



Carbon taxation in Russia: Prospects for a double dividend and improved energy efficiency



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ABSTRACT

This study analyses the sectoral and macroeconomic impact of carbon taxes on the Russian economy, one of the world's most energy- and carbon-intensive economies, while assessing the hypothesis of a double dividend. Substituting carbon taxes for labour taxes can reduce GHG emissions and enhance welfare by improving the efficiency of the tax system – a strong double dividend. The analyses confirm, when capital is not internationally mobile, that a double dividend is likely to occur under (i) a high elasticity of labour supply, (ii) high elasticities of substitution between labour and the capital-energy aggregate, (iii) low elasticities of substitution between capital and energy. It is the tax-shifting effect between capital and labour that is crucial. In contrast, welfare losses resulting from the environmental tax reform may be substantial if capital is internationally mobile.

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1. Introduction

Russia is one of the most carbon intensive economies in the world, with a carbon intensity of 1.82 metric tons of CO₂ per thousand dollars (USD) of GDP in 2009, against a global average of 0.62 (EIA, 2011). Hence Russia accounts for 5% to 6% of global carbon dioxide emissions (EIA, 2011), and by 2035 will have the highest level of carbon dioxide emissions per capita among non-OECD countries (EIA, 2010). These high carbon dioxide emission rates are mainly a consequence of outdated and inefficient technologies, reinforced by the low cost of energy. The major source of these emissions is the electricity generation sector, which has the greatest technological potential for energy saving (Bashmakov, 2009). It has been estimated (World Bank, 2008) that Russia could reduce its use of primary energy by some 45%, with consequent economic and environmental benefits.

Typically energy using technologies are embedded in capital equipment with long productive lives; these sunk costs slow down technical modernization. Moreover the replacement of technologies in Russia is particularly slow due to a combination of non-market

failures – underestimation of adoption costs,³ high discount rates, and heterogeneity of energy users – and market failures – lack of information, principle-agent problems, and low energy prices because of inefficient price regulation and non-internalized environmental externalities (World Bank, 2008). On grounds of economic efficiency, only the existence of market failure can provide justifications for government intervention (Jaffe and Stavins, 1994a, 1994b).

It has been argued that carbon taxes represent an efficient method to address concerns over carbon and energy intensity. In the short to medium term they should, *inter alia*, reduce CO₂ and non-CO₂ GHG emissions and encourage adaptations of existing capital equipment. While in the longer term they should accelerate the diffusion of more energy efficient technologies and induce technological progress (Newell et al., 1999; Ruttan, 1997); there is evidence of a significant relationship between energy prices and innovation in energy-saving technologies (Popp, 2002). Furthermore, it is argued that carbon taxes can produce environmental welfare gains and reduce the efficiency costs of the tax system if they replace other distortionary taxes, i.e., they have the potential to yield a 'double dividend' (Goulder, 1995).

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³ "There are typically costs of adoption that are not included in simple cost-effectiveness calculations. It is by no means costless to learn how a technological improvement fits into a home or firm or to learn about reliable suppliers" (Jaffe et al., 2004).

Some European countries have introduced various environmental taxes, e.g., on carbon dioxide and on sulphur dioxide, that are compensated by reductions in personal income taxes and/or social security contributions. For instance, [Bosquet \(2000\)](#) reviewed 139 modelling simulations and showed that under certain conditions the introduction of environmental taxes may achieve both, environmental and economic improvements, especially if revenues from environmental taxes are recycled through a reduction of social security contributions.

The objective of this study is to analyse the sectoral and macroeconomic impact of carbon taxes on the Russian economy while assessing the hypothesis of a double dividend. This analysis is based on a computable comparative static single-country multi-sector general equilibrium model – an energy/environment adaptation of the STAGE model ([McDonald, 2007](#)). Although there are studies estimating the impact of carbon taxes on energy consumption and GHG emissions in Russia (e.g. [Veselov et al., 2010](#)), none has addressed the double dividend issue except [Orlov and Grethe \(2012\)](#) who focus on the relevance of market structure for the effects of carbon taxation.

The rest of the paper is organised as follows. The next section gives a brief overview of the concept of double dividend. Section three provides descriptions of the model framework and reports summary statistics for the database and experiments. Simulation results are presented in Section four and Section five provides results of sensitivity analyses. The final section summarizes the results and provides a discussion of the implications and potential further development of the analysis.

2. Double dividend hypothesis

2.1. Theory

The theoretical literature distinguishes between a “weak” and a “strong” double dividend. The weak double dividend hypothesis argues that reducing other distortionary taxes by using revenues from environmental taxes can reduce the welfare costs of taxation, compared to returning the revenues to households in lump-sum form; this is relatively uncontroversial. The more ambiguous strong double dividend hypothesis argues that substituting environmental taxes for distortionary taxes can yield environmental improvement and enhance total welfare by alleviating pre-existing tax distortions ([Goulder, 1995](#)). The main findings derived from the theoretical literature on the double dividend are:

- 1) Analytical models show that when labour is the only input the *tax interaction effect*⁴ is typically larger than the *revenue recycling effect*,⁵ implying the failure of the strong double dividend hypothesis ([Goulder et al., 1997](#); [Parry, 1995](#)). The intuitive explanation is that narrow-based taxes (pollution taxes) induce a larger marginal excess burden compared to broad-based taxes (income taxes). Moreover, [Bovenberg and Mooij \(1994\)](#) show that the optimal pollution tax typically lies below the Pigouvian tax in the presence of pre-existing distortions, which means that a pollution tax swap will exacerbate pre-existing distortions.
- 2) In the presence of capital, an environmental tax reform can induce a *tax-shifting effect* between factors ([de Mooij and Bovenberg, 1998](#)). Two kinds of tax-shifting effects between capital and labour are defined. First, if capital is internationally mobile and is overtaxed compared to labour, substituting environmental taxes for capital taxes can yield a double dividend. And second, if capital

is internationally immobile and undertaxed compared to labour, substituting environmental taxes for labour taxes can reduce efficiency costs of the tax system since the burden of taxation on labour (overtaxed factor) shifts towards capital (undertaxed factor). If capital is internationally mobile, in the long term an environmental tax reform tends to increase rather than reduce initial inefficiencies in the tax system ([de Mooij and Bovenberg, 1998](#)). In the long run, capital is expected to be mobile across borders ([Obstfeld, 1996](#)).

- 3) In the presence of a fixed factor, e.g., natural resources,⁶ and untaxable Ricardian rents, an environmental tax reform can induce a double dividend since the burden of environmental taxes is also borne by lower returns on natural resources, i.e., Ricardian rents ([Bento and Jacobsen, 2007](#)). In other words, environmental taxes operate like implicit taxes on economic profit from a fixed factor.
- 4) The conditions under which an environmental tax reform can increase employment in the presence of a fixed factor are: (i) low initial tax rates on resources, (ii) a large production cost share of the fixed factor, (iii) high substitution between labour and resources, and (iv) low elasticities of substitution between the fixed factor and resources ([Bovenberg and van der Ploeg, 1996; 1998](#)).
- 5) There are other types of tax-shifting effects that can lead to a double dividend, such as tax-shifting across countries, i.e., terms of trade effects, and tax-shifting among household incomes. For example, [Killinger \(2000\)](#) and [de Mooij \(2000\)](#) show that for large economies, which can affect world market prices the burden of environmental taxation can be partially shifted to a foreign supplier through a terms-of-trade effect.
- 6) Where pollution taxes improve human health, which results in higher labour productivity, there can be additional benefits from the environmental tax reform, i.e., a *benefit-side tax-interaction effect*, which can offset the negative tax-interaction effect under certain conditions ([Williams, 2002](#)).⁷
- 7) The welfare gains from substituting environmental taxes for labour taxes can be substantially larger when tax-favoured consumption is introduced in the model ([Parry and Bento, 2000](#)).⁸ The intuitive explanation is that in the presence of tax-favoured consumption, labour taxes distort not only the consumption-leisure choice, but also the consumption choice among commodities.

The theoretical literature indicates that a strong tax-shifting effect is a necessary condition for the occurrence of a strong double dividend ([de Mooij, 2000](#)). In general, the occurrence of a strong double-dividend is ambiguous since it depends, *inter alia*, on the tax and economic structure, household preferences, factor mobility, factor substitution, and revenue recycling strategies. Hence, general equilibrium analysis is an appropriate analytical method to evaluate the occurrence of a double dividend ([Goulder, 2002](#)). This study focuses on the tax-shifting effect between labour, capital and natural resources.

2.2. Empirical evidence

A meta-analysis of environmental tax reform ([Patuelli et al., 2005](#)) found that environmental tax reforms typically led to higher employment (employment double dividend), while the occurrence of a strong double dividend in terms of welfare was ambiguous. Other surveys were provided by [Bosquet \(2000\)](#), [Bosello et al. \(1999\)](#) and [Bovenberg and Goulder \(2002\)](#). Recent empirical studies on the double dividend issue are summarised in [Table 1](#). The main conclusion from these studies is that substituting environmental taxes for labour taxes reduces the

⁴ The tax interaction effect is defined as an adverse impact on the labour market arising from reductions in the after-tax return to labour associated with the higher production costs caused by an environmental tax reform ([Goulder et al., 1997](#)).

⁵ The revenue recycling effect is the efficiency benefit from using revenues to finance cuts in the marginal rates of existing taxes ([Goulder et al., 1997](#)). [Parry \(1995\)](#) refers to the tax interaction effect as the “interdependency effect” and the revenue recycling effect as the “revenue effect”.

⁶ Apart from capital and other natural resources, entrepreneurial talent can be also considered as a fixed factor ([Bovenberg and van der Ploeg, 1998](#)).

⁷ In comparison, [Williams \(2003\)](#) considers the relationship between pollution and the health effect only.

⁸ For another special case, see [Parry and Bento \(2001\)](#).

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