UMEÅ UNIVERSITY

Essays on Energy Efficiency, Environmental Regulation and Labor Demand in Swedish Industry

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Akademisk avhandling

som med vederbörligt tillstånd av Rektor vid Umeå universitet för avläggande av filosofie doktorsexamen framläggs till offentligt försvar i Hörsal A, Samhällsvetarhuset fredag den 27 november, kl. 10:00. Avhandlingen kommer att försvaras på engelska.

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Abstract
Paper [I] Energy efficiency improvement (EEI) benefits the climate and matters for energy security. The potential emission and energy savings due to EEI may however not fully materialize due to the rebound effect. In this study, we measured the size of the rebound effect for fuel and electricity in the Swedish heavy industry. We used a firm-level panel data set for 2000–2008 and apply Stochastic Frontier Analysis for measuring rebound effect. We found that neither fuel nor electricity rebound effects fully offset the potential energy and emission savings. we also found the CO2 intensity and the fuel/electricity shares to be useful for identifying firms with higher rebound effects within each sector.

Paper [II] Energy efficiency improvement (EEI) is generally known to be a cost-effective measure for meeting energy, climate and sustainable growth targets. Unfortunately, behavioral responses to such improvements (called energy rebound effects) may reduce the expected savings in emissions and energy from EEI. Hence, the size of this effect should be considered to set realistic energy and climate targets. Currently there are significant differences in approaches for measuring rebound effect. Here, we used a two-step procedure to measure both short- and long-term rebound effects in the Swedish manufacturing industry. In the first step, we used data envelopment analysis to obtain energy efficiency scores. In the second step, we estimated energy rebound effects using a dynamic panel regression model. This approach was applied to a firm-level panel dataset covering all 14 sectors in the Swedish manufacturing industry over the period 1997–2008. We showed that, in the short run, the rebound effect did not totally offset the energy and emission savings expected from EEI. In the long run, the energy rebound effect decreased in most sectors.

Paper [III] Energy inefficiency in production implies that the same level of goods and services could be produced using less energy. The potential energy inefficiency of a firm may be linked to long-term structural rigidities in the production process and/or systematic shortcomings in management (persistent inefficiency), or associated with shorter-term issues like misallocation of resources (transient inefficiency). Eliminating or mitigating different inefficiencies may require different policy measures. Studies measuring industrial energy inefficiency have paid little attention to distinctions between the types. The aim of this study was to assess whether energy inefficiency is transient and/or persistent in the Swedish manufacturing industry. I used a firm-level panel dataset covering 14 industrial sectors from 1997–2008 and estimated a stochastic energy demand frontier model with a four-component error term. I found that, overall, persistent energy inefficiency was larger than transient, but varied considerably in different sectors. This suggests that, generally, energy inefficiencies in the Swedish manufacturing industry were related to structural rigidities connected to technology and/or management practices.

Paper [IV] I investigated whether the environment and employment compete with each other in Swedish manufacturing industries. The effect of a marginal increase in environmental expenditure and investment costs on sector-level employment was studied using a detailed firm-level panel dataset for the period 2001–2008. The results showed that the sign and magnitude of such costs on employment ultimately depend on the aggregate output demand elasticity. If the output demand is inelastic, these costs induce small net improvements in employment, while a more elastic output demand suggests negative, but in most sectors relatively small, net effects on employment. The general policy recommendation is that, in the absence of empirically estimated demand elasticities, a careful attitude regarding national environmental initiatives for sectors exposed to world market competition should be adopted.

Keywords
Energy efficiency improvement, rebound effect, stochastic frontier analysis, data envelopment analysis, stochastic energy demand frontier model, persistent and transient energy inefficiency, energy inefficiency, environmental expenditure and environmental investment costs, output demand elasticity.

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