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Cap and trade climate policy and U.S. economic adjustments

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1. Introduction

In facing the challenges of global climate change, there are two market failures that justify public initiatives (Goulder, 2004). To the extent that the anthropogenic portion of climate change is a technological problem, when firms cannot capture all of the returns on their knowledge and technology investments there results an economy-wide underinvestment in mitigation options. This is compounded by the presence of uncertainties that give rise to thresholds on minimum financial performance or potential market size below which firms do not launch R&D or technological initiatives. To date, this market failure remains the primary focus of national climate change policy with technology-push being the order of the day.

But climate change is also a problem of the divergence between "private" and "social" prices. Emissions are too high because market prices fail to internalize climate-related damages. When emissions-generating goods and services are priced properly, the benefits of avoided damages are reflected correctly in market prices and, so, reflect their social opportunity cost in use. The pricing arena calls for more direct initiatives because the technology policies designed to remedy

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the first market failure are ill suited to address this second one (and vice versa). It is in dealing with this divergence in private versus social prices that the "cap and trade" mechanism gains its comparative advantage.

In this paper, the Inter-temporal General Equilibrium Model (IGEM) of Dale Jorgenson Associates (DJA) is used to simulate the economy's reaction to the introduction of a cap and trade system. The experimental design in these simulations emphasizes the mechanisms of adjustment with particular attention devoted to important empirical questions and broader policy decisions.

IGEM is a computable general equilibrium (CGE) model of the growth and structure of the U.S. economy. It has been used in a variety of efforts related to climate change and climate change policy (e.g., see Jorgenson, Goettle, Wilcoxen, & Ho, 2000, 2008; Jorgenson et al., 2004). Because IGEM represents a comprehensive range of possible responses to economic change and because it is econometrically estimated from over 40 years of market data, it is well suited to address the broad market implications of climate change policy over the intermediate term.

The remainder of the paper is organized as follows. Sections 2 and 3 present the policy and data considerations for the IGEM simulations. Section 4 provides an overview of the effects of two pairs of variations on main policy themes—international permit trading and external offset opportunities. Section 5 explores, in detail, the mechanisms of adjustment common to all the model runs. Section 6 examines the role of induced technical change (ITC) in easing the economic burden of adjustment and provides estimates of its magnitude. Section 7 considers the effects of less responsiveness on the part of households with respect to their consumption and leisure decisions. Finally, Section 8 offers a series of conclusions derived from the above for the design and timing of cap and trade policies.

2. Policy considerations

Like any model, IGEM can only approximate the details of a complex and comprehensive cap and trade proposal. As a result, these simulations incorporate the full variety of key policy provisions considered to date. These include the emissions constraint in relation to base case emissions growth, the allocation of emissions permits, and compliance alternatives to these permits, namely domestic offsets and international credits.

The analysis assumes a modest cap on GHG emissions at 2000 levels beginning in the year 2010. It is assumed that the policy is announced in 2005 with an ensuing orderly and voluntary transition to the constrained level of emissions beginning in 2006. The cap references the emissions of six greenhouse gases – carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6) – as measured by their global warming potential (GWP). It is based on the totality of 2000 GHG emissions less non-transportation exemptions for the direct emissions from the residential and agricultural sectors and from small businesses emitting less than 10,000 metric tons of carbon dioxide equivalent ($MTCO_2E$). For the purposes of policy design, these exemptions are considered *non-covered* sources of GHG emissions while the emissions-generating activities of all other entities are considered *covered* sources.

Based on the U.S. EPA (2004) emissions inventory and assuming that activities in the commercial sector are a reasonable proxy for small business enterprises in the commercial and industrial sectors, GHG emissions from 2010 forward are constrained not to exceed 5945 million metric tons of carbon dioxide equivalent ($MMTCO_2E$). This is just over 84% of the 7039 $MMTCO_2E$ of total GHG emissions occurring in 2000 but is greater than the 5673 $MMTCO_2E$ of GHG emissions arising from 2000s fossil fuel use.