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Renewable energy and unemployment: A general equilibrium analysis

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A R T I C L E I N F O

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A B S T R A C T

Using a three-sector general equilibrium model, the impact of renewable electricity support policies on the rate of equilibrium unemployment is analyzed. In a simple two-factor version of the model, the paper shows analytically that renewable electricity support policies lead to an increase in the rate of unemployment. A numerical analysis is conducted with an expanded three-factor model. In this version, most scenarios analyzed also lead to an increase in equilibrium unemployment. However, the paper identifies conditions in which renewable energy support policies can decrease the rate of equilibrium unemployment. In particular, when the elasticity of substitution between capital and labor is low, when capital is not mobile internationally, and when the labor intensity of renewable generation is high relative to conventional generation, renewable electricity support policies may reduce the rate of equilibrium unemployment. The model is parameterized to represent the US economy, such that the magnitudes of quantities can be observed. Although there is some variation in the results depending on parameters, the findings suggest in general that reducing electricity sector emissions by 10% through renewable electricity support policies is likely to increase the equilibrium unemployment rate by about 0.1–0.3 percentage points.

1. Introduction

Policy makers concerned about high rates of unemployment as well as the environmental impacts of energy production naturally gravitate towards policies that might be able to address both problems

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at once. Consequently, support has surged for policies that promote renewable energy generation, partly because of their impact on 'green job' creation, and employment overall. For example, a report by the US Mayors states that "[Renewble energy investments] carry macroeconomic benefits as well - they create jobs, increase productivity, and generate income that creates further jobs" (Global Insight, 2008). Similarly, US President Obama's New Energy Plan for America is designed to "help create five million new jobs by strategically investing $150 billion over the next ten years to catalyze private efforts to build a clean energy future."[1]

The economics literature contains several contributions that explore the impacts of renewable energy policies on employment and the labor market. Many of these existing studies use a fixed coefficient input–output framework. For example, Hillebrand et al. (2006) conduct an analysis of the German renewable support policy using a modified input–output model, and conclude that the policy is likely to generate a positive level of net employment in the near term, but a negative level in the medium- to long-term. Lehr et al. (2008) use a similar model, but supplement with a detailed survey to generate input–output coefficients specific to the renewable electricity sector. They find that the net effect of the renewable energy support policies in Germany is positive, such that the policy lowers the long-run rate of unemployment. This conclusion is reinforced by Ragwitz et al. (2009), who estimate that EU-wide renewable energy support policies have generated a net positive impact on employment. Their study again uses an input–output framework, and this is coupled with a macro-economic model.

Other studies employ a computable general equilibrium model to assess the impacts of renewable electricity policies on employment. For example, Böhringer et al. (2012) implement a model of the feed-in tariff policy in the Canadian province of Ontario, and conclude that employment is likely to decrease, and unemployment is likely to increase, as a result of policy implementation. Kuster et al. (2007) examine the impact of renewable energy investment subsidies in EU countries on a variety of economic variables including the level of unemployment, using a multi-sector, multi-region, recursive dynamic computable general equilibrium model. They find renewable energy subsidies increase unemployment rates in each of the countries they study.

One disadvantage of these studies is that they all use relatively detailed and consequently opaque models, making the mechanism by which renewable energy policies increase or decrease unemployment rates unclear.

In contrast, there exists an established theoretical literature that explores the link between environmental taxation and employment using stylized general equilibrium models. For example, Bovenberg and de Mooij (1994) use a simple general equilibrium model with labor-leisure choice (but without involuntary unemployment) to explore the impacts of a labor to dirty goods tax shift on employment and non-environmental welfare. They find that the relatively narrow base of the environmental tax implies that the dirty goods tax is more distorting than the labor tax, and results in a fall in the real wage, and consequently a reduction in employment. Schneider (1997) uses a similar model but includes involuntary unemployment, and concludes that a shift towards environmental taxation is likely to reduce unemployment (but see comment by Scholz (1998)). A series of papers by Bovenberg and van der Ploeg (1996), Bovenberg and Van der Ploeg (1998), Bovenberg and Van Der Ploeg (1998) as well as a summary by Bovenberg (1995) is based on similar types of models that include various specifications for involuntary unemployment and consider the effect of mobile factors, substitution elasticities, initial tax rates, and factor shares. This literature generally concludes that shifting the tax burden from broadly-based income taxes to dirty goods taxes is unlikely to boost employment.

This paper aims to bridge the two literatures by developing a simple general equilibrium model with some detail around electricity generating technologies to predict the impact of policies that support renewable energy on long-run levels of employment and unemployment. Additionally, the model developed here admits the comparative analysis of alternative renewable energy support policies. The model is deliberately kept simple in order to maintain its transparency.

In the model, electricity is generated from either renewable or conventional sources. Conventional electricity requires fossil fuel inputs, which produce pollution when consumed. In contrast, renewable electricity requires no fossil fuel inputs, and produces no emissions. In addition to the electricity

[1] See http://change.gov/agenda/energy_and_environment_agenda/.