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Does carbon pricing reduce air travel? Evidence from the Australian ‘Clean Energy Future’ policy, July 2012 to June 2014

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ABSTRACT

Aviation emissions are an important contributor to global climatic change. As growth in travel demand continues to outstrip improvements in the fuel efficiency of air travel, the aviation contribution to climate change is likely to grow substantially. Consequently, measures that effectively reduce travel demand are required if atmospheric carbon concentrations are to be limited. The efficacy of the Australian *Clean Energy Future* policy which placed a $23.00AUD (FY 2012) to $24.15 AUD (FY 2013) per tonne levy on carbon-dioxide equivalent emissions from July 2012 to June 2014 is tested. Specifically, time-series regression is used to estimate the effect of this carbon price policy on the level of domestic passenger kilometres flown in Australia, while adjusting for costs of production (i.e. fuel and labour costs), economic activity (i.e. gross domestic product), competitive effects (i.e. airline capacity), and exogenous shocks. There was no evidence that the carbon price reduced the level of domestic aviation in Australia. Carbon pricing measures may have to be levied at a greater rate to affect behavioural change, particularly given the limited potential for future aviation efficiency gains.

1. Introduction

1.1. Growth in global and Australian air traffic

The number of people transported by plane has increased more than tenfold since the 1970s, reaching a staggering 3.7 billion passengers in 2016 (World Bank, 2017). Global passenger traffic for 2016, measured by revenue passenger kilometres (RPKs), rose by approximately 7.4% (to 7127 billion) on the previous year, and airline capacity, measured by available seat kilometres, was also up approximately 7.4% (ICAO, 2017d). Increased demand has translated into near record profitability, with global airline net profits (after interest charges, taxes, and write-downs) for 2016 of $34.8 billion, an aggregate operating margin of 8.9%, and record load factor of 80.4% (IATA, 2017: 14). The industry forecasts growth in airline traffic of 4.7% p.a. for the next 20 years, with total jets in service in forecast to increase from 23,480 in 2016 to 46,950 by 2036 (Boeing, 2017: 79).This level of aero-mobility has well-documented impacts on the global climate via emissions of carbon dioxide (CO_2), nitrogen oxides (NOx), aerosols and their precursors (soot and sulphate), persistent linear contrails and induced-cirrus cloudiness (Lee et al., 2009). Aviation accounts for an estimated 4.9% of the anthropogenic component of global warming and this proportion is forecast to increase significantly over time (Lee et al., 2009). A meta-analysis of published travel demand projections found that the median estimated increase in global aviation emissions was an increase of 350% between the years 2000 and 2050 (Gudmundsson and Anger, 2012).

The rapid increase in aviation emissions results from a level of demand that far outstrips any improvements in the fuel efficiency of aircraft fleets. Aviation emissions are particularly resistant to reduction because the marginal efficiency gains of aircraft technology appear to have been largely exhausted. The jet aircraft has reached a stage of technological maturity that only allows for minor and incremental efficiency gains (Bows et al., 2009). Indeed, most of the technological ‘solutions’ that have been presented over the past 20 years, including solar passenger planes, redesigned planes, and biofuels, are either technically impossible, commercially infeasible, more polluting than fossil fuels, or incapable of materially reducing emissions (Peeters et al., 2016: 40). Unlike other forms of transport and industry, the energy source of aviation is not readily substitutable. Coal-fired power stations can be replaced by nuclear, wind, and solar power. Road- and rail-based passenger vehicles can transition from oil-based fuels to renewably-sourced electricity. For jet engines, the options for technology switching

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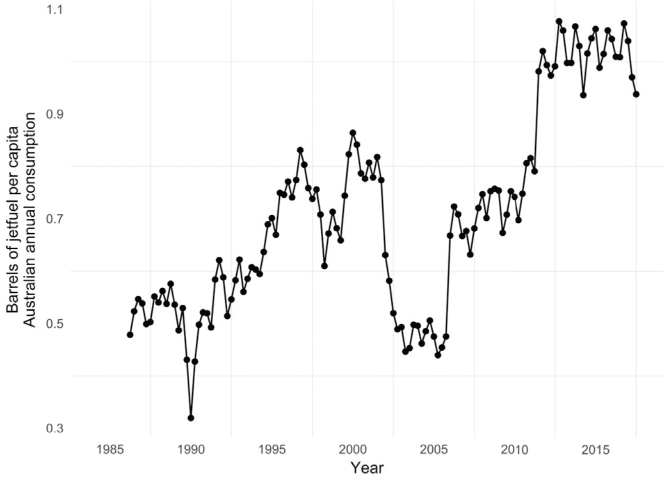

Fig. 1. Barrels of aviation turbine fuel consumed for Australian domestic aviation per capita per quarter, 1984–2017.
Source: Created by the authors from Australian Petroleum Statistics (Department of the Environment and Energy, 2017) and Australian Demographic Statistics (Australian Bureau of Statistics, 2017a)

are very limited (Stern, 2006: 337). This means that in the absence of radical technological change – the substitution of the jet engine with a clean technology – aviation remains an intractable environmental problem (Lee et al., 2009). In Australia, this is evident in the amount of aviation fuel used per head of population over time (Fig. 1). While there have been sharp intermittent falls in per capital fuel consumption due to external shocks (including significant industrial action by pilots in 1989 and the collapse of the domestic airline Ansett in 2001), the general trend is an ongoing increase in air travel demand at a rate that has outstripped improvements in efficiency by a considerable margin.

Aviation is likely to comprise a rapidly growing share of greenhouse gas emissions. For example, a study of the UK found that even a moderate growth in aviation emissions would exhaust the entire carbon 2050 budget for the UK consistent with atmospheric CO_2 levels of 450 ppm (Bows et al., 2006). As such, it is unlikely that aviation greenhouse gas emissions will be stabilized at levels consistent with risk-averse climate targets without measures that actively reduce aviation demand or restrict flying (Macintosh and Wallace, 2009). The intractable nature of the air travel emissions problem is reflected in its ongoing exclusion from global climate change instruments. The only meaningful policy option appears to be some market-based mechanism (MBM) that prices carbon emissions.

1.2. Carbon pricing and aviation

At the global scale, carbon pricing has been identified as the key policy mechanism available to governments to reduce greenhouse gas emissions (World Bank, 2014). Indeed, establishing a carbon price through taxation, emissions trading, or regulation has been described as 'the first task of mitigation policy' (Stern, 2006: 35). Carbon pricing requires emitters to be financially accountable for the environmental cost of emissions and provides an incentive to invest in new technologies that might reduce global warming. In general, a carbon price increases the costs of carbon-based production, therefore decreasing demand or leading to substitution between technologies or products. However, in the case of air travel, where the replacement of aircraft fleets is an expensive long-term response, any initial effect of carbon pricing is likely to be exhibited in decreased travel demand. Consequently, an effective carbon price should theoretically reduce aviation emissions by increasing prices and thereby reducing demand.

A MBM for greenhouse gas emissions is the preferred international approach. The framework for current global policy is provided by the International Civil Aviation Organization (ICAO), an agency of the United Nations established in 1944 to manage and govern the Convention on International Civil Aviation (i.e. the Chicago Convention) across its 192 member states (https://www.icao.int). In 2013, ICAO member states announced that they would cooperate to achieve 'carbon-neutral growth' by 2020 (CNG2020). The CNG2020 agreement advanced an aspirational set of targets, including 1.5% average annual fuel efficiency improvement between 2010 and 2020, carbon neutral growth from 2020, and a reduction of 50% in net emissions by 2050 compared to 2005 levels. Many measures were initially considered including a cap-and-trade scheme similar to the EU Emissions Trading System (EU ETS), but member states eventually decided on a global carbon offsetting scheme to reach the goal through emission reduction projects in other sectors (Carbon Market Watch, 2016).

This scheme was ratified by 39th ICAO Assembly on October 6, 2016. Member states finalized the details of a MBM to offset most of the CO_2 growth in aviation from 2020 onwards. The measure, known as the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), marks the first time a MBM covers an entire international sector. Under CORSIA, airlines from participating member states are assigned individual emission limits according to their international aviation emissions, calculated based on the average international emissions for the 2019–2020 period. If an airline's emissions exceed this limit, the airline must then buy emission rights. These are to be met by the purchase of qualifying credits from other industries and projects that limit GHG emissions (i.e. a cross-sectorial model).

CORSIA will be implemented in three stages. The pilot (2021 – 2023) and the first phase (2024–2026) are both voluntary. As of 31 January 2018, 73 states representing 88% of total international civil aviation transport have indicated they will volunteer. The second phase (2027–2035) is mandated and includes all states with an individual share of international aviation activity in year 2018 above 0.5% of total activity or whose cumulative share reaches 90% of total activity (ICAO, 2017a). Developing countries are exempt unless they volunteer to participate. Important exclusions from the scheme are domestic aviation activity and the emissions of other climate pollutants from aviation (i.e. black carbon, nitrogen oxides, and the precursors of aviation-induced cloudiness).

According to modelling by the ICAO, the estimated quantity to be offset to achieve CNG 2020 would be 142–174 million tonnes of CO_2 in 2025 and 443–596 million tonnes of CO_2 in 2035 (ICAO, 2017b). The voluntary phases are expected to offset 64% of growth revenue tonne kilometres (RTKs) or 11% of all international RTKs based on the countries that have opted in thus far, whereas the mandatory phase will offset 75% of growth RTKs or 32% of total international RTKs. Between 2021 and 2035, the MBM is expected to cover approximately 73% of growth RTKs and 25% of all international RTKs (ICAO, 2017c).

In 2013, the trade association for the world's civil airlines, the International Air Transport Association (IATA), committed to the CNG2020 target with certain caveats. These included the necessity for ICAO to work with industry, particularly in terms of research and development, to produce cheaper biofuels and more efficient aircraft as part of a broader voluntary package of initiatives in which a MBM is only used as a complement to close any gap between emissions and the CNG2020 aspirational goal. In addition, the industry strongly urged ICAO to develop a single global MBM that avoids "a patchwork of unilateral national and/or regional policy measures" (IATA, 2013).

Critics of CORSIA have argues the scheme is fundamentally flawed because of low participation (including voluntary stages, multiple exclusions, and disregard of domestic aviation), weak mandates (i.e. aspirational goals with few sanctions for non-compliance), and a failure to limit or reduce emissions at source (i.e. using carbon rights from other industries to offset increasing aviation emissions) (Scott et al., 2016; Becken and Mackey, 2017; Higham et al., 2018). Indeed, predictive modelling studies of the likely outcomes of CORSIA have