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Methodological and Ideological Options

Coming Out Clean: Australian Carbon Pricing and Clean Technology Adoption☆

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ABSTRACT

Australia implemented a carbon pricing scheme from July 2012 to July 2014 to reduce emissions. Using data envelopment analysis, I investigate whether the uptake of clean technology accelerated during this period. I also explore a few other related strategies firms used to reduce emissions. I find that during the scheme firms accelerated the adoption of cleaner technology. Much of this acceleration came from firms lagging in technology catching up with the frontier. Reallocation of operation towards cleaner facilities and opting for more efficient scale sizes also helped the pace of emissions reduction. The pattern shows some variation from industry to industry. All these activities subside as soon as the carbon pricing is repealed.

1. Introduction

Carbon pricing is considered one effective way of emissions reduction. However, the real impact of such scheme has to be measured in its capacity to expedite the adoption of newer and cleaner technologies. The economy thus thrives while containing its emissions. Alternatively, firms can simply reduce business activity to cut emissions. Such strategy adversely affects the economy. Moreover, it is reversible and as soon as the regulations are loosened or repealed, the economy can potentially revert to its pre-regulation level of emissions.

In this paper, I explore the technological impact of carbon pricing schemes using the Australian experience as a case study. For this study, I benefit from a database of energy and emissions reports of firms and their facilities in Australia. The rate of improvement in emissions technology of each facility is measured by a Malmquist index. Using this index, I examine whether the carbon pricing led to an acceleration in the adoption of cleaner technology.

The scheme was rather short-lived and ran from July 2012 to July 2014, when it was repealed by the succeeding administration. The rather short period of enforcement provides a unique window to observe how firms react to the introduction and then to the repeal of a carbon pricing scheme. In viewing both responses, one can better associate the findings with carbon pricing rather than with other causes such as changing energy prices.

I find that the rate of technological progress increases in the run up to the carbon pricing and during its enforcement. Most of the increase in technological uptake, however, is due to laggard facilities catching up with the front runners. Front-running facilities also increase their progress to some extent. Some facilities also opted for more efficient scale sizes. All these effects slow down after the carbon pricing is repealed. The pattern suggests that the acceleration in efficiency growth is very much tied to the carbon pricing.

I also consider another often overlooked strategy. Firms with multiple facilities can improve a few facilities and reallocate business operation towards them. However, if practiced in the absence of any investment and only as a temporary measure, reallocation does not help efficiency growth in the long term. This is especially true in case firms expected the carbon pricing to be repealed soon.

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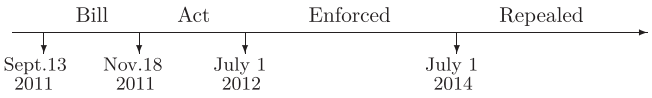

Fig. 1. The time-line of the Carbon Pricing Scheme.

I introduce an index of resource reallocation to investigate. I find that resource reallocation was practically non-existent before the carbon pricing. During the carbon pricing, reallocating of resources takes place but mostly within firms in the Electricity, Gas & Utilities sector. Further investigation reveals that reallocation of resources is mostly happening where the firm has facilities that are close to the technological frontier. Where facilities are lagging in technology and merely catching up, there is not much resource reallocation.

In summary, the carbon pricing in Australia has led laggard facilities to take various forms of actions. Front-running facilities do not exhibit qualitatively different behaviors with or without the carbon pricing. These findings could help future policies to target emissions reduction more effectively but at lower costs to the economy by providing more customized incentives to different groups of firms.

The remainder of the paper is composed as follows: In the next section, I provide some background for the Australian carbon pricing scheme and emissions reduction schemes in other countries. In Section 3, I describe the source of data and show a few trends. Section 4 covers the adaptation of the data envelopment analysis for the application. The main results are reported in Sections 5 and 6. The paper is concluded in Section 7.

2. Background

On September 13, 2011 the Australian government introduced the Clean Energy Future Plan (Clean Energy Bill, 2011) that was enacted on November 18, 2011 (Clean Energy Act, 2011). The legislation was the culmination of a political battle that began with the 2007 election campaign, in which both major political parties committed in one way or the other to an emissions reduction scheme in line with Australia's commitment under the Kyoto protocol. The legislation came into force on July 1, 2012 until it was repealed by the succeeding administration on July 1, 2014 (Fig. 1).

The centerpiece of the Clean Energy Future Plan was a carbon pricing scheme that imposed a fixed price of $23 on each tonne of carbon emissions or the equivalent (Jotzo, 2012).[2] The carbon tax only applied to on-site emissions and not to indirect emissions such as those associated with the consumption of electricity. Facilities emitting more than 25 megatonnes of carbon dioxide or the equivalent were liable under the scheme. However, agriculture and transported fuel were exempt from the carbon pricing. Subsequently, the transportation industry was spared the brunt of the legislation.

In view of the time-line in Fig. 1, the response period of firms to the carbon pricing can extend from the fiscal year 2011–12 to 2013–14.[3] During 2011–12, the carbon pricing was enacted but not enforced. That left firms with ample opportunity to respond early and preempt the carbon pricing by adopting strategies to minimize their liabilities under the new scheme.

There are indications that despite its short life, the carbon pricing had an impact. O'Gorman and Jotzo (2014) find 8.2% drop in the emissions of electricity suppliers over the course of the scheme. A Department of Environment report records a 2.9% drop in the emissions across Australia during the full course of the program and 8.9% drop in the emissions of the electricity sector for the same period (NGGI, 2017). The same report records an uptrend in emissions since 2014.

Some firms have also been under the impression that the carbon pricing would soon be repealed. A survey of 372 firms by the Australian Industry Group finds that about 70% of those firms surveyed had not reduced their carbon intensity one year after the carbon pricing was enforced with some anticipating an early abolition of the scheme (AIG, 2013).

This work adds to the current body of literature focused on the impact of emissions reduction schemes across the world. European Union (EU) has the longest running Emissions Trading System (ETS) that was introduced in 2005. The EU has seen emissions steadily fall since 2007.[4] However, Spies-Butcher and Stilwell (2009) argue that part of the drop in the EU is owing to the economic slowdown that followed the Global Financial Crisis. In 2015, China implemented a series of pilot ETS across seven cities and provinces. Jotzo et al. (2018) show that the emissions level in China plateaued in the years that followed. New Zealand introduced a carbon pricing scheme similar to that of Australia in 2008. Emissions in New Zealand have been falling slowly but steadily since then (NZGGI, 2018).

This paper moves beyond looking at emissions trends and investigates the behavioral impact of emissions schemes such as carbon pricing or ETS on individual firms. The results will provide a better understanding of which firms or industries respond more strongly to such policies and in what way.

3. Data

The source of data for this study is the National Greenhouse and Emissions Reporting Scheme (NGERS). This reporting scheme came into effect in 2008 in part to fulfill Australia's international obligations (see NGER Act, 2007, for details). It has also served as a platform for designing policies targeting emissions and energy consumption.

Firms whose annual energy consumption, energy production, or emissions are above a set threshold are obligated to report into the NGERS. At the start of the reporting scheme in 2008 the thresholds for mandatory reporting were (NGER Act, 2007, Part 2 Section 13):

(a) total amount of greenhouse gases emitted from the operations of facilities under the operational control of entity is 125 kilotonnes or more; or
(b) total amount of energy produced from the operations of facilities under the operational control of entity is 500 TJ or more; or
(c) total amount of energy consumed from the operations of facilities under the operational control of entity is 500 TJ or more.

In 2009, the thresholds were reduced to 87.5 kilotonnes of emissions and 350 TJ of energy consumption or production. In 2010, the thresholds were further lowered to 50 kilotonnes of emissions or more than 200 TJ of energy consumption or production. The thresholds have stayed unchanged since.

It is judicious to make an early distinction between firm and facility in the current context. In the NGERS, a facility is basically a plant, location or establishment. A firm is the umbrella organization that controls and runs the facility. In case a firm controls only one facility (single-facility firm), then firm and facility are the same entity. However, a number of firms in the dataset control several facilities in different locations and sometimes in different industries (multi-facility firms).

The NGERS requires that reporting firms record their energy consumptions and CO_2 equivalent emissions by activity or type of energy and emissions in each facility that they control. Each activity is further classified as either scope 1 or scope 2. Scopes are defined as:

Scope 1: emissions and energy usage as a result of on-site energy conversion. This could include fuel combustion, fugitive emissions, industrial processes, or waste handling.

[2] All monetary values are in Australian Dollars.

[3] Fiscal years in Australia start on July 1 and end in June 30 of the following year.

[4] See EU Emissions Trading System data review.