher taxes and earmarking) are key in the light of linking sustainability, in its aspects of optimality of use of resources and effectiveness of investments accruing from rents generation. Earmarking and rent capture/distribution is evidently the political economy side of this framework. Following Baumol (2010) in his re-visitation of the Cost disease under an environmental point of view, we can highlight that resource taxes are socially useful to rebalance the production costs in favour of environmental services based activity (vs manufacturing, energy and construction, which heavily depends on direct resource use), such as services offered by nature, environmental services supporting manufacturing, all activities with high labour/environmental capital content and thus exposed to rising cost prices. Resource taxation and its earmarking (subsidy) could tackle this critical point of society and economic development. Institutional challenge can help achieving sound sustainable development path inspired by rent taxation. How (efficacy), when (timing) and where (scope, aims) money are spent matters. Genuine saving measures depend on the quality of institutions in a political economy reasoning (Kolstadt and Wiig, 2009). Resource curse scenarios are the vicious side of sustainability that RTR can tackle and eventually turn into virtuous cycles.

2.1 Resource taxes within ETR. Specific Resource taxes features.

When we apply the theoretical reasoning developed in the ETR literature to real world Resource taxation, some points should be kept in mind to understand the effective 'political economy' framework and the final effects and objectives of such taxes. Table 1 (and the surveys below) shows a list of relevant papers within a literature that is less consolidated with respect to that dealing with pollution taxes and ETR effects and experiences. What it maybe lacks is a series of papers comprehensively describing the potential structure of a 'resource tax reform' as disentangled from ETR in general. We try to offer some insights on this point while commenting on the literature works.

Specific fields such as aggregate extraction, minerals are investigated. It is often the case that the focus is on 'taxes on non renewable' resources that pose the well known problem of (optimal) resource taxation for rents capture. Efficiency and distribution issues are analysed. Insofar extraction activity involves emission

production; resource tax could be aimed at internalising different externalities: emission and land use related to extraction. Static and inter temporal externalities should also be dealt with. Within a more general ETR, then, the need of applying diverse instruments could arise if objectives of environmental policy making are multiple.
Rent capture and distributional issues, incentive based mechanisms and dynamic efficiency, interaction with other fiscal measures, comparison of efficiency and effectiveness associated with resource use and consumption based tools are among the main investigated issues. Dynamic issues are at the core of any reasoning around resource taxation.

2.2 Theoretical and conceptual literature

The literature on resource taxation is huge and goes back to the early years of environmental economics and policy. Robinson (1983) claimed that this literature went back to 25 years before, in his analysis of the welfare cost of resource taxation. He presents the well known facts that the scarcity rent and the intrinsic inelasticity of supply are strictly interrelated concepts and that taxes should be heavier on such resources compared to similar commodity.

Starting from that, it is useful to recall some taxonomy and definitions regarding 'resource taxes', a term less general and contained in the basket of environmental taxes but still far too general, embedding various typologies of instruments and aims. A brief sketch of the key theoretical issues is useful to achieve some more detailed taxonomy on the basis of features and aims.

Taxing rents is often efficient (distortions as we highlight can exits, but we should take into account different efficiency notions in fiscal settings: the efficiency of the instrument in itself, the relative or net efficiency when we apply neutral fiscal reforms rebalancing fiscal sources, the efficiency in stimulating dynamic increases in productivity (Markandya, 2009) and effective. We thus should deal with (different type of) fiscal and also induced innovation efficiency. As a complement, we can also state (Maloney, 2002) that taxing resource rents may be a way to neutrally swap such rents, minimising distortions if any, to generate quasi-rents related to fixed costs in technological progress (R&D, etc..). Nature rents finance innovation rents towards a possible and typical sustainable path.

Taxing rents is price determined and not determining. Resource rents taxes are cash flow based tools, where the cash is the rent. A rent does not enter production costs and determine value, that is why in principle such taxes belong to a family of non distortionary taxes (Bosquet, 2002, though see Tilton, 2004 for highlights of distortions related to royalty taxes and Garnaut, 2010, who comments on concrete – not only theoretical - neutrality of mineral taxes in the Australian framework. Some potential distortionary effects are highlighted).

Coady and Dreze (2000) generally address the purposes of commodity taxation (resource allocation, revenue generating, distribution of income: often fiscal reforms and TER/RTR involve trade offs between such aims, that should be mitigate by adopting the correct mix and level of tools), embedding the theory of optimal taxation – efficiency point – into the theory of fiscal reforms – not only based on efficiency.

'Taxes' can classified at least in: royalty taxes (resource rent tax applied on the marginal unit of value or output), quasi rent taxes (monopoly power due to sunk costs), profit tax or pure rent taxes (not applied on the marginal unit). The latter are claimed to be non distortionary as known.[15] See also Tilton (2004) for taxonomy on rents. Including externality arguments, the reduced output could be desirable, and the royalty resource tax acts as a pigovian kind of tool.

[15] "A royalty drives a wedge between the world price and the price that producers receive for each unit of output, decreasing the quantity supplied to below the efficient level, creating an efficiency cost equal to the shaded triangle (the forgone rents on minerals no longer mined). Thus, royalties are inefficient. In contrast, a pure profit or resource-rent tax extracts a portion of the rent. As the marginal unit of output earns no rent, no tax is paid on it and the producer receives the world price for it. The pure rent tax, therefore, has no effect on output" (Ergas et al., 2010). Hung and Quyen (2009) add insights in saying that not withstanding the equivalence in static framework between an ad-valorem and a specific sale tax (royalty taxes), in the dynamic Hotelling model for an exhaustible resource the ad valorem tax is definitely welfare-superior to the specific tax.

2.3 Political economy and some more insights on Resource taxes features and effects

Focusing the attention on more recent works in the literature, van der Ploeg (2010) interestingly revisit the Hotelling and Hartwick models including political economic distortions. First, it demonstrates that is not sub optimal for resource rich countries to get genuine saving in the short run if extraction technologies are expected to improve (waiting for better time). Then, including different social groups and imperfectly defined property rights, political distortions lead to lower sustainable consumption and lower than optimal accumulation of assets (sovereign funds). This is truer the more social groups are rivalising over resources. Prices rise too fast as a consequence of fast depletion. The theoretical model tries to capture the issue of fractionalised interest groups and property rights in the management of resources in resource rich countries.

Regarding the issue of 'optimal taxation' in presence of commodity taxes and non renewable resources, Daubanes and Lassere (2011) examine the Ramsey rule, and show that contrary to other claims that capital should not be based in the very long run, royalty tax (the income of natural capital reserves) should be higher than a tax on another commodity with equal elasticity. They also are variable – not constant as usual commodity - and depend on government needs: the higher the needs, the closer this tax to monopoly price.

Those two papers give support for the rationale of RTR and use of revenues for social aims, and touch a political economy perspective.

Another recent paper that extensively surveys design and aims of resource taxes is Boadway and Keen (2009), who stress the difference between rents and quasi rents (both possibly present in resources exploitation, the latter associated to sunk cost investments not existence of resources as such). They correctly stress that: "Economic rent is the amount by which the payment received in return for some action—bringing to market a barrel of oil, for instance—exceeds the minimum required for it to be undertaken. The attraction of such rents for tax design is clear: they can be taxed at up to (Just less than) 100 percent without causing any change of behaviour, providing the economist's ideal of a non-distorting tax. And this appeal on efficiency grounds—which is conceptually distinct from any notion of fairness based on the government's legal or moral claim to ownership of the resource—is reinforced on equity grounds (at least from a national perspective) if those rents would otherwise accrue to foreigners". Distributional issue are highlighted insofar society can (should) extract rents in order to fulfil sustainability goals in general terms, fund specific activity and compensate social losses. It is remarked in the paper that the host country can get substantial benefits from such resource based capture of rents. What Tilton (2004) notes by using basic economic theory is that if governments should maximise social welfare by capturing rents through resource taxes, and social welfare is somewhat linked to the net present value accruing from such fiscal actions, it is not clear whether taxes should be reduced or increased compared to the status quo situations. In fact, there is one tax level that maximise net present value of revenues[16], which looks like a bell with respect to tax rates. It is certain that starting at low level, welfare increases if we move tax levels up.

With a focus on recent tax reforms on mining in Australia, Ergas et al. (2010) stress the difference between a royalty and a pure rent tax, the former being the latter a profit tax that should not affect agents behaviour. A trade off is indeed noted, between reduced incentives to mine and reduced incentives to minimise costs with a pure rent tax. Along complementary lines, Daubanes (2007) "illustrate and argue that the exhaustibility constraint the monopolist extractor faces can be exploited by the regulator to relax the standard trade-off between inducing efficiency and raising revenues from the monopoly". Frestad (2010) with a focus on Norway, treats the issue of jointly implementing corporate income taxes and taxes aimed at extracting extra profits from natural resource use, and studies the effect on firms of this asymmetric fiscal weight (heavier on natural resource rents).

[16] Fraser (2002) note that both the size of profit margin on extracted resource and the level of riskiness of the resource deposit play a role in determining the relative revenue-generating performance of alternatively structured RRTs; the role of each of these factors is mutually re-enforcing in situations which feature either low profit margins

and low riskiness, or high profit margins and high riskiness. As a consequence, it can be concluded that no particular

structure of RRT is superior at generating tax revenue in all situations.

2.4 Moving to open economies and dynamic issues in Resource taxes arguments

Moving from closed economy to open economy reasoning makes the reasoning a bit more complex. Trade is an issue that connects to resource richness, given that abundance of natural stocks is a source of competitive advantage in resource intense productions. Property right enforcement plays a great role in this context given that poor enforcement may bias relative resource values (leading to fast depletion, excess of supply). In addition, countries could (unsustainably) compete by relaxing property right enforcement and lowering taxes in order to attract investments. Rents may well be under efficiency captured or captured by foreign investors (in the profit part). Again political economy considerations match fiscal and economic reasoning.

Looking at oil rich and oil poor countries, Bretscgher and Valente (2010) theoretically and empirically show (some EU countries are within the study) that a national tax policy on domestic resource use not of laissez faire kind improves national welfare through rent transfer mechanisms.

Fairly interest is linked to the Amundsen and Schoeb (1999) paper that moves from a political economy point of view. Their claim is that resource taxation, high/low; more or less efficient, affects international distribution of wealth but does not create incentives for consumers to reduce the purchase of resource intensive goods. This opens the way to RTR that use part of the revenue to change the relative prices of the goods in the economy according not only to emission intensity but also resource intensity. Sustainable capital compensation and relative price reshuffling are two complementary actions to pursue. Bento and Jacobsen (2007) in fact observe that, contrary to some pessimistic results of the 'double dividend' literature on the rising costs of tax distortions after a green fiscal reform is implemented, an ecological tax reform should be part of an efficient fiscal system. Including a fixed factor into the model (associated to what they term Ricardian rents), they show that double dividend achievements are substantial, and the tax distortions costs of a green fiscal reform in presence of fixed factors (non renewable stocks) are negative and up to 11%.

Schoeb (2003), in his extensive paper on the situations where we may experience double dividends, highlights two relevant points. First, he shows as known that as resource consumption falls, marginal environmental damage decreases, and so should the Pigovian tax. He highlights and emphasise that what matters is the 'time path of the environmental tax rather than its level. To delay extraction, the initial environmental tax should be high and then fall over time in real terms. Second, distributional international issues are present. As example, if resource consumers countries coordinate environmental policy (e.g. a carbon tax), it is demonstrated that the time path of extraction in producer countries is unaffected. The tax plays the role of a pure rent capturing tool transferring income from one area to another. Finally, he stresses "Such a tax would have no effect at all on the environment and would thus be a pure rent-capturing tax. If the resource-owning country can exercise market power, by contrast, they may attempt to raise the initial resource price, because this would reduce the environmental tax and allow the resource-owner to capture some of the tax revenues that the resource-consuming countries would otherwise collect".

Taking a growth perspective, another model (Groth and Schou, 2007) presents counter intuitive but supportive results for the double dividend idea, in showing that resource taxes, and not income taxes and subsidies to capital accumulation (as in endogenous growth theory), are decisive for growth rates. Capital accumulation only affects levels, not growth. When resources are a necessary input in the sector where growth is generated, a time varying tax can increase long run growth. Assonance to the Solow model results by which only labour augmenting technical change is key for steady state per capita GDp growth is clear if we substitute necessary resources for labour. Pricing resources increase their productivity and the chances to get positive per capita GDP growth in the long run state (see Solow, 2010 for a survey of the environmental implications of his models). Pittel and Bretscher (2010) further stresses the role of (varying) with time taxes and technological change.
They analyze an economy in which sectors are heterogeneous with respect to the intensity of natural resource use. Long-term dynamics are driven by resource prices, sectoral composition, and directed technical change, that determine growth and stability conditions. Technical change is found to be biased towards the resource-intensive sector. Resource taxes have no impact on dynamics except when the tax rate

varies over time. Constant research subsidies raise the growth rate while increasing subsidies have the opposite effect.

What we can infer from the theory in policy terms is the indication that, besides different incentives and distortions associated to specific tools in the static world (royalty taxes vs rent taxes vs etc..), when taking a dynamic perspective time varying / decreasing tax rates seem optimal for achieving sustainable paths.

The efficiency and effectiveness of a full RTR is another story. Static and dynamic issues are to be dealt with. Revenue generation can be substantial at least in the short run, starting with high tax rates compared to the status quo and low elasticities. Revenue recycling could be allocated to distributional (giving rent share to society as a stakeholder), sustainable consumption (given that resource taxes hardly affect consumption choices, price changes could be determined by subsidies to resource light goods), damage compensation (to get at least a zero genuine saving after extraction) and technological purposes (increasing productivity is again a key point for bringing together growth and sustainability). All actions contribute to some extent or another to the achievement of sustainable development in its three pillars.

2.5 Empirical literature

The width of the literature is not impressive, and a strong bias towards empirical analyses on resource rich developing countries exists. The main reasons are an interest on the management of natural resources on poor areas exposed to the 'resource curse' risk and lack of investments (negative genuine saving), and in addition a lack of proper data. This has limited the empirical literature, even in advanced countries where in fact evidence is even lower. If we add the fact that resource taxes have been generally less implemented (besides mining taxes) compared to emission taxes, there is also a lack of policy oriented empirical analysis. The share of resource taxes on GDP in the EU- and not only, even in resource rich country such as Russia (Bosquet, 2002) - is extremely low and confirms this statement. Similarly to the specific waste realm, where only in recent years new data and policy actions have allowed dome robust empirical analyses.

There are some studies that link to the resource curse hypothesis, not only dealing with developing countries.

For example, Harkness (2009) analyzes the four hypotheses of resource curse occurrence in an advanced country (US) using data on Kentucky coal counties: (1) that resource abundance retards growth, that resource rents lead to (2) under-taxation by the government and (3) the diversion of funds away from the provision of public goods, and (4) that resource abundance and/or rents increase corruption. He shows that while on the one hand such countries present lower long run economic growth, it is not true that they under tax rents and under invest in local public goods such education. This exercise could be well replicated for the case of EU regions with high resource intensity. In a cross section study on US as a whole, Kapyrakis and Gerlagh (2004) found that in fact natural abundance reduced the (1986-2000) rate of growth and also decreased investments in public goods/R&D and increased crime rates.

A more usual but fairly interesting study is by Hamilton et al. (2005), who address a country factual issue (what would have been the economic growth of countries had they followed a genuine saving sustainable policy). The show that not being sustainable (not compensating capital losses, that is not reinvesting rents in other assets as the Hartwick rule prescribes) can be highly detrimental: Venezuela and Gabon would be as wealthy as South Korea, a country with massive performances in HDI and GDp over the last 30 years, while Nigeria would witness a GDP per capita five times as much as the current level. Morbee (2009) takes a political economy modelling strategy, analysing from theoretical and empirical point of views the issue of 'government take', the share of revenues that resource rich countries claim from producers. It is shown that this share is highly variable and depends on the institutional 'flavour' of the government and on the stock abundance of resources. Bornhorst et al. (2008) analyses on resource rich countries present evidence on the share of revenues from hydrocarbons, the relation between this share and domestic taxes. The key test is on the hypothesis by which higher resource based taxation hampers non resource based taxation. Outliers are Norway (low resource taxes, high non resource taxes) and Kuwait (very high resource taxes, medium-low non resource taxes). Econometrics shows that the two fiscal revenues are associated to a 'statistically significant negative relation, with a typical result being that a 1 percentage point increase in hydrocarbon

revenue (in relation to GDP) lowers non-hydrocarbon revenues by about 0.2 percent after controlling for other factors that might be expected to impact on Domestic revenues. However, our finding that the negative response of the domestic revenue Effort to hydrocarbon revenues is broadly the same in countries with low and high corruption Levels, which suggests that factors other than the domestic revenue effort are the more important Determinants of governance problems'. Within a complementary point of view, Segal (2010) addresses the possibility of reducing poverty at global level by transferring resource rents to citizens through cash flows, a typical distributional aim. This is defined 'resource dividend', one of the possible dividends (a social one) of a RTR. Estimates show that taking the 2000-2006 resource rent (World bank data, price of resource – 15 natural resources available – minus the average cost times the extraction/production) and income distribution figures, such a transfer could reduce the share of people living under 1$ per day by 27-66% and the Gini coefficient is reduced by more than 5 points in 9 out of 17 countries. Rents as a share of GDp are estimated as being between 51% (Nigeria), 40% (Iran), and a low peak for Turkey (0.4%) among the considered countries.

Regarding EU countries, it is interesting to note two studies that try to evaluate the rent associate to a renewable resource, hydropower, and investigate the effects of the introduction of a new resource rent tax, taking into account the issue of cost minimization of production processes, basically by designing a resource fiscal system that penalize inefficient firms. As we commented on, rent taxes could lack incentives, both regarding cost minimization of firms and the resource consumption by consumers. Incentive based structure is then crucial in the design of RTR.

3. Resource taxes within ETR

When we apply the theoretical reasoning developed in the ETR literature to real world Resource taxation, some points should be kept in mind to understand the effective 'political economy' framework and the final effects and objectives of such taxes. **Table 1** shows a list of relevant papers within a literature that is less consolidated with respect to that dealing with pollution taxes and ETR effects and experiences. What it maybe lacks is a series of papers comprehensively describing the potential structure of a 'resource tax reform' as disentangled from ETR in general.

Specific fields such as aggregate extraction, minerals are investigated. It is often the case that the focus is on 'taxes on non renewable' resources that pose the well known problem of (optimal) resource taxation for rents capture. Efficiency and distribution issues are analysed. Insofar extraction activity involves emission production, resource tax could be aimed at internalising different externalities: emission and land use related to extraction. Static and intertemporal externalities should also be dealt with. Within a more genera ETR, then, the need of applying diverse instruments could arise if objectives of environmental policy making are multiple.

Rent capture and distributional issues, incentive based mechanisms and dynamic efficiency, interaction with other fiscal measures, comparison of efficiency and effectiveness associated with resource use and consumption based tools are among the main investigated issues. Dynamic issues are at the core of any reasoning around resource taxation.

Table 1 – Resource taxation based studies

Work	Main contents
Enhanced recycling through a material tax, Butlin, 1983	The study concludes that a consumption tax based on the exhaustible resources and energy used in the production of a good is likely to create more savings for fossil fuels than for other exhaustible resources.
Fraser, 2002, An evaluation of the relative performance of alternatively structured resource rent taxes Resources Policy	both the size of profit margin on extracted resource and the level of riskiness of the resource deposit play a role in determining the relative revenue-generating performance of alternatively structured RRTs; the role of each of these factors is mutually re-enforcing in situations which feature either low profit margins and low riskiness, or high profit margins and high riskiness. As a consequence, it can be concluded that no particular structure of RRT is superior at generating tax revenue in all situations.
Hung, Quyen 2009, Specific or ad valorem tax for an exhaustible resource?, Economic letters	Not withstanding the equivalence in static framework between an ad-valorem and a specific sale tax, this paper shows in the dynamic Hotelling model for an exhaustible resource that the ad valorem tax is definitely welfare-superior to the specific tax.
Broadway and Keen, 2009, Theoretical Perspectives on Resource Tax Design, mimeo.	This paper reviews the challenges for tax policy in dealing with the resource sector, the principal instruments used, and some of the central design issue
Garrod and Willis, 1999, Externalities from extraction of aggregates Regulation by tax or land-use controls, Resources Policy	Quarries create externalities such as noise, dust, and visual disamenity in the production of minerals. Externalities can be regulated by taxes, or land-use controls specifying externality levels not to be exceeded. This article shows how stated preference methods can be used to estimate the value to local residents of avoiding different externality levels from a quarry. From this a tax value per tonne is derived,
Lund, 2009, Rent Taxation for Nonrenewable Resources, Annual review of environmental resources	
Groth an Schou, 2007, Growth and non-renewable resources: The different roles of capital and resource taxes Journal of environmental economics and management	We contrast effects of taxing non-renewable resources with the effects of traditional capital taxes and investment subsidies in an endogenous growth model. In a simple framework we demonstrate that when non-renewable resources are a necessary input in the sector where growth is ultimately generated, interest income taxes and investment subsidies can no longer affect the long-run growth rate, whereas resource tax instruments are decisive for growth.
Amundsen and Schob, 1999, Environmental taxes on exhaustible	Environmental problems are tied to the use of exhaustible resources. A resource tax extracts rents from the resource owning countries, without creating significant

resources, Eur. J. Of political economy	incentives for consumers to reduce their resource consumption. The placement of the tax burden on resource owners affects the international distribution of wealth
Peery Cover and Pasten, 2009, Does the Chilean Government Smooth Taxes? A Tax-Smoothing Model with Revenue Collection from a Natural Resource, SSRN	Does the Chilean government smooth taxes? This paper argues that the answer is yes, but only if one takes into account royalties from copper
Bornhorst et al., 2008, Natural Resource Endowments, Governance, and the Domestic Revenue Effort: Evidence from a Panel of Countries SSRN	The recent development literature stresses that countries that receive large revenues from natural resource endowments typically raise less revenue from domestic taxation, and that this creates governance problems because the lower domestic tax effort reduces the incentive for the public scrutiny of government
Pittel and Bretscher, 2010, Sectoral Heterogeneity, Resource Depletion, and Directed Technical Change: Theory and Policy, *CER-ETH Working Paper No. 08/96* and Canadian Journal of economics Alvarez Cuadrado & van Long, 2008, Relative Consumption and Resource Extraction *CIRANO - Scientific Publications 2008s-27*	We analyze an economy in which sectors are heterogeneous with respect to the intensity of natural resource use. Long-term dynamics are driven by resource prices, sectoral composition, and directed technical change. We study the balanced growth path and determine stability conditions. Technical change is found to be biased towards the resource-intensive sector. Resource taxes have no impact on dynamics except when the tax rate varies over time. Constant research subsidies raise the growth rate while increasing subsidies have the opposite effect. We also find that supporting sectors by providing them with productivity enhancing public goods can raise the growth rate of the economy and additionally provide an effective tool for structural policy.

4. Conclusions and Insights for implementation of RTR

At a conceptual level, we may affirm that there are some structural differences that deserve attention when we move the reasoning on concepts and implementation of ETR from emission taxes to resource based taxes. First, in some (most?) cases we face a *striking difference between pollution externality and resource-based externality and scarcity*. Given that scarcity is often not the priority issue (materials and resources are abundant), key issues are the sustainable management of extraction and the possibility that large differences in environmental taxation between not very distant regions/countries could drive trade. This is in itself not detrimental, but could generate hot spots and extraction to happen in less regulated environments, wherein compensatory mechanisms are not institutionalised. Global environmental effects of extraction may increase as a consequence. Second, *price elasticity might be low*. This means that you could be forced to massively increase prices if you wanted to 'reduce' extraction. This action would privately cost very much with

probably low public gains in sustainability. Third, then, *sustainability is a consequence driven more by 'compensation' effects* (in a weak fashion of that SD) than by 'pollution reduction'. Extraction and its ancillary negative social effects should be at least compensated for, and further they could be over compensated (through private and public goods provision to local communities and society as large). This is exactly what SD is about: giving new generations more capital stocks than the present one, in quality and quantity terms. Weak sustainability seems the ideal framework for reasoning around resource tax implementation at least when dealing with materials (though even other resources, such as water, are not strictly characterised by absolute scarcity and risk of depletion). The approach here is then different from an approach discouraging extraction through price-based mechanisms (tax). Extraction is based on demand growth but under conditions that minimise the impact on land resources. This constraint, in theory, could produce severe limitations on extraction activities depending on the choices made by local planners. The key incentives consist of the internalisation of local external costs in the cost structures of extraction activities. This approach seems to encompass a 'weak sustainability' rule, according to which reduction in natural capital due to quarrying is compensated for by investments in natural capital in the surrounding areas, and investment is internalised in production costs through the charges levied (we refer to the EEA, 2008 report '*Effectiveness of environmental taxes and charges for managing sand, gravel and rock extraction in selected EU countries*, report n.2, Copenhagen: European Environmental Agency, and the 2007 draft country report 'aggregate taxes in Italy') [17]. Tax implementation, institutional improvements, and planning. When dealing with resources, environmental planning plays a key role. This is mostly true in cases such as aggregate taxes and similar situations. The resource tax may have indirectly and positively affect the policy and market environment through institutional improvements: valuable resources before given away for free emerge. Economic values drive better management and planning, including monitoring of activities due to the tax imposition and tax collections. A key factor is the monitoring and quantification of flows that followed the introduction of the tax before which there was only qualitative evaluation of quarries. Thus, we would argue that a resource tax may contribute to better environmental performance through complementarity effects with other policy/economic factors, such as planning and ex post compensation schemes[18]. More specifically, we would suggest that the dynamic interplay between taxes and planning can be described as follows. If taxes reduce extraction levels through direct and indirect effects at time T, then future planning rounds at times T+1,2.. May take this into account and reduce authorized extracted material per value added (more efficiency overall should be the aim of future planning). Taxes are important, but their effects need to be integrated within a complementarity framework, with other instruments. The generated revenue, which is likely to be substantial, may then be recycled and earmarked to compensatory environmental or public good based projects and/or to society for other aims (labour tax cuts as well as in core ETR). The matter is in the end probably more one of **capturing and managing the rents society owns from a collective natural resource**, and reinvesting such rents (in a Hartwick's rule kind of fashion and in accordance to Genuine saving accounting, which poses the basis for economic-environmental sustainability) rather than using prices to internalise externality in a common fashion. Managing properly rents exploitation is a key economic-environmental issue along such line of reasoning. As an analogy, even the EU ETS grandfathering or auctioned structures, do not probably differ in terms of efficiency, but they do in terms of

[17] "A balance needs to be struck between the theoretical rhetoric of sustainable development and the commercial realities faced by the minerals industry" (Kellett, 1995, p. 572). Kellett is in favour of a "loose" definition of sustainability, that allows a movement towards a more sustainable basis for policy through a combination of recycling of aggregates and reductions in the amount of primary aggregates extracted each year.

[18] "the lack of recognition that high quality restoration is a positive element of a sustainable policy and as such should be distinguished from, day to day issues such as control over noise, dust and vibration plays down a genuinely credible sustainable aspect of the latest policy advice", and " local plan policies on aggregates need to be written specifically with sustainability issues in mind. Thus the central issue should be the balance between environmental quality before working commences and after restoration is complete. Issues of demand management and the localization of supply may be relevant to the realization of policies. Control over working to protect local populations form nuisance will remain a central theme in mineral plans bit it is not directly related to sustainability. Finally resource depletion issues and the questions related to the economics of recycling of aggregates are best left to the market" (Kellett, 1995, pp. 576-577).

distributional effects and rents capture. Rents finance investments in various (new) forms of capital: compensate or create new natural capital, substitute human and technological capital for natural capital.

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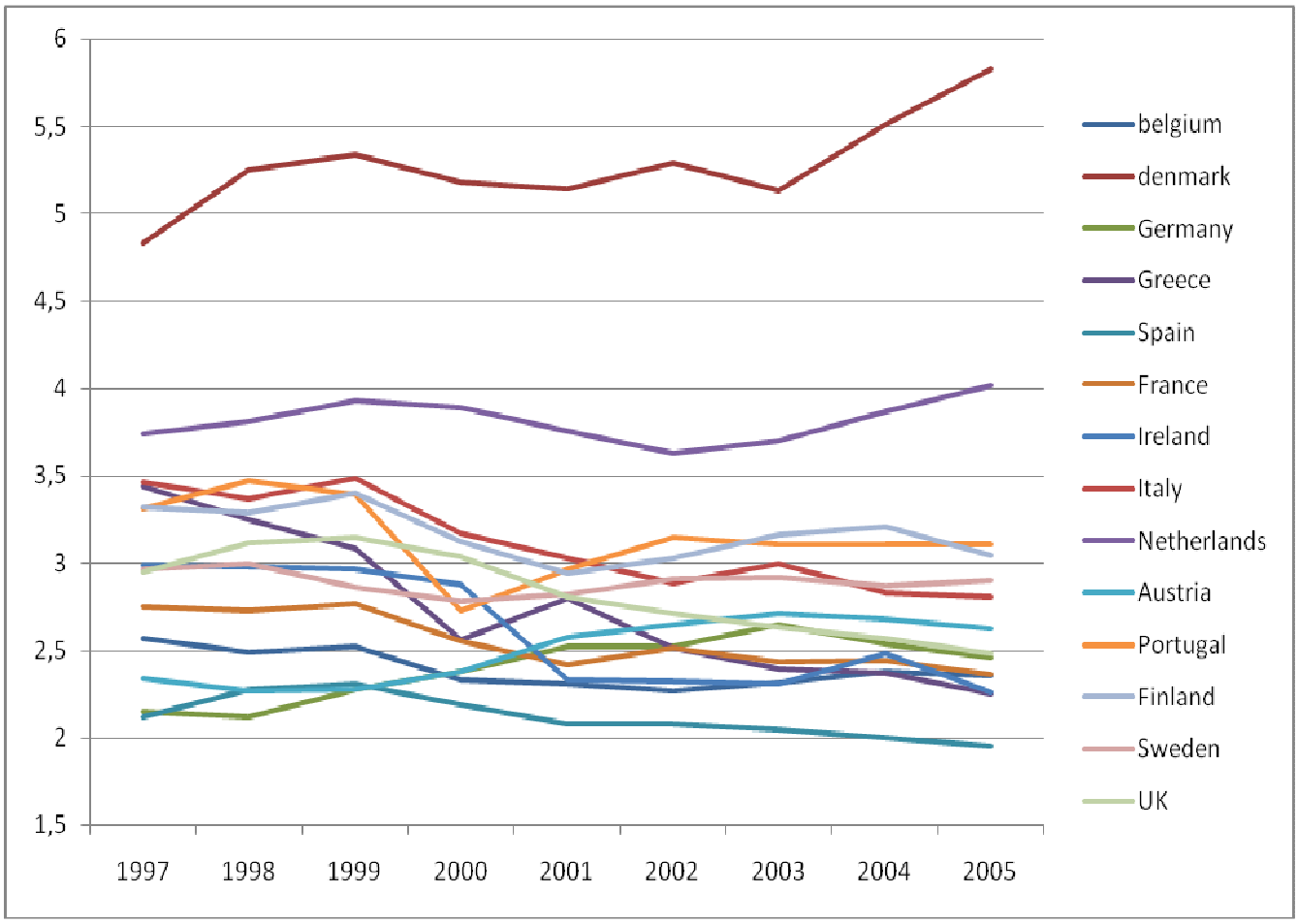

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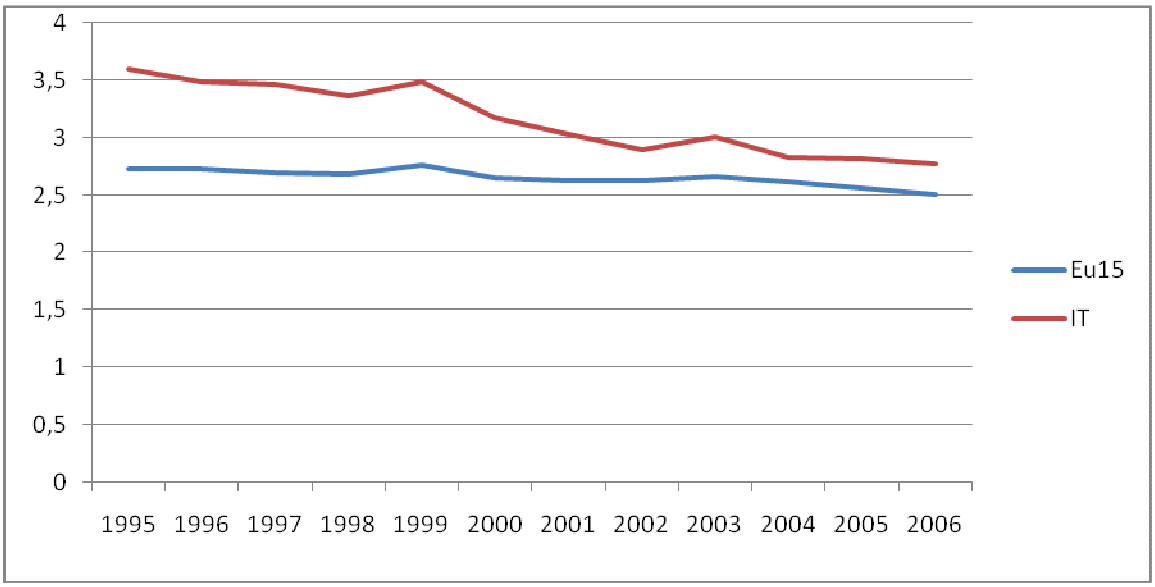
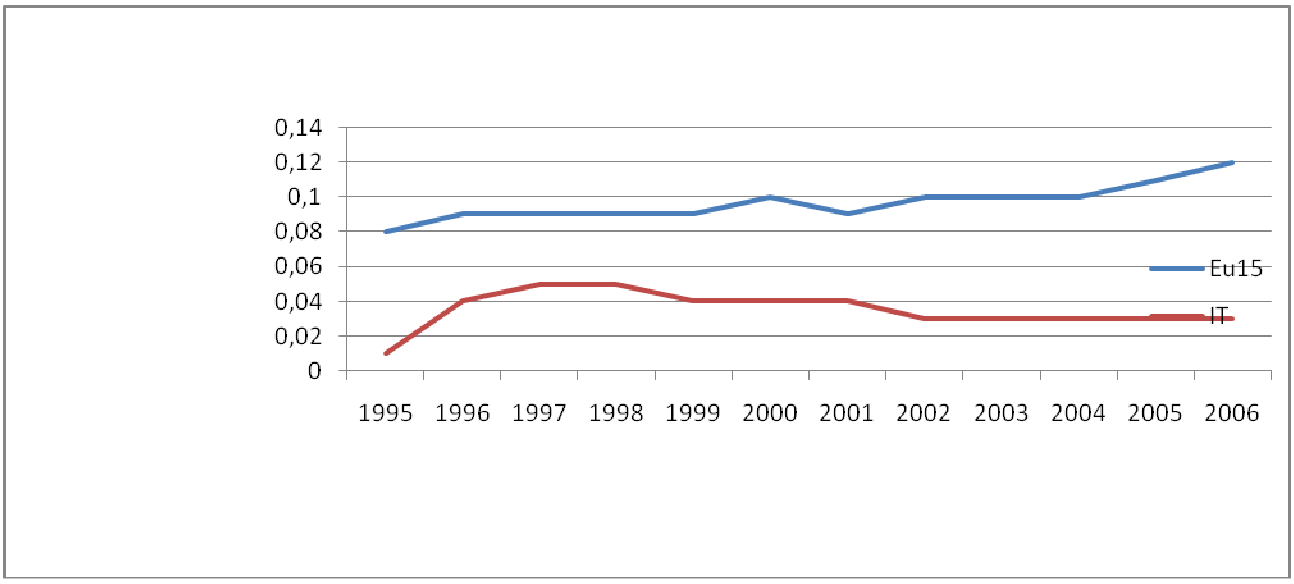
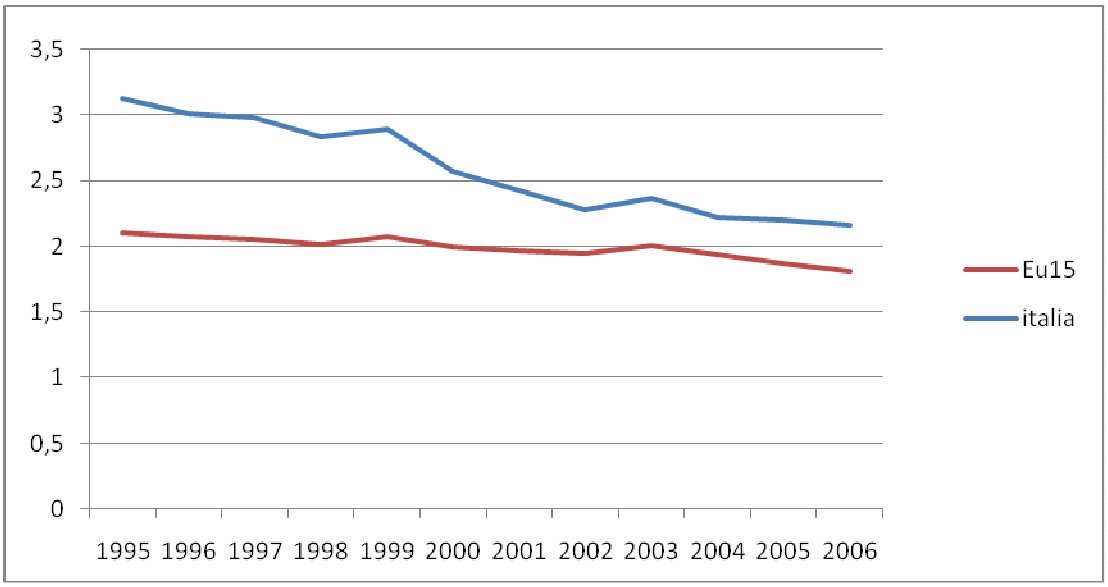


2. Share of GDP, total Energy + transport + environmental & resource taxes



3. Share of GDP, environmental & resource taxes



4. Share of GDP, total Energy taxes