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Modelling the impact of energy policies on the Philippine economy: Carbon tax, energy efficiency, and changes in the energy mix

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ABSTRACT

As part of its global obligations to responding to climate change, the Philippines is committed to limiting future emissions growth through policy interventions such as funding research on mitigation and direct regulation of energy efficiency requirements. The Philippines is also interested in extensions of such policies, including the use of carbon taxes, measures to enhance energy efficiency, and changes to the country's electricity generation mix.

This paper develops a computable general equilibrium (CGE) model of the Philippine economy to analyse the effects of such climate change policy options in the period to 2020. The modelling results indicate that given the current level of development in the Philippine electricity generation and transport sectors, even relatively modest measures have marked impacts on emissions with marginal economic impacts. A carbon tax of $US5 per a tonne, results in a 9.8% reduction in emissions and a 0.5% reduction in GDP from baseline levels to 2020. Similarly, a 2% increase in energy efficiency throughout the Philippine economy results in an 8.5% reduction in emissions and 0.6% reduction in GDP compared to the underlying baseline of no policy response. Finally, a 10% shift in the coal-fired generation capacity results in an 11.0% reduction in emissions with GDP in fact increasing by 1.9% over baseline levels.

1. Introduction

There is broad consensus that climate change is a reality and that its causes are significantly anthropogenic in origin, with the IPCC (2007) noting that mean, maximum, and minimum temperatures have increased 0.14 °C per decade since 1971.

The Philippines will be particularly affected by climate change, with the country's average annual mean temperature projected to increase by 0.9 °C–1.2 °C by 2020 and 1.7 °C–3.0 °C by 2050 (UNFCCC, 2007; World Bank, 2010). Issues with

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great pertinence to the Asia Pacific, such as increased typhoon activity and sea level rise (World Bank, 2010) or food security (Bandara and Cai, 2014), are now emerging as critical challenges in the Philippines. For instance, the projected impacts of climate change on the Philippines include increased typhoon activity and a projected 30 cm rise in sea level by 2045. This is close to the Asian Development Bank's (ADB, 2009) 'low scenario' which indicates these rises would affect 2000 ha and around 500,000 people.

Commencing in 1991 the Philippines has enacted a wide range of climate change-related policies and has taken an active role mitigating aspects of climate change in the application of the Clean Development Mechanism. The Inter-Agency Committee on Climate Change was established in 1991 and in 1992 in response to its Earth Summit commitments, the Philippine Council for Sustainable Development was created. The Philippines ratified the Kyoto Protocol in 2003, leading to the formation of the Presidential Task Force on Climate Change Adaptation and Mitigation and the Advisory Council on Climate Change (Rincon and Virtucio, 2008).

Given the pace of international developments and experiences with climate-related natural disasters, the Philippines has increasingly focused on its national response, culminating in the passing of the Climate Change Act of 2009, the establishment of the Climate Change Commission, the introduction of the National Framework Strategy on Climate Change in 2010 and creation of the National Climate Change Action Plan 2011–2028.

It is likely that further international discussions at the United Nations Framework Convention on Climate Change (UNFCCC) Conferences of Parties (COPS 21) in Paris in December 2015 and further developments at the international or regional level will see the Philippines adopt emerging policy responses to climate change. In this context, the modelling of potential responses becomes crucial as any policy shifts will have implications for the Philippine economy.

The main aim of this paper is to evaluate and analyse the potential short and long-term economic effects on the Philippine economy of policy responses to climate change, including the introduction of a carbon tax, improvements in energy efficiency and changes in the energy mix using a computable general equilibrium (CGE) model referred to as the PHILGEM-E model. The remainder of this paper is organised as follows. Section 2 provides a brief overview of the use of CGE models in climate change policy and discusses the structure of PHILGEM-E model. Section 3 outlines the results from the modelling of three policy responses while Section 4 discusses their implications. Section 5 concludes the paper.

2. Methodology

2.1. The use of CGE models in climate change policy

CGE models are widely used tools in economic analysis. They have been applied to the evaluation of a range of potential impacts including welfare, outputs, prices, consumption, international trade, income distribution, poverty, pollution, and other indicators of policy actions and events in international trade, government spending and taxation, and the environment (for a discussion of these issues see Cabalu and Rodriguez, 2007; and Cororaton and Cockburn, 2007). CGE models represent the entire economic systems and are able to accommodate macroeconomic feedbacks through changes in the price of goods and costs of production when policy shock occurs. The appeal of these models is also based mainly on their ability to combine economic theory with actual data of the entire economic system. It is therefore able to generate insights on the effects of policies and events in a context that is a step closer to the real world without severely compromising economic theory. CGE models have been used extensively in the analysis of climate change with a particular focus on the impact of mitigation efforts. These include static and dynamic versions of multi-country and country-specific models (Fujimori et al., 2014a).

2.1.1. International CGE models on mitigation

CGE models focused on mitigation examine the impacts on economies of reducing greenhouse gas emissions. Reflecting the wide range of potential policy levers, CGE models have evaluated climate change mitigation in a number of ways. These include the use of taxes, trading of emission permits, abatement investments, and quantitative limits on emissions. Multi-country and country-specific models have been used in this analysis. Recent examples of studies that used multi-country models include: Fujimori et al. (2014b), Timilsina and Mevel (2013), Calzadilla et al. (2011), Nurdianto and Resosudarmo (2014), Klepper and Peterson (2006), Babiker (2005), and Bohringer (2000), with these studies drawing on earlier research from studies such as Whalley and Wigle (1991). Specific models have been developed for a number of countries including Australia (Allen Consulting Group, 2006; Adams and Mai, 2002; McDougall, 1993), Austria (Breuss and Steininger, 1998), China (Garbaccio et al., 1998), India (Pal et al., 2015; Rana, 2003; Yusuf et al., 2010), Ireland (Jensen et al., 2003), Israel (Palatnik and Shechter, 2008), Malaysia (Jaafar et al., 2008), Norway (Brendemoen and Vannemo, 1994; Glomsrod et al., 1992), South Africa (van Heerden et al., 2006) and Turkey (Telli et al., 2008).

Carbon taxes have been prominent in policy discussions to reduce the quantity of carbon dioxide emissions and evaluating the impacts of taxes on carbon emissions are among the most popular measures in CGE models. Some of these studies based emission cuts on existing or proposed agreements and targets. For example, Palatnik and Shechter (2008), Klepper and Peterson (2006), Babiker (2005), Bollen et al. (2000) and Bohringer (2000) based their targets on the Kyoto protocol while Yusuf et al. (2010) focused on the Indonesian action plans submitted to the Copenhagen Accord. There are also studies which used rather arbitrary targets for emission cuts. Examples include McDougall (1993) and van Heerden et al. (2003) which imposed a tax of $25 and $5 per ton of carbon dioxide emissions, respectively. In some cases, the amount