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Distributional effects of carbon taxation

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HIGHLIGHTS

- Distributional effects of carbon tax within both household and economic sectors are examined.
- The effects of ex-ante and ex-post preferential measures are categorized and compared.
- We analyze the progress and shortcomings of existing studies.
- We put forward implications for policy-making and future research.

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ABSTRACT

The carbon tax is a frequently discussed economic instrument for carbon emissions mitigation and prevention of global climate change. However, a range of issues may emerge when introducing a carbon tax; among these issues, the distributional impact has been frequently highlighted as an obstacle to the public acceptance of such a mitigation policy. This literature review focuses specifically on the distributional effects of carbon taxes and contributes to existing studies by providing a classification and discussion on how to comprehensively assess distributional impacts and what measures can be taken to mitigate the potential adverse distributional impact. We confirm that a pure carbon tax without revenue recycling in developed economies tends to be regressive, i.e. lower income households being more affected, while our research does not support the perception that it reveals progressivity in developing countries. In terms of its effects on economic sectors, we find that sectors with higher energy intensity are more affected by a uniform carbon tax, while preferential measures to protect these industries face a trade-off between environmental effectiveness and economic growth. We also stress that different designs for carbon tax mechanisms play a key role in affecting the distributional impacts and impacts in other policy arenas, indicating that trade-offs between efficiency and equity always exist when designing a carbon tax. This study may help to identify the shortcomings of existing designs and puts forward practical implications for future research; moreover, it offers valuable information to help policy-makers to understand the trade-off between equity and efficiency when designing a carbon tax.

1. Introduction

A carbon tax is a tax levied on one or several greenhouse gas (GHG) emissions associated with the combustion of fossil fuels. In practice, such a tax is often introduced based on the carbon content of fossil fuels. A carbon tax is a type of Pigouvian taxes which are levied on market activities that generate negative externalities. In 1920, the British economist Arthur C. Pigou argued in his seminal book "The Economics of Welfare" that when the marginal social cost of a market activity diverges from the marginal private cost, the market is not efficient and will lead to an oversupply of such a product; at the same time the producer has no incentive to internalize the marginal social cost, which will lead to economic externalities [1]. GHG emissions are an example of such an externality. The basic idea of any GHG taxation is based on this Pigouvian tax that aims to internalize the cost of the externalities into the market price in order to achieve a reduction in GHG emissions and hence to mitigate climate change.

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One of the earliest propositions of a carbon tax was proposed by Ridley Nicholas, the former environment minister of the UK, and then was echoed in the Department of Environment's Pearce report [2] as a method of putting a price on environmental benefits and losses [3]. However, this particular report and many other such reports have meanwhile been added to the public discourse, and the academic literature is unanimous in the assessment of these types of taxes as a cost-effective instrument to internalize externalities [4], and yet, most countries have not implemented such as tax. Criticism came, on one hand, from questioning the science of climate change and its potential human contribution as well as its harm to society [5,6], and on the other hand were based on doubting the effectiveness of a carbon tax [3,5,7,8]. However, with the impetus of ongoing international climate negotiations and the increasing urgency of action following the Paris negotiation, the carbon tax as an economic instrument for climate change mitigation has received increasing attention.[1]

Meanwhile, the effectiveness of a carbon tax on carbon emissions mitigation has been frequently shown [10–13]. Indeed, since the carbon tax was first implemented in Finland, Poland, Sweden, Norway and Denmark in the 1990s, additional countries/regions—including Latvia (in 1995), Slovenia (in 1996), Estonia (in 2000), Switzerland (in 2008), British Columbia (in 2008), Ireland (in 2010), Iceland (in 2010), Japan (in 2012), France (in 2014), Mexico (in 2014) and Portugal (in 2015)—introduced a carbon tax; and the governments of South Africa and Chile have issued policy documents to tax carbon from 2016 and 2018, respectively; moreover, China and South Korea are also considering the introduction of a carbon tax [14]. Ex-post evaluations of carbon tax schemes have shown that a carbon tax could contribute to a reduction in CO_2 emissions. For example, Andersen [15] surveyed 20 ex-post studies for the Nordic countries, concluding that carbon emissions were curbed when compared to business-as-usual forecasts. Of these countries, Norway's carbon tax had reduced the household emissions by 3–4% between 1991 and 1993; and in Denmark, a 7% decline in industrial CO_2 emissions had been achieved from 1991 to 1997 while total industrial output increased by 27% [15]. Similarly, an IPCC report [10] shows that emissions in Sweden were 9% lower in 2007 compared to 1990. In addition, ex-ante simulations also support the tax's effectiveness [16,17]. For example, Meng et al. [18] found that a carbon tax of \$23/tCO_2 in Australia could cut emissions with a 12% reduction rate in 2004–2005; Cabalu et al. [19] showed that a \$5/tCO_2 carbon tax may potentially reduce Philippine's emissions by 9.8% to 2020. Based on a literature review, the IPCC [10] reported that 10% higher fuel prices might lead to roughly a 7% reduction in fuel use and emissions in the long run.

However, many countries that are experiencing the pressure to control CO_2 emissions are still hesitant to take actions to implement a carbon/GHG tax or a carbon emission trading scheme, despite the scientific evidence on their effectiveness in reducing energy consumption and associated emissions. An important reason for this situation is that environmental taxes often face political opposition from both the industry and the public [20]. There are many cases of failed tax initiatives, such as the energy tax in the US in 1993, the fuel tax escalator in the UK in 2000, a fossil fuels tax in Switzerland in 2000, a road pricing in Edinburgh in 2005, and the French carbon tax in 2010 to name just a few [20]. Some of the arguments fielded by the opposition are that carbon taxes tend to negatively affect GDP growth [19,21–23] and international competitiveness of industries [24,25], as well as leading to regressive distributional effects [4,11,12,26]. The potential adverse distributional impact is frequently seen as one of the main obstacles [4,27,28]. Due to differences in income, living conditions, consumption preferences and patterns, different socio-economic groups would react differently to the same stimuli [13,29,30]. The concern that the tax burden will fall more heavily on the poor is seen as a major obstacle to its policy acceptability because poor people often spend a larger proportion of income on energy-intensive products to meet their basic needs (e.g. house heating, electricity) and lack options for substitution [27,31,32]. In addition, special interest groups, energy intensive sectors and especially the fossil fuel industry have been very effective to lobby against the introduction of such taxes [20,33], making the distributional impact across industries worthy of emphasis.

So far, numerous studies have been conducted on the effectiveness of carbon taxes, and numerous studies have also focused on the distributional aspects but a comprehensive review of these studies is currently lacking. Therefore, the aim of this study is to provide such a review looking specifically at the distributional effect of carbon taxation across household groups and economic sectors.

2. Overview of carbon taxation designs

There are winners and losers when a carbon tax is introduced in an economy. Fig. 1 shows how the effects of a carbon tax are conveyed to each category of economic agents through the processes of primary distribution and redistribution of national income[2] in the short run. As shown in Fig. 1, on one hand, taxing carbon will directly lead to higher energy prices and thus increase the energy cost of a production sector; then the sector might respond to such a cost increase by adjusting its inputs and outputs. The adjustment of sectoral inputs includes inputs from other sectors as well as labor and capital inputs. Changes to its outputs will affect revenues and associated taxes [36]. Carbon tax revenues will provide an income stream to the government and increase the government share of GDP or be cycled back to tax payers. For enterprises, the price elasticities of their products will determine to a large extent if they can easily transfer their tax burden to consumers or not. Sectors producing higher price elasticity products may have to absorb the tax burden; meanwhile they might encounter a sales decrease thus eventually resulting in a profit loss. For consumers, they not only bear the direct and indirect tax burden due to the price increase of energy and other goods and services, but are also affected from the changes in their labor and capital income caused by the levy, constituting a complex effect from both the income and expenditure sides. Given the fundamental role of energy in an economy, the short-term effects of a carbon tax will eventually ripple throughout the economy with possibly surprising outcomes [22,37]. In the long run, the reduction activities in company may bring long-term benefits as taxing carbon can push firms to reduce energy consumption and associate costs through low-carbon technology innovation and

[1] On November 30, 2015, the opening day of COP21 (the 21st session of the Conference of the Parties to the United Nations Framework Convention on Climate Change) in Paris, the Carbon Pricing Leadership Coalition (CPLC) was officially launched with the goal of the initiative to advance effective carbon pollution pricing systems and expand their use globally. Ahead of the Paris climate talks, a Carbon Pricing Panel was convened by World Bank Group President Jim Yong Kim and the International Monetary Fund's Managing Director Christine Lagarde, and meanwhile joined by OECD Secretary General Angel Gurria, to call on their peers to follow their lead and urge countries and companies around the world to put a price on carbon pollution. And the carbon tax is exactly one of the two main types of carbon pricing [9].

[2] Primary distribution of income depicts how the value generated by the production process is distributed among labor, capital and the government in the form of wages and salaries (labor remuneration), operating surplus/mixed incomes (capital income), and taxes on production [34], namely the distribution of national income among households, enterprises and the government. Redistribution of income refers to the regular transfers between institutions/sectors through taxes, government expenditures and social security system, etc. [35].

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