The Impact of the Carbon Price on the Emissions intensity of Australia's Power Sector

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Overview

Australia naturally has a highly emissions-intensive economy. Currently Australia's emissions per unit of GDP are about twice the level of the OECD average (IEA, 2014) mainly due to low fossil fuel energy prices. Under the Paris Agreement, Australia's target is to reduce emissions by 26 to 28 per cent below 2005 levels by 2030. This will see the emissions intensity of the economy fall by around 65 per cent, and the emissions per capita halved. It appears that in order to meet Australia's climate commitments, the implementation of an emissions intensity scheme for the electricity industry could be reconsidered by the Australian government as part of its climate change review.

In 2011, the Carbon Pricing Mechanism (CPM) was introduced as a key element of the Climate Change Plan to reduce greenhouse gas emissions to 5 per cent below 2000 levels by 2020. Stationary energy in Australia is the largest source of CO2 at around half of total emissions (Treasury, 2015), of which more than two-thirds come from electricity generation (i.e. electricity generation accounts for 35 per cent of all CO2 emissions in Australia). In the confines of the Australian electricity market, the intention behind imposing a price on carbon was to encourage producers to switch away from coal-fired generation and move to gas and renewable sources of energy through increasing the cost of fossil fuel combustions. Thus, the CPM became effective on the first of July 2012, with an introductory phase during which the price of uncapped permits was fixed with a planned transition to an emissions trading scheme (ETS) in July 2015 (however, the CPM was repealed by the Abbott government on 17 July 2014). During the implementation of the CPM, the average emissions intensity in the power sector decreased by 4.6%. Although there is consensus that carbon pricing is required to support lower carbon emissions technologies, a debate remains on the extent to which the carbon price could result in a decrease of emissions intensity in the power sector. Any such a reduction could also be attributed to other factors (in addition to carbon prices), such as the Renewable Energy Target (RET), a range of non-pricing policies to improve energy efficiency, and the closure of some coal-fired generators.

Therefore, this paper assesses the impact of the CPM on the emissions intensity of the electricity sector by employing a time-varying parameter analysis using daily data within the Australian National Electricity Market (NEM). This study seeks to answer the question: to what extent can the observed decrease in emissions intensity be attributed to the CPM over the policy implementation period? This paper also investigates the trend of emissions intensity in the power sector since the tax was repealed by considering any changes in electricity generation by fuel type. In other words, it analyses whether emissions intensity has reverted back to its pre-2012 levels after the carbon tax was repealed.

To the best of my knowledge, this paper is a pioneer empirical study using time-varying analysis on the impact of the CPM on emissions intensity in the electricity sector across the NEM even after the tax was repealed. This research contributes to the literature in several dimensions. For example, it extends the relatively sparse literature on the impact of the Australian CPM on the electricity sector, and measures the actual impact of the CPM on emissions intensity of the power sector in Australia by using econometric evidence from the NEM. Another contribution of the analysis is that this paper develops a framework for examining the impact over a long sample that includes the period the carbon tax became effective – from July 2012 to June 2014 – as well as the period after the tax was repealed – from July 2014 to December 2017. While previous studies in the Australian context have been restricted to a shorter period, the present paper examines a significantly longer time period, allowing additional insights to be gained on the impact of the introduction and the repeal of the tax on emissions intensity in Australia.

Moreover, to improve the estimates of the impact of the CPM, some of the assumptions made by previous studies have been relaxed in the econometric model specification. Existing studies in Australia (e.g. O'Gorman and Jotzo, 2014) are restricted by some assumptions in estimating the impact of the CPM which affect the robustness or exactness of the results, potentially resulting in biased estimates.

Mothods

This study will be one of **the first ex-post studies using available data** after the introduction of the CPM. In order to analyse empirically the impact of the carbon price on the emissions intensity of Australia's power sector, a time-varying parameter model is employed. This model uses the daily data for four major regional markets (New South Wales (NSW), Queensland (QL), Victoria (VIC), and South Australia (SA)) across NEM, and is estimated for each market separately. The dataset is constructed on a daily basis from 1 July 2012 to 30 December 2017. Recall that the carbon tax became effective on 1 July 2012, with an intended introductory phase until 30 June 2015, during which the price of uncapped permits was fixed: first at 23 AUD/tCO2e, then from 1 July 2013 at 24.15 AUD/tCO2e, and from 1 July 2014 at 25.40 AUD/tCO2e. After the election of a new government, the carbon tax was repealed by the Australian Senate on 17 July 2014. Thus, based on the introduction and the later abolishment of the tax, through creating dummy variables to estimate the models, two sub-periods have been taken into consideration: 1. the time

period referring to the years when the carbon tax was imposed (from 1 July 2012 to 30 June 2014); and 2. the period after the tax was abolished (from 1 July 2014 to 30 December 2017).
To investigate whether and to what extent changes in emissions intensities can be explained by the CPM, this study assumes that such changes can be predominately attributed to variations in fuel costs, fossil-fuel mix, carbon and fuel intensity improvement, the closure of some brown and black coal-fired plants, the Renewable Energy (electricity) Target, and carbon prices. This paper also investigates changes in the composition of electricity supplied to the NEM and the merit order during the two-year period of the introduction of the carbon price as well as the period after it was repealed.

Results

Based on this analysis, the empirical results demonstrate that declines in emissions intensity were primarily driven by a combination of contributing factors unrelated to the carbon price. It seems that the CPM could not result in displacement of coal by existing renewable or gas generators. In other words it could not lead to a significant impact on the composition of electricity supplied in the NEM or the merit order of generation. Therefore, the carbon-induced effects on emissions intensities for all states considered were of little importance. The incidence of taxation would apparently be borne by consumers, rather than generators, and it would be unlikely for carbon costs to be internally absorbed to a significant extent by generators in the short term. The impact of the CPM on investment in power generation assets has been limited, and this is probably due to ongoing political uncertainty about the continuation of the CPM. Thus, the observed reduction in the average emissions intensity could be attributed mainly to other non-pricing policy instruments in force in Australia, and non-carbon related changes in the fossil fuel mix. For example, the greatest abatement effects in the power sector have come from increases in renewable generations due to the Renewable Energy Target, and a range of other policies to improve energy efficiency. Furthermore, the findings show that the reduction in emissions intensity was also partly caused by the permanent or temporary closure of a number of older and less efficient coal-fired generators due to a weaker demand as well as a flood to the power stations (e.g. the flooding of the Yallourn power station, one of the most emission-intensive power plants in Australia), which reduced output and led to a significant drop in emissions in the power sector.

Conclusions

This paper finds that the CPM has limited effects in changing the merit order and the dispatch of power stations during the first two years of its operation. The CPM has not led to significant impacts on investment in low carbon power generation assets, and it could not reduce power sector emissions substantially. These findings could be crucial for policymakers to make better-informed regulatory decisions when designing climate policies to reduce domestic emissions and support international efforts and, more specifically, when considering a transition to an emissions trading scheme under the Liberal-National coalition government.

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