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The effect of *ESCOs* on energy use

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HIGHLIGHTS

- Panel data tests of energy service company (*ESCO*) activities effect on energy use.
- System GMM estimation of *ESCOs* effect on energy use.
- The *ESCO* reduction effect increases over time.
- The long-run reduction provides energy savings of around 20 percent.

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ABSTRACT

Energy saving can importantly help prevent greenhouse gas emissions and, thus, climate change. Energy service companies (*ESCOs*) provide a crucial instrument for delivering improved energy efficiency and potentially contributing to substantial energy savings in the public and private sectors. This paper investigates empirically the effect of *ESCO* activities on energy use. Based on a dynamic *IPAT* model, using a panel data of 94 countries over the period 1981 to 2007, we provide significant evidence that *ESCOs* reduce energy use. This finding proves robust to different dates of the first *ESCO*. The negative *ESCO* effect increases over time. The dynamic adjustment process produces small effects in the short run, but large effects in the long run. Moreover, the long-run *ESCO* effect differs across the stages of development. That is, for the high- and low-income countries, the short-run *ESCO* effect remains negative, but the long-run effects differ, remaining negative in high-income countries, but becoming positive in low-income countries. Finally, we discuss energy policy implications.

1. Introduction

Many analysts argue that the increased greenhouse gas (GHG) emissions, largely from the excessive use of fossil fuels, explain much of recent and projected climate change. With the growing awareness of the serious consequences of climate change (Intergovernmental Panel on Climate Change (IPCC), 2007; Tol, 2009), many countries enacted energy policies to reduce energy use. For example, the European Union (EU) Energy Efficiency Plan (EEP), 2011, published in March 2011 by the European Commission as a follow-up to the 2006 *Action Plan for Energy Efficiency*: *Realizing the Potential* (Action Plan for Energy Efficiency: Realising the Potential (EEAP), 2006), proposes to save 20 percent of its primary energy consumption by 2020 compared to projections.[1] EU leaders know that the greatest energy saving potential lies in buildings, since nearly 40 percent of final consumption comes from houses, public and private offices, shops, and other buildings. Thus, to meet the energy reduction targets, the EEP considers instruments to trigger the renovation process in public and private buildings and to improve the energy performance of the components and appliances used in them.

The European Commission proposes the development of energy service companies (*ESCOs*) as catalysts for the renovation. Marino et al. (2010) update the *ESCO* market in the EU members and neighboring countries, exploiting energy saving potentials through *ESCOs* in addition to special barriers and policy interventions to increase energy efficiency investments. Since the early 1970s, high energy prices, greater energy demand, climate change,

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[1] The 20-percent objective translates into a saving of 368 million tons of oil equivalent (Mtoe) by 2020 compared to projected consumption in that year of 1842 Mtoe.

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global warming, emerging carbon markets, environmental concerns, and international agreements created opportunities for the development of *ESCO* businesses (Goldman et al., 2005; Vine, 2005; Bertoldi et al., 2006; Kiss et al., 2007; Urge-Vorsatz et al., 2007; Ellis, 2010; and Sarkar and Singh, 2010). To what extent does the newly emerging *ESCO* industry improve energy use? Or, equivalently, how effective are *ESCO* activities as a policy tool to cut energy use? Moreover, do the stages of economic development (low- and high-income countries) influence the effect of *ESCOs* on energy use differently? To answer these questions requires empirical analysis. In this present paper, we develop a dynamic panel model to evaluate the effect of *ESCO*s on energy use.

An *ESCO* offers energy-efficiency technologies, including development and design of energy efficiency and emission reduction projects, installation and maintenance of energy efficient equipment, monitoring and verification of the project's energy savings, and finally, a guarantee of the savings for clients in the public, industrial, commercial, or residential sectors (Vine, 2005; World Energy Council (WEC), 2008; Ellis, 2010; Marino et al., 2011). The *ESCO*'s remuneration relies directly on the amount of energy saved through energy performance contracting (*EPC*). Two main models for *EPC* exist—shared-saving and guaranteed-saving models (Bertoldi et al., 2006; and Okay et al., 2008). In the shared-saving model, the *ESCO* and the client share the cost saving at a pre-determined percentage for a fixed number of years. In the guaranteed-saving model, the *ESCO* guarantees a certain level of energy saving for the customer. Europeans seem to prefer, at the margin, guaranteed-saving schemes, since they use shared-saving contracts to a lesser extent (Marino et al., 2011). The investment's financing can come from the internal funds of the *ESCO*, from the customer's own funds, or from a third party funding source. In the latter case, a financial institution allows a credit either to the *ESCO* or directly to its client and, then, the loan receives a guarantee for the projected energy or cost savings given by the *ESCO*.

Today, the United States (US) owns the most mature *ESCO* market in the world. Energy-efficiency technologies represent a major share of industry activity, accounting for 75-percent of *ESCO* revenues in 2008 (Satchwell et al., 2010). The US market, however, possesses a short history. *ESCO*s emerged first in the 1970s after the oil crisis, which led to higher energy prices, and grew during the utility integrated resource planning and demand-side management (DSM) era of the late 1980s and early 1990s (Goldman et al., 2005; Urge-Vorsatz et al., 2007). The concept gradually spread to Europe and Japan (Vine et al., 1998; Shito, 2003; Vine, 2005; Bertoldi et al., 2006; Patlitzianas et al., 2006; Rezessy et al., 2006; Kiss et al., 2007; Patlitzianas and Psarras, 2007; Marino et al., 2010, 2011). For example, Italy initiated *ESCO* activity in the early 1980s (Vine, 2005), where now *ESCO*s account for 90 percent of the energy-efficiency actions (Linares and Perez-Arriaga, 2009). Despite the increased awareness of energy efficiency measures and favorable legislative framework, the *ESCO* market in Europe grew slowly in recent years, partly due to the 2008 financial crisis and the Great Recession. Germany, Italy, and France established a large number of *ESCO*s, while most countries only established a few (Marino et al., 2011). In the 1990s, the *ESCO*s spread to developing countries (Davies and Chan, 2001; Lee et al., 2003; Okay et al., 2008; and Ellis, 2010). By 2008, China established the largest *ESCO* industry in the developing world in terms of total investment (Taylor et al., 2008). Recently, the *ESCO* industry received attention from international agencies as a new business model to promote energy efficiency in the world (Bleyl, 2009; Singh et al., 2009; Sarkar and Singh, 2010; Ellis, 2010; and Limaye and Limaye, 2011). Some key international agencies involved in *ESCO* development include the World Bank, the Asian Development Bank, and the US Agency for International Development (Energy Sector Management Assistance Program (ESMAP), 2006; Asian Development Bank (ADB), 2009 and United States Agency for International Development (USAID), 2010). Currently, EU leaders plan to promote the development of *ESCOs* to reach their energy saving target (Energy Efficiency Plan (EEP), 2011).

Vine (2005), Goldman et al. (2005) and Kiss et al. (2007) analyze the results of a survey of *ESCO* activity in 38 countries outside the US, inside the US, and inside 40 pan-European countries, respectively. Marino et al. (2010) and Marino et al. (2011), based on the results of a large-scale survey carried out in 2009 and 2010 in 39 European countries, present a comprehensive view of the European *ESCO* industry and propose policy recommendations to further promote *ESCO* activities. Vine (2005) gives details on the most important barriers facing the *ESCO* industry in various countries such as customers and engineering companies unfamiliar with or uninterested in *ESCO*s and *EPC*; lack of financing; low energy prices; and lack of government support, commitment, and leadership by example; and so on. In some countries, *ESCO*-industry associations; financing, measurement, and verification protocols; and information and education programs provide key mechanisms for promoting *ESCO* activities. Vine (2005) concludes that countries putting emphasis on the removal of subsidies, and the privatization of energy industry and power sector will lead in the development of the *ESCO* industry. Goldman et al. (2005) find that *EPC* overcomes market barriers for energy-efficiency investments among large, institutional public-sector customers in the US. Kiss et al. (2007) review European national *ESCO* market indicators and find that the public sector provides the primary focus of *ESCO* activity. Marino et al. (2010), (2011) point that as of 2010, the *ESCO* market in Europe still falls far below utilizing its full potential. The authors along with Sarkar and Singh (2010) and Limaye and Limaye (2011) promote ideas for scaling up energy-efficiency investments through *EPC*s. They propose an innovative public-private partnership (or Super *ESCO*) business model to bundle public facilities to lower transaction costs, bring in economies-of-scale, and attract large service providers into the markets.

Using the international survey data from Vine (2005), Okay and Akman (2010) plot the relationships amongst a set of *ESCO* indicators (age of *ESCO* market, number of *ESCO* companies, total value of *ESCO* projects, and sectors targeted by *ESCO*s) and country indicators (per capita GDP, energy consumptions, CO_2 emissions, and global innovation index). In their descriptive study, the positively correlated relationships between the *ESCO* indicators and energy consumption per capita lead them to conclude that the ineffectiveness of *ESCO*s or the lack of saturation of *ESCO* markets limit the reduction of energy use in most of the countries. Bivariate correlations, however, do not provide reliable results, since one does not control for other relevant factors.

In this paper, we use an empirical approach to examine the effects of *ESCO*s on energy use. To the best of our knowledge, we use the first econometric method to evaluate this issue. Our analytic framework uses a dynamic panel model derived from the *IPAT* identity (Commoner et al., 1971; Ehrlich and Holdren, 1971,1972; Holdren and Ehrlich, 1974). The sample consists of 94 countries over the period 1981 to 2007. We provide significant evidence that *ESCO*s effectively reduce energy use and this result remains robust to different dates of the first *ESCO*. Further examination shows that this negative *ESCO* effect increases over time. These findings illustrate the rationale and support for the EU's adoption of *ESCO*s as a policy tool to reduce energy use. Moreover, we find that the *ESCO* effect differs across the stages of development over time, keeping negative in high-income countries, becoming positive in low-income countries, however. With this finding and the literature reviewed, we propose policy