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Unemployment and environmental regulation in general equilibrium☆

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ABSTRACT

This paper analyzes the effects of environmental policy on employment (and unemployment) using a new general-equilibrium two-sector search model. We find that imposing a pollution tax causes substantial reductions in employment in the regulated (polluting) industry, but this is offset by increased employment in the unregulated (nonpolluting) sector. As a result, while the policy causes a substantial shift in employment between industries, the net effect on overall employment (and unemployment) is small, even in the short run. An environmental performance standard causes a substantially smaller sectoral shift in employment than the emissions tax, with roughly similar net effects. Thus, policymakers who want to minimize sectoral shifts in employment might prefer performance standards over environmental taxes.

The effects on the unregulated industry suggest that empirical studies of environmental regulation that focus only on regulated firms can be misleading, significantly overstating the net employment effects (and those that use nonregulated firms as controls for regulated firms will be even more misleading, overstating both the net effects and effects on the regulated industry). This implies that overall effects on employment are less of an issue for environmental policy than the empirical literature might suggest.

1. Introduction

Effects on employment have played a central role in the political debate over environmental regulations, especially during the recent economic downturn, with opponents deriding regulations as “job killers” and proponents touting “green jobs.” This focus is understandable, given the large potential welfare effects of involuntary unemployment. However, economic studies of the effects of environmental regulation do not adequately answer the question of how regulation affects unemployment.

A substantial number of empirical studies have looked at how regulations affect employment.[1] But while such studies provide valuable information on employment changes in regulated industries, they do not measure the effects on unregulated industries, so to the extent that regulation affects employment in those other industries, such studies cannot measure the overall effect. A more serious problem is that these studies often employ a difference-in-differences approach, using firms in unregulated industries (or firms in regulated industries, but in areas that are unregulated or subject to less stringent regulation) as controls. To the extent that regulation affects employment at those firms, such studies will not only miss the effects on unregulated firms, but also yield biased estimates of the effects on regulated firms.

Addressing those issues requires a general-equilibrium analysis. But existing general-equilibrium models used to analyze environmental regulation almost always assume full employment. And the few models in this area that do allow for unemployment typically focus on types of unemployment that are largely unimportant in the United States (e.g., unemployment caused by strong unions that negotiate wages well above free-market levels).[2]

This paper develops a new model to study how environmental regulation affects employment and unemployment. It incorporates a search model with frictions as in Mortensen and Pissarides (1994), together with a simple two-sector general-equilibrium model of environmental policy, roughly calibrated to correspond to the effects of

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[1] For examples, see Berman and Bui (2001), Curtis (2012), Greenstone (2002), and Morgenstern et al. (2002)

[2] See, for example, Bovenberg and van der Ploeg (1996).

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imposing a carbon policy in the United States. In this model, unemployed workers must search and match with job openings in each period; the interaction of carbon policy with this matching process plays a key role in determining the economy-wide employment impacts of the regulation.

Our paper makes three substantial contributions. First, we show that effects on jobs in the polluting sector of the economy are generally offset by opposite effects (of roughly similar magnitude) in the nonpolluting sector. For example, imposing a pollution tax causes a substantial employment drop in the polluting sector, but also an offsetting increase of similar magnitude in the nonpolluting sector, driven both by consumer substitution from polluting to nonpolluting goods and by decreased competition for workers from the polluting sector (which makes it easier for the nonpolluting sector to hire). Consequently, while there is a substantial shift in employment between industries, the net effect on unemployment is small, even in the short run.

Given its stylized nature, one shouldn't rely on the precise quantitative predictions of our model. However, the existence of significant general-equilibrium effects on unregulated industries has strong implications for how to interpret empirical work on this topic. These effects create a fundamental identification problem. Empirical studies that look only at regulated firms will greatly overstate the net effect on employment (though they can measure the job loss in the regulated sector).[3] Difference-in-differences studies that use unregulated firms as a control group will be even further off, not only missing job gains in unregulated firms, but also seriously overstating job losses in regulated firms. Our results suggest that those studies could overstate effects on regulated firms by a factor of almost two and overstate the overall net effects by far more. Some of these effects can pose a problem even for a study such as Walker (2013), which uses linked worker-firm data and follows workers over time, because it implicitly uses workers initially employed in unregulated firms as controls.[4] This emphasizes the importance of considering general-equilibrium effects.

Second, we show that the magnitude of the employment shift (both the job losses in the polluting sector and gains in the nonpolluting sector) is much smaller under a performance standard (a constraint on pollution emissions per unit of output) than under a pollution tax. A performance standard is equivalent to a tax on emissions and subsidy on output in the dirty industry (see, for example, Holland, 2009, Holland et al., 2009, and Fullerton and Metcalf, 2001). As a result, the price increase for polluting goods is much smaller under a performance standard than under an equivalent emissions tax, and thus the substitution in consumption and corresponding shift in employment is correspondingly smaller. This suggests that, to the extent that policymakers want to minimize sectoral shifts in employment, performance standards (and related intensity-standard policies) may be attractive, even though they are less efficient overall than emissions taxes that finance other tax reductions.

Third, the paper develops and demonstrates a tractable framework for bringing unemployment into computable general equilibrium (CGE) models of environmental regulation. This general framework could be useful for studying a wide range of other questions involving unemployment and environmental regulations, such as questions about the optimal timing of regulations (e.g., should a major new environmental regulation be implemented during recession, or would it be better to wait until after the economy has rebounded?), about the design of regulations (e.g., how is the choice of price-based versus quantity-based regulations affected by unemployment concerns?), or about the distributional implications of changes in employment patterns resulting from regulation. And it could readily be adapted to look at employment effects of other types of policies, such as trade policy, where employment effects play an important political role.

Our model differs substantially from previous efforts to evaluate the impact of environmental policy on unemployment in a general equilibrium model. Balistreri (2002) uses a reduced-form representation of unemployment, rather than explicitly modeling search as we do. Our approach has a number of advantages, including the ability to look at temporary effects on unemployment resulting from sectoral shifts in demand. Shimer (2013) also looks at employment, with a focus on sectoral shifts caused by environmental policy, but again does not explicitly model search (workers who choose to switch industries must spend and exogenous amount of time unemployed). As a result, short-run unemployment is caused by the reallocation process. In our model, however, unemployment is caused by the search friction and the interaction between environmental policy and the search friction leads to changes in unemployment over time. Further, Shimer (2013) assumes that environmental policy cannot affect the total level of employment, whereas our model allows for endogenous levels of employment.

Aubert and Chiroleu-Assouline (2017) explicitly model employment search for low-income workers in a model of environmental taxation, but differs from our model along several key dimensions. First, Aubert and Chiroleu-Assouline (2017) model a stationary search friction and thus cannot consider the dynamic response of the labor market to environmental policy. Second, their model considers both high-skill and low-skill labor, with unemployment only for low-skill workers. Third, the model does not explicitly distinguish between clean and dirty sectors (they are identical) and thus cannot analyze the reallocation of workers between sectors, which is a crucial piece of our analysis. Finally, their model does not include an abatement function and does not consider performance standards.

The rest of the paper is organized as follows. Section 2 presents the structure of the model. Section 3 explains the calibration of the model, and Section 4 discusses the policy simulations and results. Section 5 considers extensions of the baseline model, and the final section offers conclusions.

2. A two-sector model with search frictions

Understanding how environmental policy affects both regulated and unregulated firms requires general-equilibrium analysis. But standard general-equilibrium models of environmental policy assume full employment: wages adjust such that labor demand and labor supply equate each period. To model unemployment, we introduce a search friction into a two-sector model of clean and dirty production. The search friction from Pissarides (1985) and Mortensen and Pissarides (1994) is well-developed in the macro-labor economics literature and is a useful starting point for analyzing how environmental policy might affect unemployment. Search-friction models introduce unemployment as an equilibrium concept and include labor market dynamics such as flows into and out of unemployment in both the transition and the steady state and have been shown to match historical unemployment volatility in the United States under certain conditions.[5]

Our central case model is a simple two-sector extension of the

[3] This practice—interpreting estimated effects on the regulated sector as representing the overall effect on employment—is common. For example, several recent EPA regulatory impact analyses estimate effects on overall employment based on coefficients from Morgenstern et al. (2002) for the effects on regulated industries. Smith et al. (2013) provides an extensive discussion of how EPA has estimated employment effects in regulatory impact analyses.

[4] For example, if regulation-induced price increases cause consumers to substitute toward products from unregulated firms, that could benefit workers initially employed at those firms, which the study's triple-difference design would misinterpret as a harm to workers initially employed in regulated firms.

[5] Initial search and matching models suffered from the unemployment volatility puzzle: unemployment was unresponsive to productivity changes. Various reconfigurations of the model have been proposed to resolve the puzzle, including increasing the utility of leisure – see Hagedorn and Manovskii (2008) – and making wages sticky – see Hall (2005). Ljundquist and Sargent (2017) demonstrate that unemployment volatility in these models depends on the fundamental surplus fraction (the match surplus received by the firm as a fraction of productivity). In our model, this fraction plays a similar role in determining the responsiveness of overall employment to the costs imposed by environmental policy.