Energy efficiency and health : A dynamic general equilibrium Analysis

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Since the last couple of years, energy efficiency improvement is becoming a priority for governments, industries and households around the world. On of the reasons for that is the growing concerns on climate change phenomena and the related emphasis in greenhouse gas mitigation. In fact, IEA (2015) and IPCC (2014) stress the relevance of energy efficiency policies as a fundamental tool to reach the 2^oC climate policy objective. One other reason deals with the competitiveness and distributional benefits of higher levels of energy efficiency for firms and households, are also increasingly present in the debate. Such socio-economic and political interest in energy efficiency led to the development of the energy efficiency economics since 1970s and opened the door to a remarkable contributions in this field. One of the most important results of these developed researches is to provide a sound basis for the discussion of the so-called energy efficiency "paradoxes", i.e. rebound effect, and for the design and implementation of corrective policies.

Over the past decade, several scientific studies have provided evidence that various aspects of the built environment the human-modified places where people live, work, play, shop and more can have significant and directly measurable effects on health outcomes, i.e. physical, mental and social well-being (Houd, 2005). One of the recently identified channel through which built environment can impact household's health is the housing energy efficiency.

In this paper, we propose an analytical and numerical inter-temporal general equilibrium models to investigate the macro-economic impact of efficiency energy improvements in the presence of heath. We propose a challenging and comprehensive framework that examine energy efficiency in, both, residential and industrial sectors. We consider the US case where the residential and industrial sectors are responsible for more than 50% of energy consumption. Our purpose if to identify the main channels through which energy efficiency and health interact and shape the influence of energy transition on the economy.

The main results of our first numerical simulations calibrated on the USA show that:

— a 3% increase in industrial energy efficiency leads to an increase in industrial energy consumption of more than 0.5% in the long run. It means that in the long run the economy experiences a direct rebound effect while factors in production tends to be weakly substitutes.
— Nevertheless, in the short run, energy consumption in the industrial sector drops of around 3% and takes almost 10 years to back to its initial level. It means that the redirect rebound effect takes time to appear and because during the transition period the decrease in industrial

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energy consumption is quite sizable with respect to the increase in consumption due to rebound effect, the net direct impact of industrial energy efficient improvements on energy consumption could be not so important. We will investigate in the following what are the determinants of the transitional period.

— In the long run, the direct rebound effect is associated with an indirect rebound effect in the residential sector around 1%, with a initial transitional period where residential energy consumption drops of 3% with respect to its prior improvement steady-state value. We demonstrate that this indirect rebound effect originates from the influence of health on labor productivity. These two combined rebound effect leads to a long term rise in total energy consumption of less than 1%.

— Because non-energy consumption and final production are connected respectively to residential and industrial energy consumption, the improvement in industrial energy efficiency generates a sort-term decrease in non-energy consumption (more than -3% wrt to initial steady-state value) and a short- term recession (more than -2% wrt to initial steady-state value), but finally increases both in the long run.

— By affecting output and consumption, energy efficiency improvements in the industrial sector affects health-care expenditures and the health-status. The first one, initially drops from 12% at the time of the efficiency improvement to rise from almost 2% in the long run. This leads to a short-term decrease in health-status which finally rises from 0.5% in the long run. Those movements are associated with a short term drop of welfare and a long run welfare gain of more 0.2% wrt to the initial steady-state.

— Finally, we demonstrate that health-status, by affecting health-care expenditures and labor productivity, can have sizable effects on the economic impact of energy efficiency improvements in residential sector.

In policy terms, this study adds to the debate on investing in housing energy-efficiency schemes to improve health outcomes. It thereby lends support to the argument according to which improving energy efficiency is a lever for reducing pubic expenditures on health care. It also highlight the complexity of defining energy efficiency policies in the household and the industry sectors since the two sectors are dependent.

KEYWORDS

Health, Energy efficiency, Rebound effect.

JEL CLASSIFICATION

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