Analysis

The economic and environmental impact of a carbon tax for Scotland: A computable general equilibrium analysis

Grant Allan a,b,c, Patrizio Lecca a,b,c,d,* , Peter McGregor a,b,d , Kim Swales a,b,c,d

a Department of Economics, University of Strathclyde, United Kingdom
b Strathclyde International Public Policy Institute, United Kingdom
c Fraser of Allander Institute, University of Strathclyde, United Kingdom
d Centre for Constitutional Change, United Kingdom

ARTICLE INFO

Article history:
Received 19 June 2013
Received in revised form 21 November 2013
Accepted 17 January 2014
Available online 18 February 2014

JEL classification:
C88
Q51
Q58

Keywords:
Carbon tax
CGE modelling
Double dividend
Regional economics

ABSTRACT

Using a disaggregated energy–economy–environmental model, we investigate the economic and environmental impact of a Scottish specific carbon tax under three alternative assumptions about the use of the revenue raised by the tax: revenues raised are not recycled within Scotland; revenues are used to increase general government expenditure or to reduce Scottish income tax. We find that by imposing a tax of £50 per tonne of CO2 the 37% CO2 reduction target is met with a very rapid adjustment in all three cases if the model incorporates forward-looking behaviour. However, the adjustment is much slower if agents are myopic. In addition, the results of the model suggest that a carbon tax might simultaneously stimulate economic activity whilst reducing emissions and thus secure a double dividend, but only for the case in which the revenue is recycled through income tax.

© 2014 Elsevier B.V. All rights reserved.

1. Introduction

Since devolution, the Scottish Government has increasingly adopted a distinctive environmental and energy policy (Allan et al., 2008). The Climate Change (Scotland) Act includes a target to reduce CO2 emissions to 42% below in 1990 levels by 2020. This is stricter than the 34% CO2 emissions reduction adopted by the UK Government. Moreover, the corresponding Scottish Government target for renewable electricity generation in 2020 is equivalent to 100% of electricity consumption in Scotland and preliminary data suggest that the interim 2011 target of 31% was exceeded by 4 percentage points.

However, earlier discussions have established that whilst Scotland has adopted challenging targets, many key policy instruments are reserved to the UK government (Allan et al., 2008; McGregor et al., 2013). At present the main “green” elements of the tax system remain under Westminster control. This includes fuel duties, air passenger duty and the climate change levy. Also reserved to the UK Government are: the tax-transfer system; powers over the structure and regulation of the electricity market; Renewable Obligation Certificates, the Renewable Transport Fuel Obligation and the Renewable Heat Incentive; Climate Change Agreements; and the Carbon Reduction Commitment.

The Scottish Government has succeeded in making Scottish energy policy more distinctive, first through setting different targets (as described above) and second by developing specific policies within the non-reserved powers at their discretion. These powers include the judicious use of the planning system and additional funding for alternative renewable technologies in pre-commercial scales, such as the Wave and Tidal Energy Scheme (WATES), the Saltire Prize, and the Scottish Community and Household Renewable Initiative. Nevertheless, the Committee on Climate Change report into Scottish emission targets concluded that with current policies, and assuming the current cap on emissions under the EU ETS, the Scottish Government’s target of a 42% reduction will be missed, with emissions only falling by 38% in 1990 levels.

Economists typically regard a carbon tax as the most efficient way to reduce carbon emissions (Pearce, 1991; Tullock, 1967). Furthermore, continuing pressure for greater fiscal autonomy is likely to expand the range of climate change policies that the Scottish Government has at its disposal (McGregor and Swales, 2013). It is therefore of interest to consider the effect of a Scottish specific carbon tax. This is particularly relevant given the more demanding environmental targets set by the Scottish Government and the present discussions around increased...
fiscal autonomy for Scotland. The Scottish Act (2012) has augmented the income tax raising power of the Scottish Parliament, so that it will have the power to make a balanced-budget adjustment in public expenditure funded by corresponding changes in the basic as well as higher rates of income tax up to 10 p in the pound.1

In this paper we employ an empirical energy–economy–environmental model2 of Scotland to simulate the impact of a Scottish specific carbon tax on the levels of carbon emissions and of aggregate and sectoral economic activity. The simulations are conducted under alternative assumptions about the use of the revenues raised by the tax, for example, to increase general Government expenditure or to reduce the rate of income tax.

The remainder of the paper is organised as follows. Section 2 outlines the arguments for a carbon tax and introduces the notion of the double dividend. Section 3 summarises the key features of the model. Section 4 briefly describes the model parameterization and discusses the simulation set up. Section 5 discusses the simulation results. In Section 6 we provide a sensitivity analysis and in Section 7 we present brief conclusions.

2. The Case for a Carbon Tax

Firms, households and governments generate emissions of CO2 that impose a cost on present and future generations in the form of global climate change. However, those directly emitting CO2 do not directly bear the cost of their own emissions. That is to say, they are not forced specifically to take these costs into account when they make production and consumption decisions. These costs are known generally as externalities and the notion that they can be internalised by the governments’ setting a tax equal to the marginal cost imposed on others was first suggested by Pigou (1920). Coase (1960) persuasively argues that imposing appropriate property rights can also solve this problem. In this case, the owners of the right to pollute the atmosphere would charge for allowing individuals and organisations to emit CO2. This is the basis for the use of tradable permits for controlling emissions. However, the fundamental principle behind carbon taxes and carbon trading is the same. A price should be set for emitting carbon, either through a specific tax or the requirement to acquire a permit.

Essentially, the arguments that favour treating externalities in this way, are similar to those that favour the use of free markets in general. It is an effective means of decentralised decision making. In this specific case, the government has set targets for the level of carbon emissions. However, this decentralised approach should lead to these targets being met at minimum cost in terms of foregone consumption. Setting a price on carbon emissions generates an appropriate set of incentives. For instance, firms will seek to adopt less emissions-intensive production techniques. Given that the price of products that embody carbon emissions will rise, consumers will tend to consume less of these products. Further there is an increased incentive for technical change that involves reducing carbon emissions in the future (Goulder and Mathai, 2000; Goulder and Schneider, 1999).

There is an additional potential benefit from the use of carbon taxes. Carbon taxes (or tradeable permits, if owned by the state) are sources of revenue for the government. This additional revenue can be used to reduce other taxes that generate distortions in the operation of the economy, thereby producing a so-called ‘double dividend’. Here, not only the CO2 emissions are reduced (the first dividend), but also the efficiency with which other elements of the economy operate can be simultaneously improved (the second dividend) generating a decrease in the unemployment rate, increase in employment rate and in GDP. In the literature, there is an extensive discussion concerning the possible nature of this second dividend and the circumstances under which it exists. Using applied general equilibrium models, Bor and Huang (2010), Bovenberg and Van der Ploeg (1998), Glomm et al. (2008), Goulder (1995), Manresa and Ferran (2005), Hoel and Schneider (1997), all find evidence of the existence of the second dividend and in some cases even a triple dividend, which is associated with a decrease in poverty (Van Heerden et al., 2006).

3. The AMOSENVI Model of Scotland

3.1. General model features

AMOSENVI is a large scale, multi-sectoral energy–economy–environment computable general equilibrium model for Scotland. The model has seventeen industry sectors3 of which thirteen are energy sectors. Among energy sectors we identify nine electricity generation facilities and the notion that they can be internalised by the governments’ setting a tax equal to the marginal cost imposed on others was first suggested by Pigou (1920). Coase (1960) persuasively argues that imposing appropriate property rights can also solve this problem. In this case, the owners of the right to pollute the atmosphere would charge for allowing individuals and organisations to emit CO2. This is the basis for the use of tradable permits for controlling emissions. However, the fundamental principle behind carbon taxes and carbon trading is the same. A price should be set for emitting carbon, either through a specific tax or the requirement to acquire a permit.6

6 A key role of the government is to produce public goods: goods that provide freely available services where it is difficult to exclude individuals from benefiting from these services. These goods are provided inadequately by the private market. The classic example is defence.


8 See Table A1 in the Appendix for details about sectoral aggregation.

9 AMOSENVI is a single country model where the RUK and the ROW are exogenous in the model therefore we are not able to capture the spillover coming from the RUK or the ROW. This seems a reasonable first approximation given that the Scottish economy is less than 5% of the UK economy on any measure of scale.

8 See Table A1 in the Appendix for details about sectoral aggregation.

9 AMOSENVI is a single country model where the RUK and the ROW are exogenous in the model therefore we are not able to capture the spillover coming from the RUK or the ROW. This seems a reasonable first approximation given that the Scottish economy is less than 5% of the UK economy on any measure of scale.
دریافت فوری متن کامل مقاله

امکان دانلود نسخه تمام متن مقالات انگلیسی
امکان دانلود نسخه ترجمه شده مقالات
پذیرش سفارش ترجمه تخصصی
امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
امکان دانلود رایگان ۲ صفحه اول هر مقاله
امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
دانلود فوری مقاله پس از پرداخت آنلاین
پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات

ISIArticles
مرجع مقالات تخصصی ایران