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The Effect of Energy Service Companies on Energy Use in Selected Developing Countries: A Synthetic Control Approach

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ABSTRACT

This study investigates the empirical effect of the service provided by the energy service companies (ESCOs) on the total energy use in thirteen developing countries by employing a transparent and data-driven statistical methodology, the synthetic control method (SCM). This methodology compares the post-treatment total energy use of a treated country, a country that has initiated ESCO activities, with the trajectory of total energy use for a synthetic control unit, a combination of economies being similar to the treated country with the exception of no ESCO activities initiated. The SCM can account for the potential heterogeneity regarding the effect of ESCO activities in various countries. In these thirteen countries, we find that the ESCOs exert a strong energy-saving effect in Colombia, Ghana, Kenya and South Africa; while a robust energy-using effect is found in Chile. No significant energy using or saving effects are found in the rest of treated countries.

Keywords: Energy Service Companies, Synthetic Control Method, Total Energy Use
JEL Classifications: O13, Q43, Q55

INTRODUCTION

In view of the growing concerns over global warming and rising as well as volatile energy prices, energy efficiency (EE) is regarded as a pillar of sustainable economic growth and energy policy. By improving EE, it is expected that the purposes of energy saving (ES) and a reduction in total energy use can be achieved in a cost-effective way, which reduces the CO_2 emissions and other environmental impacts, increases national security, reduces production costs, and increases the overall productivity. However, achieving both EE and ES improvements can be difficult, for a sufficiently large scale and timely combination of technology development, market mechanisms, government policies, and the cooperation of governments, EE stakeholders, and the private sector are all required (IEA 2010). The development and promotion of the Energy Service Company (ESCO) industry is regarded as one possible way to increase both EE and ES.

ESCOs are private companies that develop, install, and finance EE projects[1]. In particular, energy performance contracting (EPC) which guarantees energy and/or dollar savings is the essence of the ESCOs' business. On balance, there are two types of EPC in existence–shared savings and guaranteed savings. In a shared-saving contract, the ESCO and the customer share the cost savings from the ESCO service according to a predetermined percentage, while the ESCO takes over both the performance risk and the credit risk. Alternatively, in a guaranteed-saving contract, the customer is guaranteed a certain amount of energy savings by the ESCO. In this kind of contract setup, the ESCO assumes the entire performance risk, while the customer repays the loan and

1 The ESCO industry began in the 1970s in response to the oil shocks and grew with deregulation and restructuring in the energy markets in the US and Europe. It spread to developing countries in the 1990s (e.g., Goldman et al. 2005, Bertoldi et al. 2006, and Fang et al. 2012). The increasing global need to implement EE projects on a widespread basis is expected to further expand the scale of ESCOs.

the lender absorbs the credit risk. In general, the remunerations of ESCOs are paid through the financial benefits (energy bill and other savings) produced (Bertoldi et al. 2006; IEA 2010; Larsen et al. 2012; and Fang et al. 2012). The provision of specialized expertise, products, services and financing by the ESCO helps overcome two of the principal barriers to EE investment by public sector and private industries, i.e. access to financing and aversion to risk (IEA 2010). As such, the ESCOs have become an important vehicle for promoting EE around the world (Vine 2005).

Nevertheless, it needs to be asked what the effect of the ESCOs on energy use is after their application. There is very little literature that empirically explores this issue. Most of the literature focuses on the overview and examination of the status quo of ESCO activities, such as the number of ESCOs, market size estimates, the existence or not of an ESCO association, ESCO industry trends and performance, as well as the barriers to or driving forces behind the development of an ESCO industry, either within a country or internationally[2].

Whether the ESCO industry actually improves a country's EE and decreases its total energy use is an empirical question. First, as noted above, ESCOs provide ES through the use of performance-based contracting. The measurement and verification of the performance are critical for guaranteed savings. Nevertheless, there are difficulties in calculating savings, ensuring adequate equipment maintenance, and verifying savings (GAO, 2005). Stipulated rather than proven savings are usually used due to their low cost. However, stipulation data can guarantee neither actual EE nor ES. Second, an improvement in EE does not mean the achievement of ES. The rebound effect of an EE improvement might make the EE policies less effective or even ineffective[3]. Third, the growth rate of GDP might outweigh the improvement rate in terms of EE, which means that the total energy use will still grow (i.e. no absolute decoupling happened even though a relative decoupling existed). Fourth, it is also possible that the ESCOs will bring on the effects of ES because of the projects' increased awareness, developed capacity and financial institutions, initiated policy reforms, and so on, although the development of ESCOs per se might not even be successful. To sum up, the empirical effect resulting from the ESCO on energy use is unclear and the magnitude of this effect may be different in various countries as well. It is therefore interesting and important to explore this question by means of an empirical examination.

To the best of our knowledge, Okay and Akman (2010) and Fang et al. (2012) are the only two studies that have empirically examined the effect of ESCOs on energy use using country-level data. Specifically, Okay and Akman (2010) investigated the statistical relationships among the ESCO indicators (age of ESCO market, number of ESCO companies, total value of ESCO projects, and the percentage of the sectors targeted by ESCOs) and the country indicators (per capita energy consumption, CO_2 emissions, and GDP, as well as the global innovation index). They found positive correlations between the ESCO indicators and per capita energy consumption, which may indicate either the ineffectiveness of ESCOs or the unsaturatedness of ESCO markets in most of the countries. However, as mentioned by Fang et al. (2012), analyses conducted using bivariate correlations do not provide reliable results since other relevant factors are not controlled for.

Consequently, Fang et al. (2012) used panel data for 94 countries over the 1981-2007 period to examine the effect of ESCOs on total energy use. In their study, the ESCO activity was proxied by a dummy variable, which equaled one since the year in which the ESCO activity began; and zero otherwise. By estimating a dynamic panel data model with the generalized method of moments, they concluded that ESCO activity significantly improves EE and reduces the total energy use, based on a whole sample. Moreover, the energy use effect of ESCOs is enhanced over time. They further divided the sample into high- and low-income groups, and found that ESCOs effectively reduce total energy use in high-income countries but raise total energy use in low-income countries. These energy use effects of ESCOs are larger in the long run for both subsamples.

However, as different countries may experience the effect of ESCO activities in different ways and at different times, the mechanisms through which the energy use can be affected may be case specific. As such, cross-country studies that draw conclusions by averaging the data usually ignore the heterogeneous experiences and circumstances faced by different countries, and hence may generate no reliable inference for individual countries. In addition, the cross-country estimators usually suffer from the endogeneity problem and are thus likely to lead to biased estimations. Accordingly, country-specific case studies on the energy use effect of ESCO activities may be a possible alternative for this stream of research.

To abstain from the previously mentioned problems, in this research we will revisit the issue of the energy use effect of ESCO activities by empirically implementing a battery of country case studies with a recently developed econometric technique, the synthetic control method (SCM, hereafter), proposed by Abadie and Gardeazabal

2 The following selected papers examine the status of the ESCO industry in a country or internationally. For example, Goldman et al. (2005), Hopper et al. (2005), Hopper et al. (2007), Bharvirkar et al. (2008), Satchwell et al. (2010), and Larsen et al. (2012) studied the case of the USA; Bertoldi et al. (2006) and Kiss et al. (2007) analyzed the case of European countries; Rohdin and Thollander (2006) examined the case of Sweden; Schleich and Gruber (2008) studied the case of Germany; Ürge-Vorsatz et al. (2007) explored the cases of six countries; Yu (2012), Kostka and Shin (2013), and Li et al. (2014) studied the case of China; Painuly et al. (2003) and Lee et al. (2003) analyzed data for South Korea; Ellis (2010) reviewed the developments of ESCOs in developing countries; and Vine (2005) and Hansen et al. (2009) surveyed the status of ESCO activity internationally.

3 The rebound effect indicates that the improvement in EE might increase the energy use. The full rebound effect can be distinguished into the following different direct and indirect effects. First, the direct substitution effect occurs when a fall in the energy price occurs due to the application of more energy-efficient technologies. This substitution effect causes a rise in energy demand. Second, the income effect resulting from a decreased energy price enables increased consumption of other goods or services. Extra energy is thus required to produce these items. Third, improved technologies create new production possibilities and increase economic growth. More energy has therefore been consumed (e.g., Gillingham et al. 2013). The existence of the rebound effect is uncontroversial. However, the size and importance of this effect in real world situations continue to be debated.

(2003) and Abadie et al. (2010)[4]. The advantage of the proposed SCM framework is that it can deal with the type of endogeneity caused by omitted variable problem, by considering the presence of unobservable time-varying confounding factors. This distinguishing gain improves on those panel data models that can only cope with unobservable time-invariant confounders. Accordingly, this approach can be viewed as an alternative to conventional cross-country estimators that tend to have the endogeneity problem.

Specifically, within the synthetic control framework, we investigate whether ESCO activities initiated in year T_0 in the treated economy lead to higher (or lower) energy use levels after the year T_0, compared to countries that have no ESCO activities (the control countries). In this approach, the counterfactual for each "treated" economy is constructed by a weighted average of "control" countries, such that the actual country and its synthetic counterpart coincide as much as possible with respect to energy use levels before the "treatment" (ESCO activities) and in all relevant characteristics that are unaffected by it. As such, the difference between the energy use levels of the treated economy and its synthetic counterpart following the treatment reveals the influence of ESCOs on energy use.

Due to the availability of suitable control units, we focus our study sample on a couple of developing countries that started their ESCO activities sometime in the 1990s and 2000s, which include Nepal, the Philippines and Thailand in Asia; Chile and Colombia in Latin America; Cote d'Ivoire, Ghana, Kenya and South Africa in Africa; and Egypt, Jordan, Morocco and Tunisia in the Middle East and North Africa. Our primary findings show that the effect of ESCOs on total energy use is heterogeneous. Specifically, we find that the ESCO activities exert a significant energy-saving effect in Colombia, Ghana, Kenya and South Africa, yet a strong energy-using effect of ESCOs is found in Chile. As for the rest of the treated countries, although some energy-using or energy-saving effects of ESCOs have been revealed by the SCM, these outcomes are not strongly supported by the placebo tests, however. As such, we cannot decisively conclude the effect of ESCO activities on total energy use in these countries.

The remainder of this paper is structured as follows. Section 2 briefly outlines the synthetic control approach that we employ to assess the treatment effect of ESCO activities on energy use. The data sources and the construction of relevant variables are explained as well. Section 3 presents our main results. In addition, energy use effects of ESCO activities in various countries are discussed. Finally, Section 4 offers concluding remarks.

2. METHODOLOGY AND DATA

2.1. SCM

The SCM is a recently developed econometric technique that is used to implement comparative case studies in a data-driven format. In general, the basic idea of the SCM is to construct a synthetic control group that is more alike to the treatment unit in the pre-treatment period than any individual unit of the control group would be. As such, the SCM provides an attractive data-driven algorithm to construct the combination of control units for the study of the effect of policies or events that likely intervene in the performance of a region or a country at an aggregate level.

Specifically, the SCM framework can be outlined as follows. Suppose that there is a panel of $J+1$ countries over T periods. Within this group of countries, only country i receives the treatment, i.e., the event of initiating ESCOs, at time T_0, where $T_0 < T$, while the rest of the J potential control units still have no ESCO activities. Accordingly, the treatment effect of country i received at time t can be specified as

$$\alpha_{it} = Y_{it}(1) - Y_{it}(0), \quad (1)$$

Where $Y_{it}(0)$ is the outcome (total energy use) that would be observed for country i at time t without initiating ESCOs, while $Y_{it}(1)$ is the outcome (total energy use) that would be observed for country i at time t if it initiated the ESCO activities in periods T_0+1 to T. Our ultimate goal is to estimate the vector $(\alpha_{i,T0+1},\ldots, \alpha_{i,T})$. However, as $Y_{it}(1)$ is observed in periods T_0+1 to T, but $Y_{it}(0)$ is not, an estimate of $Y_{it}(0)$ is required to estimate the treatment effect of initiating ESCOs on total energy use.

For the purposes of research, we apply the approach developed by Abadie et al. (2010) to identify the previously mentioned treatment effect via the following model for all the potential outcomes:

$$Y_{jt}(0) = \delta_t + \theta_t Z_j + \lambda_t \mu_j + \varepsilon_{jt}$$

$$Y_{jt}(1) = \delta_t + \alpha_{jt} + \theta_t Z_j + \lambda_t \mu_j + \varepsilon_{jt} \quad (2)$$

where $j=1, 2,\ldots, J+1$, δ_t is an unknown common factor with constant factor loading across all units, Z_j is a vector of observed covariates that are not affected by the introduction of ESCOs, θ_t is a vector of time-specific parameters, μ_j is a country-specific unobservable, λ_t is an unknown common factor, the ε_{jt} are transitory shocks with a mean of zero, and α_{jt} is different from zero as $j = i$ and $t > T_0$.

Suppose that the first country ($i=1$) has initiated the ESCO industry in a certain year (T_0) during the study period and that the remaining J countries ($j=2, 3,\ldots, J+1$), which serve as the control group in our study, have not. Abadie and Gardeazabal (2003) and Abadie et al. (2010) propose making use of the observed characteristics of the units in the control pool. In particular, the underlying idea is to find weights ($W = \omega_2,\ldots,\omega_{J+1}$), with $\omega_j \geq 0$, $j = 2,3,\ldots,J+1$, and $\sum_{j=2}^{J+1} \omega_j = 1$, such that the weighted outcome of the selected countries in the control pool resembles the treated country with respect to the (logarithm of) total energy use levels in the pre-intervention period and all other relevant aspects (Z). Formally, we will seek W such that:

4 The SCM has recently been applied to investigate the effect of an inflation targeting policy on inflation rates by Lee (2011), to assess the impact of trade liberalization on GDP per capita by Billmeier and Nannicini (2013), and to test the average causality between catastrophic natural disasters and economic growth by Cavallo et al. (2013).

$$\sum_{j=2}^{J+1} \omega_j^* Y_{jt} = Y_{1t} \text{ for } t \le T_0 \text{ and } \sum_{j=2}^{J+1} \omega_j^* Z_j = Z_1, \quad (3)$$

and then use $\sum_{j=2}^{J+1} \omega_j^* Y_{jt}$ for $t > T_0$ as an estimate of the unobserved counterfactual (logarithm of) total energy use $Y_{1t}(0)$. By so doing, we can further obtain the following estimate for the treatment effect as

$$\hat{\alpha}_{1t} = Y_{1t} - \sum_{j=2}^{J+1} \omega_j^* Y_{jt}, \qquad t > T_0, \quad (4)$$

In practice, the weights are non-parametrically estimated and are determined in such a way that condition (3) approximately holds. Specifically, let X_1 be the (k × 1) vector of pre-treatment covariates of the treated country and X_0 the (k × J) matrix assembling the vectors of pre-treatment covariates of the un-treated countries. Consequently, the vector W^* is then decided by minimizing the following distance

$$\|X_1 - X_0 W\|_V = \sqrt{(X_1 - X_0 W)' M (X_1 - X_0 W)} \quad (5)$$

where M is a (k × k) symmetric and positive semi-definite matrix that weights the relative importance of the various covariates contained in X. Obviously, the optimal weights W depend on the weighting matrix M. According to Abadie and Gardeazabal (2003), the vector M is chosen by minimizing the mean squared prediction error of the outcome variable in the pretreatment period. In particular, to find the best-fitting convex combination of the control countries, an iterative optimization procedure is performed by searching among all positive semi-definite matrices M and the set of W^* (weights).

To sum up, the SCM estimates the unobservable counterfactual by weighting the outcomes of potential controls, with the weights being objectively selected in a manner such that the pretreatment outcome and the covariates of the synthetic counterpart are very similar to those of the targeted country. As such, the SCM has the advantage of transparency because the weight W^* is objectively chosen to find the control units that are employed to construct the synthetic counterpart of the treated economy. It also comes with flexibility since the set of control units can be appropriately adjusted to make the underlying comparison more reasonable. Moreover, while conventional panel data models control only for time-invariant confounders or share a common trend, such as the fixed effects or the difference-in-differences models, the SCM allows the effect of unobservable confounders change along time.

Nevertheless, one restriction of the SCM is that it provides no statistic to objectively assess the statistical significance of the results because the number of periods covered by the sample and the number of observations in the control group are genuinely small. Alternatively, Abadie et al. (2010) suggest that placebo experiments based on permutation techniques can be performed to make statistical inferences. Specifically, the placebo test is implemented as follows: One can apply the SCM sequentially to the countries in the control pool and then compare the benchmark outcomes with the placebo runs. When comparing these placebo tests, only if the gap between the actual total energy use level and the synthetically predicted one is the largest for the country where the treatment really occurred can one conclude that the effect of the ESCOs on total energy use is significant.

2.2 Data

Applying the SCM to perform a battery of cross-country case studies requires identifying a group of workable experiments first. For that consideration, our selection of the treated countries has to meet the following conditions: (1) The energy use levels measured in kilotons of oil equivalent and other covariates are available for sufficiently long periods, (2) the treated countries initiated the ESCOs in the 1990s or 2000s, so that we can have at least 10 years of pre-initiation observations to calibrate the path of energy use by the synthetic country made up by the countries in the donor pool, and (3) there is a group of control economies remaining that did not initiate ESCO activities beyond the initiating episode of the treated country to sufficiently supply a group of potential controls. Given these requirements, we select the following treated countries: Nepal, the Philippines and Thailand in Asia; Chile and Colombia in Latin America; Cote d'Ivoire, Ghana, Kenya and South Africa in Africa; and Egypt, Jordan, Morocco and Tunisia in the Middle East and North Africa. Table 1 presents the starting years of ESCO activities and the number of countries in the donor pool for these treated countries.

As the data employed in this study are obtained from various sources, in what follows we will briefly describe the construction of the relevant variables and their original sources. First of all, since we are interested in the treatment effects of ESCO activities on the energy use pattern of the treated countries, we first obtain the data containing the information about the initiation of ESCOs from Fang et al. (2012), which are constructed based on the survey of international ESCO activities from Vine (2005). When applying the SCM in a panel setup, we refer to the treatment as the initiation of ESCOs within a country in a certain period in which it experiences no ESCO activities preceding the initiation.

Furthermore, the outcome variable in our study is total energy use, which is measured in kilotons of oil equivalent. Other covariates in the vector of Z include GDP per capita, measured in constant 2005 US dollars, urbanization, measured as the share

Table 1: ESCO countries and starting years

Region	Country	Starting year	Number of countries in potential control
Asia	Nepal	2002	60
	Philippines	1995	42
	Thailand	2000	59
Latin America	Chile	1996	43
	Colombia	1997	43
Africa	Cote d'Ivoire	2000	59
	Ghana	1996	43
	Kenya	1997	43
	South Africa	1998	43
Middle East and North Africa	Egypt	1996	43
	Jordan	1994	41
	Morocco	1990	40
	Tunisia	2000	59

of urban population in total population, and population, which is the total population of a country. The choice of these covariates closely follows the work of Fang et al. (2012). In addition, to reduce the variation in these series, we construct the working variables by taking logarithms of all the series used in this study, and the data used to construct these variables are taken from the dataset of World Development Indicators published by the World Bank.

3. RESULTS AND DISCUSSION

We report and discuss the results of the SCM estimation and implemented experiments in this section. First, the comparisons between the treated countries and their synthetic controls are shown numerically in Tables 2-5 and graphically in panel A in each of Figures 1-4. For illustrative purposes, these results are grouped by region. Based on these presented results, we then discuss in detail the potential heterogeneity regarding the effect of ESCOs on the total energy use in each treated country.

Specifically, Tables 2-5 provide a numerical comparison based on the explanatory variables between each targeted country and its synthetic counterpart, with the average of all the countries in the donor pool serving as a reference. The explanatory variables include population, GDP per capita, and urbanization, and all are transformed into logarithms. Since some of the explanatory variables have missing values for some of the years, to maximize the sample size, all the covariates selected are averaged over the pretreatment period in the algorithm. Furthermore, we also follow Abadie et al. (2010) to use some of the pretreatment outcome variable (the log of total energy use) as additional control variables to improve the pretreatment fit. Finally, we report the root mean square prediction error (RMSPE) of (the log of) total energy use to calibrate the overall treatment fit. In general, the lower the value of RMSPE, the higher pretreatment quality.

Panel A in each of Figures 1-4 graphically presents the paths of (the log of) total energy use over the entire study period, with the solid line denoting the energy use path of the treated country and the dashed line representing that of the synthetic counterpart. Furthermore, the vertical dotted line in each graph indicates the year (T_0) in which ESCO activities were initiated. As mentioned previously, the synthetic control unit for each treated country is the weighted outcomes of its corresponding controls in the donor pool. As such, the higher the coincidence between the solid and dashed lines before T_0 indicates the higher the quality of the pre-initiation fit achieved by the SCM. On the other hand, the difference between the solid and dashed lines after T_0 shows the treatment effects resulting from the initiation of ESCO activities. The larger the difference between the solid and dashed lines after T_0, the larger the treatment effect.

Moreover, in terms of the statistical inference, a battery of placebo experiments is performed and the test results are provided in panel B of Figures 1-4. In particular, for each treated economy, the dashed lines show the gap in (the log of) total energy use between each country in the control group and its corresponding synthetic counterpart, while the superimposed dark line reveals the difference in (the log of) total energy use between the treated country of interest and it synthetic control.

Table 2: Energy use predictor means - Asia

Nepal	Treated	Synthetic	Average of 60 countries
ln (population)	16.876	16.876	16.060
ln (GDP per capita)	5.610	5.612	7.331
ln (urbanization)	2.453	3.298	3.864
ln (total energy use)_1992	8.720	8.720	9.052
ln (total energy use)_1997	8.867	8.866	9.099
ln (total energy use)_2001	9.033	9.033	9.191
RMSPE		0.012	
Philippines	**Treated**	**Synthetic**	**Average of 42 countries**
ln (population)	17.927	17.908	16.005
ln (GDP per capita)	6.862	6.861	7.389
ln (urbanization)	3.846	3.733	3.736
ln (total energy use)_1985	10.076	10.065	8.640
ln (total energy use)_1990	10.262	10.222	8.810
ln (total energy use)_1994	10.373	10.369	8.958
RMSPE		0.027	
Thailand	**Treated**	**Synthetic**	**Average of 59 countries**
ln (population)	17.892	18.093	16.026
ln (GDP per capita)	7.608	7.364	7.390
ln (urbanization)	3.408	3.753	3.857
ln (total energy use)_1990	10.644	10.645	9.089
ln (total energy use)_1995	11.034	11.033	9.079
ln (total energy use)_1999	11.165	11.161	9.176
RMSPE		0.033	

Table 3: Energy use predictor means - Latin America

Chile	Treated	Synthetic	Average of 43 countries
ln (population)	16.406	16.096	16.119
ln (GDP per capita)	8.375	8.384	7.380
ln (urbanization)	4.424	4.359	3.823
ln (total energy use)_1986	9.212	9.258	8.696
ln (total energy use)_1991	9.570	9.585	8.840
ln (total energy use)_1995	9.817	9.793	9.012
RMSPE		0.042	
Colombia	**Treated**	**Synthetic**	**Average of 43 countries**
ln (population)	17.349	17.136	16.144
ln (GDP per capita)	7.970	7.940	7.391
ln (urbanization)	4.232	4.160	3.834
ln (total energy use)_1987	10.021	10.030	8.746
ln (total energy use)_1991	10.106	10.105	8.840
ln (total energy use)_1996	10.250	10.249	9.047
RMSPE		0.013	

In the placebo experiments, as countries with poor fits prior to the initiation of ESCO activities comparatively provide imprecise information to measure the post-ESCO gaps, we hence exclude those countries with pre-ESCO value of the RMSPE higher than a certain level of the pre-ESCO RMSPE of the treated country in question[5]. Specifically, for most of the treated countries, we

5 In their research on the effects of California's Proposition 99, Abadie et al. (2010) use two, five, and 20 times the RMSPE of the targeting state. It is

Table 4: Energy use predictor means - Africa

Cote d'Ivoire	Treated	Synthetic	Average of 59 countries
ln (population)	16.450	16.449	16.114
ln (GDP per capita)	6.934	6.935	7.346
ln (urbanization)	3.716	3.715	3.890
ln (total energy use)_1990	8.589	8.589	9.089
ln (total energy use)_1995	8.632	8.686	9.079
ln (total energy use)_1999	8.868	8.829	9.176
RMSPE		0.034	
Ghana	**Treated**	**Synthetic**	**Average of 43 countries**
ln (population)	16.512	16.514	16.119
ln (GDP per capita)	5.944	5.974	7.380
ln (urbanization)	3.605	3.359	3.823
ln (total energy use)_1986	8.418	8.419	8.696
ln (total energy use)_1990	8.574	8.575	8.817
ln (total energy use)_1995	8.775	8.776	9.012
RMSPE		0.018	
Kenya	**Treated**	**Synthetic**	**Average of 43 countries**
ln (population)	17.015	17.247	16.144
ln (GDP per capita)	6.273	5.831	7.391
ln (urbanization)	2.850	2.979	3.834
ln (total energy use)_1987	9.194	9.196	8.746
ln (total energy use)_1991	9.294	9.294	8.840
ln (total energy use)_1996	9.432	9.433	9.047
RMSPE		0.006	
South Africa	**Treated**	**Synthetic**	**Average of 43 countries**
ln (population)	17.472	17.679	16.105
ln (GDP per capita)	8.426	8.427	7.363
ln (urbanization)	3.993	4.042	3.818
ln (total energy use)_1997	11.593	11.581	9.083
RMSPE		0.009	

Table 5: Energy use predictor means - Middle East

Egypt	Real	Synthetic	Average of 43 countries
ln (population)	17.851	17.769	16.119
ln (GDP per capita)	6.769	6.859	7.380
ln (urbanization)	3.770	3.642	3.823
ln (total energy use)_1986	10.182	10.187	8.696
ln (total energy use)_1990	10.384	10.361	8.817
ln (total energy use)_1995	10.471	10.469	9.012
RMSPE		0.012	
Jordan	**Real**	**Synthetic**	**Average of 41 countries**
ln (population)	14.942	14.998	16.134
ln (GDP per capita)	7.597	8.009	7.391
ln (urbanization)	4.254	4.214	3.774
ln (total energy use)_1984	7.854	7.854	8.641
ln (total energy use)_1988	7.990	7.990	8.755
ln (total energy use)_1993	8.234	8.234	8.942
RMSPE		0.021	
Morocco	**Real**	**Synthetic**	**Average of 40 countries**
ln (population)	16.906	16.881	15.900
ln (GDP per capita)	7.189	6.884	7.487
ln (urbanization)	3.793	3.535	3.680
ln (total energy use)_1980	8.491	8.483	8.523
ln (total energy use)_1985	8.627	8.620	8.685
RMSPE		0.023	
Tunisia	**Real**	**Synthetic**	**Average of 59 countries**
ln (population)	15.995	16.007	16.026
ln (GDP per capita)	7.720	7.731	7.390
ln (urbanization)	4.107	4.112	3.857
ln (total energy use)_1990	8.506	8.512	9.089
ln (total energy use)_1995	8.666	8.671	9.079
ln (total energy use)_1999	8.861	8.866	9.176
RMSPE		0.016	

exclude the control units with the RMSPE values >5 times the RMSPE of the treated country, except for Kenya and South Africa which use >10 times as the criterion[6]. In general, this exercise leads to a range of countries extending from 5 countries (in the case of the Philippines) to 30 countries (in the case of Nepal) being discarded in the placebo tests.

To account for the potential heterogeneity regarding the effect of ESCO activities in each treated country, in what follows, we will discuss the results of the experiments for the treated countries one by one in alternative regions.

3.1. Asia

The estimate outcomes for the treated economies in Asia are graphically presented in Figure 1, with panel A presenting the SCM results and panel B showing the corresponding placebo test results for each treated country. First, let us focus on the case of Nepal. In panel A, one can see that the average of total energy use over the years before the initiation of ESCOs literally coincides with that based on the synthetic control unit, which consists of Bangladesh (0.055), Benin (0.176), Congo, Dem. Rep. (0.305), Tajikistan (0.024), Tanzania (0.322) and Togo (0.118)[7]. After the initiation of ESCOs in 2002, however, the realized path of total energy use in Nepal begins to be lower than the energy-use pattern of the synthetic control unit. This may indicate that ESCOs exert some effect on energy saving in Nepal. However, the placebo test for Nepal in panel B shows that four "fake" experiments from the 29 comparison counterparts have treatment effects that are greater than the benchmark estimates. As such, we cannot be so confident to conclude that ESCOs in Nepal have been effective in terms of reducing energy use.

We next move to the case of the Philippines that started its ESCO industry in 1995. In panel A we find that the ESCO activities seem to take effect 5 years after their initiation in the Philippines, for we

usually the case that the selection rule becomes stricter when the number of "times" in relation to the RMSPE of the targeting unit is becoming smaller.

6 As Kenya has a very small RMSPE (0.006), based on the criterion that the RMSPE should be at least five times greater than that of the treated country, 32 out of the 43 controlled countries would need to be taken out for Kenya which will leave only ten countries for comparison purposes. To increase the number of countries being controlled for, we thus relax the criteria from five times to ten times to select the countries left in the donor pool. A similar situation also applies to the case of South Africa.

7 Figures in parentheses denote the corresponding weights of the selected countries used to construct the synthetic unit. For a complete list of potential control countries and the control units selected by the algorithm in each experimental run as well as their corresponding weights, please refer to Table A1 in the appendix.

Figure 1: Results for Asia. (a) Panel A. SCM results: Trends in (the log of) total energy use, (b) Panel B. Corresponding placebo experiments

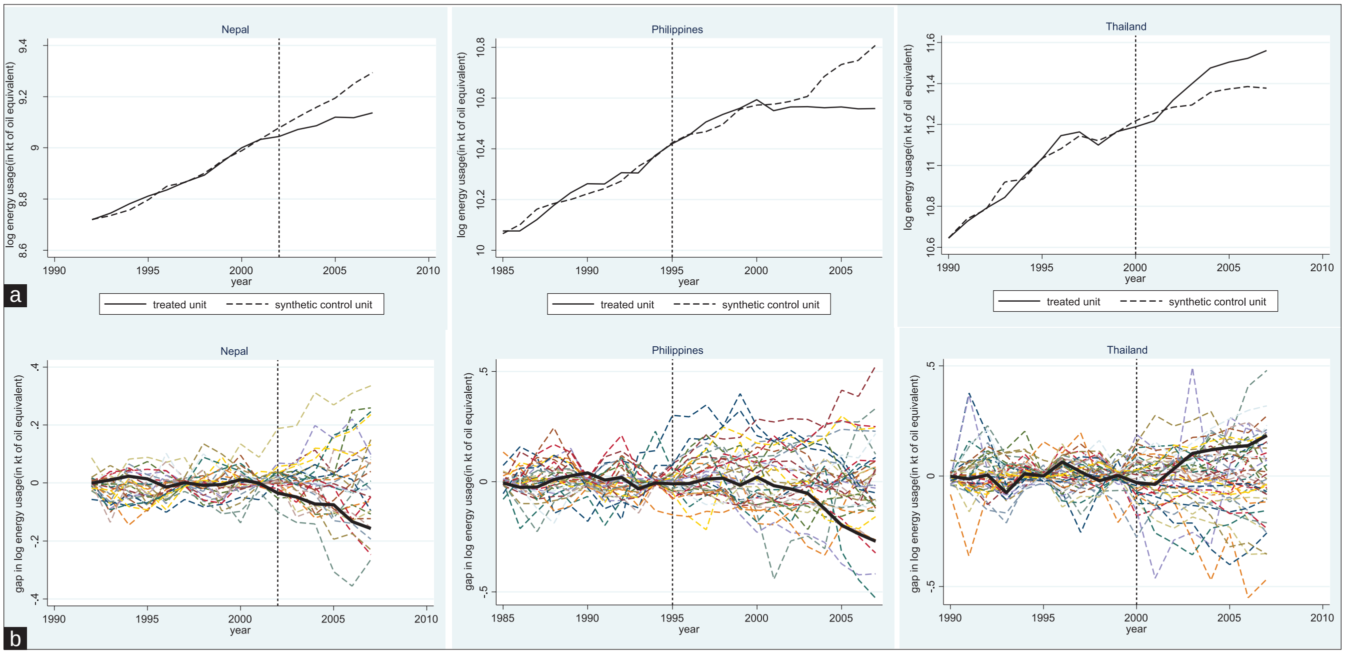
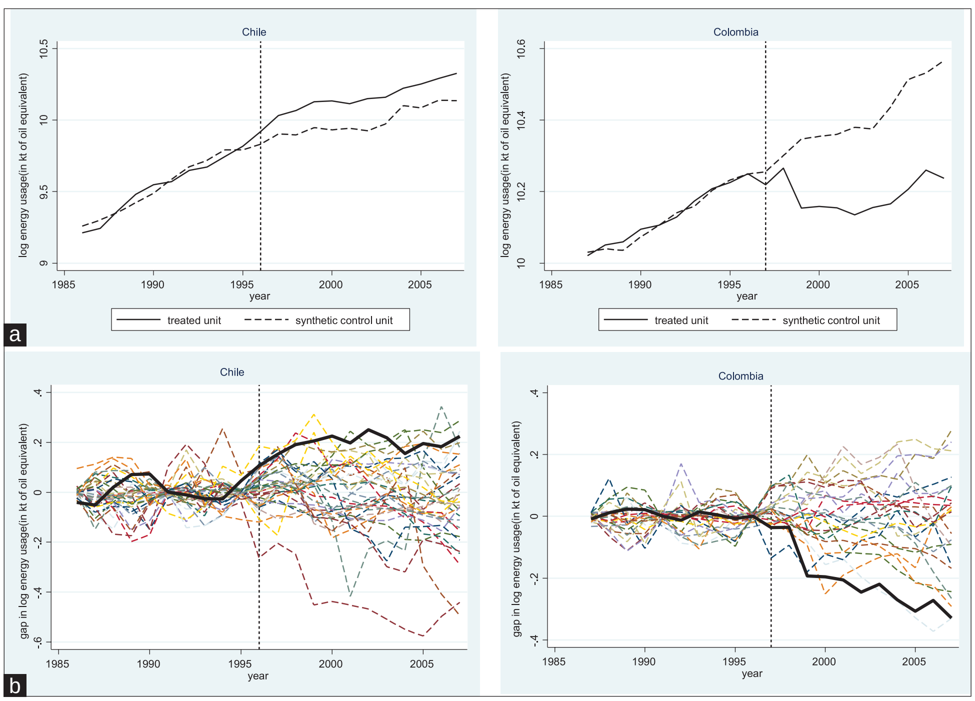


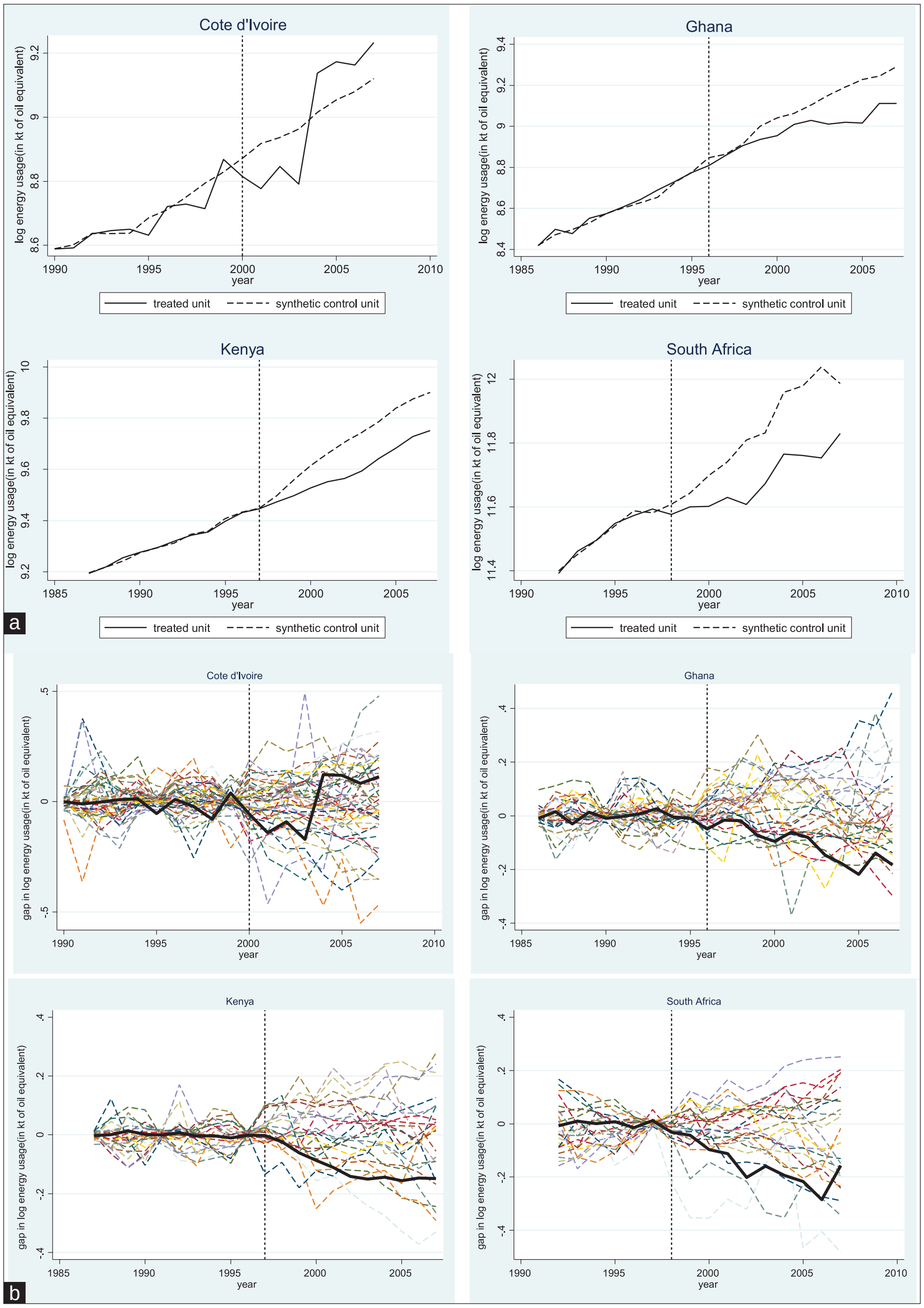
Figure 2: Results for Latin America. (a) Panel A. SCM results: Trends in (the log of) total energy use, (b) Panel B. Corresponding placebo experiments



observe an obvious divergence between the patterns of realized and synthetic energy use in 2000. However, according to the results of the placebo test in panel B, the energy-saving effect is not that statistically robust, as some "fake" experiments exert larger energy-saving effects than the Philippines. On the other hand, for the case of Thailand, the corresponding graphical display in panel A shows that Thailand uses more energy after its initiation of the ESCO industry in the year 2000, compared to the energy using path of its synthetic control unit. However, the placebo test in panel B also shows that this energy-using effect possibly induced by the ESCOs is not statistically robust as several "fake" experiments exert larger energy-using effects than Thailand.

To sum up, for the selected treated countries in Asia, we find that the ESCO activities may reduce or increase the total energy use. The effects, however, are not that significant, which may be due to the limited ESCO growth and development in Asia (except for the cases in China, Japan, and South Korea) (Limaye, 2013). In Nepal,

Figure 3: Results for Africa. (a) Panel A. SCM results: Trends in (the log of) total energy use, (b) Panel B. Corresponding placebo experiments

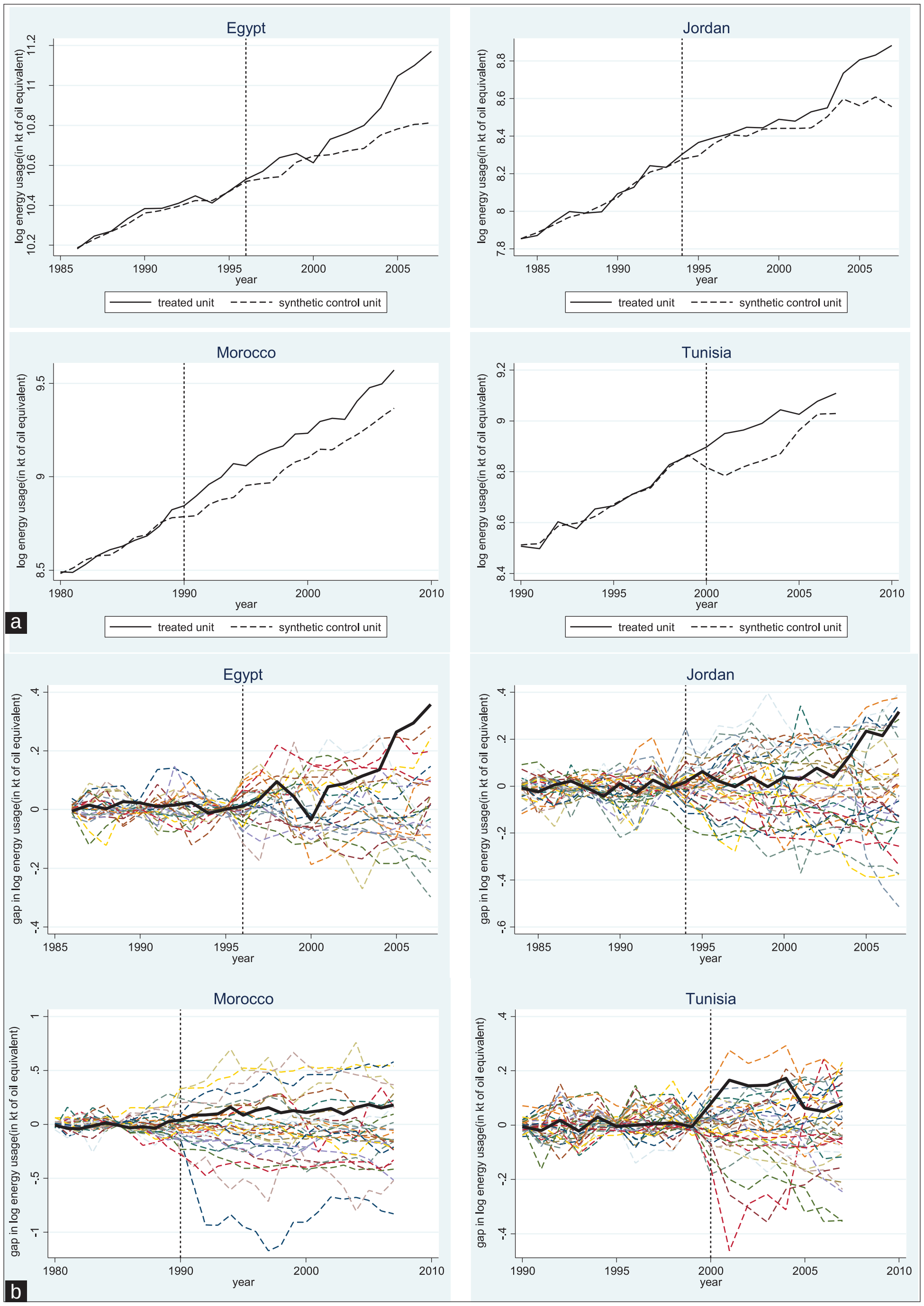


the residential, commercial, and industrial sectors respectively comprise 30%, 30%, and 40% of ESCO activities. Specifically, the lack of financing, unfamiliarity with the EPC, and the insufficient human resource development are the most important barriers facing the ESCO industry in Nepal (Vine, 2005).

In the Philippines, the ESCO activities started in the 1990s with the introduction of demand-side management programs and the ESCO association registered in 2005 (Hansen et al. 2009). The commercial and industrial sectors comprise 30% and 70% of ESCO activities, respectively. In 2001, a lighting retrofit project was successfully completed and showcased with the aid of the World Bank IFC/GEF program (Vine, 2005). In addition, an UNDP-GEF funded 5-year project, which started in 2005, was implemented and addressed the barriers to widespread utilization of energy efficient lighting systems in the Philippines (Hansen et al. 2009)[8]. It is also interesting to look at the indicator of energy intensity which is measured as total primary energy consumption per dollar of GDP. The energy intensity can be applied to infer the EE of a country where a decrease in the

8 IFC, GEF, and UNDP are the abbreviations for the International Finance Corporation, Global Environmental Facility, and United Nations Development Programme, respectively.

Figure 4: Results Middle East and North Africa. (a) Panel A. SCM results: Trends in (the log of) total energy use, (b) Panel B. Corresponding placebo experiments



energy intensity indicates an increase in EE. One can see that for the case of the Philippine, the energy intensity decreases consistently from 1999 onwards[9]. However, the ESCO market development is still not so active and the financial mechanisms and energy policy are also delayed (Murakoshi and Nakagami 2009).

9 According to the EIA International Energy Statistics, the total primary energy intensity in the Philippines decreased from 14,096 (Btu per 2005 US Dollars) in 1999 to 9,270 (Btu per 2005 US Dollars) in 2010. For more detailed data, See http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=92&pid=46&aid=2&cid=regions&syid=1980&eyid=2011&unit=BTUPUSDM.

In Thailand, the commercial and industrial sectors comprise 30% and 70% of ESCO activities, respectively (Vine, 2005). In 1992, the first energy law, the Energy Conservation Promotion Act, came into force and required that the designated facilities undertake EE activities. Through the Act, the Energy Conservation Promotion Fund was established. In addition, Thailand was also assisted by the GEF to develop the ESCO industry. These forces made the development of the ESCO market promising. However, barriers such as ineffective implementation of the law and regulations on targeted sectors, low energy prices, and difficulty in lending directly to ESCOs due to lack of collateral, etc., make the effects of EE promotion and energy conservation limited (Hansen et al.

2009; Ellis 2010; Intarajinda and Bhasaputra 2012). Intarajinda and Bhasaputra (2012) indicated that the economic growth from the industrial and commercial sectors directly affects the energy consumption and the development of the ESCO business is not relevant to the trend of energy consumption.

3.2. Latin America

The outcomes of the ESCO episodes in Latin America are presented in Figure 2. First, let us look at the case of Chile. In panel A, we find that ESCO activities seems to enhance energy use in Chile, for the realized path of energy use in Chile is observed to be higher than the path of energy use of the synthetic control unit. In addition, this energy-using effect is robustly shown by the placebo experiment in panel B as the gap between the realized and synthetic energy use, for the treated country seems to be the largest among all comparison units after the treatment period. As such, one can conclude that ESCO activities may exert a significant energy-using effect in Chile.

On the other hand, the case of Colombia presents a totally different story. As can be seen in panel A, the path of realized energy use in Colombia is obviously lower than the counterfactual one after the initiation of ESCO activities in 1997. Moreover, the placebo test in panel B also lends support to the view that this energy-saving effect is robust, as the gap between the true and synthetic energy use for Colombia is the largest among all comparison units after the treatment period. Accordingly, this outcome provides strong evidence to support the notion that ESCO activities do exert some energy-saving effect in Colombia.

It is interesting to see that although both countries are in Latin America and the dates for initiating ESCOs are close (1996 and 1997 for Chile and Colombia, respectively), the effects of ESCOs on the energy use are completely different in these two countries. In Chile, as indicated by Hansen et al. (2009), ESCO activities mostly focus on the commercial sector, buildings and large shopping malls, as well as on the industrial sector, primarily the agricultural and food industries. Energy contracts with the public sector are overlooked. In addition, the high availability of hydroelectric power and the supply of cheap natural gas from Argentina kept electricity and gas prices low for a long time, which discouraged investment to improve EE. Around 2005, EE began to increase because of the pressure exerted by rising energy prices and the initiation of energy security policies and plans. However, various obstacles such as a lack of information on the issue of EE and on the management instruments, poor participation, high transaction costs, and the lack of knowledge and accreditation of measurement and verification instruments and procedures do not make the real prospects for market growth very encouraging. Furthermore, Chile's economy is mainly based on the energy-intensive industries such as copper mining, pulp and paper, textiles, and food processing. As such, we think the economic growth and the underdevelopment of the ESCO industry are the likely causes that result in the realized path of energy use observed in Chile being higher than the path of energy use for the synthetic control unit.

On the other hand, in Colombia, the commercial and industrial sectors respectively comprise 40% and 60% of ESCO activities. According to Vine (2005), the lack of financing, shortage of EE technology, as well as unfamiliarity with the EPC are the barriers facing the ESCO industry. Beyond that, however, data on the level of ESCO activity in Colombia is limited (Ellis, 2010). Nevertheless, as we checked the data for energy intensity from the EIA International Energy Statistics, we found that associated with the initiation of ESCOs the total primary energy intensity steadily decreased from 9,961 (Btu per 2005 US Dollars) in 1998 to 7,471 (Btu per 2005 US Dollars) in 2010[10]. The steady decrease in energy intensity may be the main reason that caused the path of realized energy use in Colombia to be obviously lower than the path of energy use for the synthetic control unit.

3.3. Africa

Evidence regarding the effect of ESCO activities on energy use in Africa is shown in Figure 3. In general, the outcomes from the SCM analyses presented in panel A indicate that ESCO activities may have some energy-saving effect in most of our selected treated countries in Africa, such as Ghana, Kenya and South Africa, with the exception of Cote d'Ivoire. In addition, one can refer to the placebo tests in panel B to find that this energy-saving effect is somewhat robust for these three countries, because for each of them the gap between the realized and synthetic energy uses is almost the largest among all comparison units after the treatment period. As such, one can conclude that ESCO activities may exert an energy-saving effect in Ghana, Kenya and South Africa.

As for the case of Cote d'Ivoire, one can see that the pretreatment fitting quality for Cote d'Ivoire is not as good as that for its counterparts in the same region[11]. This may due to its more volatile pattern of energy use, which may cause difficulty in finding a good synthetic control unit to mimic its energy use pattern before and after the treatment period. As such, the effect of ESCO activities on energy use is indecisive in Cote d'Ivoire.

In Ghana and Kenya, the industrial sector comprises more than 60% of ESCO activities. However, in South Africa, ESCO activities are spread across various sectors (Vine, 2005 and Ellis, 2010)[12]. All these three countries greatly benefit from the support of international organizations, GEF in particular, in developing EE and ESCO projects. Ellis (2010) indicated that South Africa was one of the developing countries with the highest value of ESCO projects in 2001. In addition, by inspecting the data from EIA International Energy Statistics, it is shown that, with the initiation of ESCOs, the total primary energy intensities exhibit a decreasing trend in Ghana and South Africa. The decreasing energy intensity (i.e., the increasing EE) as well as the support from international organizations might be the main reasons for the energy-saving

10 For more detailed data, see http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=92&pid=46&aid=2&cid=regions&syid=1980&eyid=2011&unit=BTUPUSDM.

11 The pretreatment fitting quality can also be shown by the RMSPE reported in Table 4. The higher the value of the RMSPE, the lower the pretreatment fitting quality is. We can see that the RMSPE for Cote d'Ivoire is 0.034, which is much larger than that for Ghana (0.018), Kenya (0.006) and South Africa (0.009).

12 Vine (2005) indicated that the percentages for sectors that ESCO activities targeted were 15%, 20%, 25%, 5%, and 35% for the residential, commercial, industrial, agricultural, and municipal sectors, respectively.

effects shown in Ghana, Kenya and South Africa in comparison with the energy use based on the synthetic controls.

3.4. Middle East and North Africa

The estimate results for the interested countries in the Middle East and North Africa region are summarized graphically in Figure 4. By and large, the SCM outcomes shown in panel A reveal that ESCO activities may have some energy-using effect in Egypt, Jordan, Morocco and Tunisia, since for all these four countries the realized paths of energy use are higher than the synthetic control ones. This energy-using effect of ESCO activities, however, is not that robust to the placebo experiments presented in panel B, as several permutations are above the baseline effect in each of the treated countries. As such, one can conclude that ESCO activities may exert some energy-using effect in the selected treated countries in the Middle East and North Africa, but this energy-using effect is not robustly supported by the placebo tests.

This insignificant energy-using effect of ESCO activities is expected because the ESCO markets in these four countries are still underdeveloped. Although policies and programs supported by international organizations for promoting EE have already been set up and implemented, particularly in Tunisia, Morocco and Egypt (Hansen et al. 2009), ECONOLER (2011) indicated that in Egypt the market for EE-related activities has not yet taken off as it is still facing significant market barriers such as subsidized energy tariffs and an inadequate EE promotion framework, while in Jordan and Tunisia there is still much to do to promote the development of ESCO activities.

4. SUMMARY AND DISCUSSION

For the thirteen ESCO episodes that we have analyzed in the different regions referred to above, we find that the empirical evidence can be summarized into five groups: (a) Treated countries with significant energy-saving effects of ESCOs with strong support from placebo tests, such as Colombia, Ghana, Kenya and South Africa, (b) treated countries with some energy-saving effects of ESCOs, but without strong support from placebo tests, such as Nepal and the Philippines, (c) treated economies with significant energy-using effects of ESCOs with strong support from placebo tests, such as Chile, (d) treated economies with some energy-using effects of ESCOs, yet with no robustness found as a result of the placebo tests, such as Thailand, Egypt, Jordan, Morocco and Tunisia, and (e) treated units with inconclusive energy-using effects of ESCOs, such as Cote d'Ivoire. It is therefore obvious that the effect of ESCOs on the total energy use differs from one country to another. In general, the effect of ESCOs on the total energy use depends on various factors such as the degree of ESCO development, economic growth, international support, financial institutions, energy conservation regulations, energy prices, enforcement, energy intensity, and so on. The SCM considers the heterogeneous experiences and circumstances faced by different countries, which extends the homogeneity assumption of the traditional regression analysis and provides heterogeneous empirical effects of ESCOs on the total energy use in each selected country.

5. CONCLUSIONS

In this study, we investigate the effect of ESCO activities on total energy use. The question we asked is: Do economies that initiate ESCO activities use more (or less) energy than those that do not have ESCO activities? By employing a recently developed synthetic control approach, we perform a battery of data-driven comparative case studies. More specifically, the SCM compares each treated country, i.e., the country that initiates ESCOs, with an estimated counterfactual, which is a weighted average of the control units that are similar to the treated economy along the chosen covariates and pretreatment realizations of the outcome variable (the total energy use).

For the thirteen developing countries studied in this research, we find that the impact of ESCOs on total energy use is heterogeneous. It can be seen that the ESCO activities exert a significant energy-saving effect in Colombia, Ghana, Kenya and South Africa. The initiation of ESCO activities in these countries and the support from international organizations improve EE and achieve the purpose of energy saving. On the other hand, a strong energy-using effect of ESCOs is found in Chile. The underdevelopment of the ESCO industry, the lack of energy contracts with the public sector, and economic growth likely result in Chile's higher energy use relative to that for the synthetic control unit. As for the rest of the treated countries, although some energy-using or energy-saving effects of ESCOs are revealed by the analyses of the SCM, however, these outcomes are not strongly supported by the placebo tests. As such we cannot deterministically conclude the effect of ESCO activities on total energy use in these countries.

It has been shown that the ESCOs can be an effective way to increase both EE and ES, while the underdevelopment of the ESCO industry might result in failure in energy saving. Therefore, to make ESCOs an effective instrument to reduce energy use, the creation of driving forces for ESCOs development (e.g., support from international organizations, removing energy subsidy, increasing ESCO perceptions and environmental concerns among others) and the removal of developing barriers (e.g., lack of financing, unfamiliarity with the EPC, lack of government support and incompatible legal and regulatory frameworks among others) are important issues faced by the policy makers.

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APPENDIX

Table A1 provides the complete list of countries in the control pool. The countries selected by the SCM algorithm to construct the synthetic control unit are attached with their corresponding weights in parentheses.

Table A1: The countries in the donor pool and the individual weights for each treated country

Country	Countries in control
Asia	
Nepal	Albania, Algeria, Angola, Armenia, Azerbaijan, Bangladesh (0.055), Belarus, Benin (0.176), Bolivia, Bosnia and Herzegovina, Cameroon, Congo, Dem. Rep. (0.305), Congo, Rep., Costa Rica, Dominican Republic, Ecuador, El Salvador, Georgia, Guatemala, Honduras, Hong Kong, Indonesia, Iran, Iraq, Kazakhstan, Kuwait, Kyrgyz Republic, Lebanon, Libya, Macedonia, Malaysia, Moldova, Mongolia, Namibia, Nicaragua, Nigeria, Oman, Pakistan, Panama, Paraguay, Peru, Russian Federation, Saudi Arabia, Senegal, Serbia, Singapore, Sri Lanka, Sudan, Syrian Arab Republic, Tajikistan (0.024), Tanzania (0.322), Togo (0.118), Turkmenistan, United Arab Emirates, Uruguay, Uzbekistan, Venezuela, Vietnam, Yemen, Zambia
Philippines	Albania, Algeria, Angola, Bangladesh, Benin, Bolivia, Cameroon, Congo, Dem. Rep., Congo, Rep., Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Hong Kong, Indonesia (0.053), Iran (0.062), Lebanon, Malaysia, Mongolia, Nicaragua, Nigeria (0.014), Oman, Pakistan (0.525), Panama, Paraguay, Peru (0.345), Saudi Arabia, Senegal, Singapore, Sri Lanka, Sudan, Syrian Arab Republic, Tanzania, Togo, United Arab Emirates, Uruguay, Venezuela, Vietnam, Yemen, Zambia
Thailand	Albania, Algeria, Angola, Armenia, Azerbaijan, Bangladesh, Belarus, Benin, Bolivia, Bosnia and Herzegovina, Cameroon, Congo, Dem. Rep., Congo, Rep., Costa Rica, Dominican Republic, Ecuador, El Salvador, Georgia, Guatemala, Honduras, Hong Kong, Indonesia (0.687), Iran, Iraq, Kazakhstan, Kuwait, Kyrgyz Republic, Lebanon (0.156), Libya, Macedonia, Malaysia (0.140), Moldova, Mongolia, Nicaragua, Nigeria, Oman, Pakistan, Panama, Paraguay, Peru, Russian Federation, Saudi Arabia, Senegal, Serbia, Singapore, Sri Lanka, Sudan, Syrian Arab Republic, Tajikistan, Tanzania, Togo, Turkmenistan, United Arab Emirates, Uruguay, Uzbekistan, Venezuela, Vietnam (0.017), Yemen, Zambia
Latin America	
Chile	Albania, Algeria, Angola, Bangladesh, Benin, Bolivia, Cameroon, Congo, Dem. Rep., Congo, Rep., Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Hong Kong, Indonesia, Iran (0.329), Kuwait, Lebanon, Malaysia, Mongolia, Nicaragua, Nigeria, Oman, Pakistan, Panama, Paraguay, Peru, Saudi Arabia, Senegal, Singapore (0.221), Sri Lanka, Sudan, Syrian Arab Republic, Tanzania, Togo, United Arab Emirates, Uruguay (0.36), Venezuela (0.09), Vietnam, Yemen, Zambia
Colombia	Albania, Algeria (0.261), Angola, Bangladesh, Benin, Bolivia, Cameroon, Congo, Dem. Rep., Congo, Rep., Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Hong Kong (0.032), Indonesia (0.066), Iran (0.094), Kuwait, Lebanon, Malaysia, Mongolia, Nicaragua, Nigeria, Oman, Pakistan, Panama, Paraguay, Peru (0.32), Saudi Arabia, Senegal, Singapore, Sri Lanka, Sudan, Syrian Arab Republic, Tanzania, Togo, United Arab Emirates, Uruguay, Venezuela (0.227), Vietnam, Yemen, Zambia
Africa	
Cote d'Ivoire	Albania (0.01), Algeria (0.011), Angola (0.011), Armenia (0.006), Azerbaijan (0.006), Bangladesh (0.101), Belarus (0.007), Benin (0.005), Bolivia (0.011), Bosnia and Herzegovina (0.008), Cameroon (0.012), Congo, Dem. Rep. (0.017), Congo, Rep. (0.018), Costa Rica (0.011), Dominican Republic (0.011), Ecuador (0.012), El Salvador (0.011), Georgia (0.006), Guatemala (0.013), Honduras (0.01), Hong Kong (0.013), Indonesia (0.012), Iran (0.009), Iraq (0.007), Kazakhstan (0.006), Kuwait (0.006), Kyrgyz Republic (0.004), Lebanon (0.007), Libya (0.007), Macedonia (0.007), Malaysia (0.009), Moldova (0.005), Mongolia (0.005), Nicaragua (0.009), Nigeria (0.012), Oman (0.007), Pakistan (0.016), Panama (0.012), Paraguay (0.009), Peru (0.054), Russian Federation (0.008), Saudi Arabia (0.007), Senegal (0.284), Serbia (0.007), Singapore (0.006), Sri Lanka (0.012), Sudan (0.01), Syrian Arab Republic (0.01), Tajikistan (0.003), Tanzania (0.011), Togo, Turkmenistan (0.006), United Arab Emirates (0.006), Uruguay (0.013), Uzbekistan (0.007), Venezuela (0.008), Vietnam (0.018), Yemen (0.063), Zambia (0.008)
Ghana	Albania, Algeria, Angola, Bangladesh, Benin, Bolivia, Cameroon, Congo, Dem. Rep. (0.224), Congo, Rep., Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Hong Kong, Indonesia, Iran (0.072), Kuwait, Lebanon, Malaysia, Mongolia, Nicaragua, Nigeria, Oman, Pakistan (0.074), Panama, Paraguay, Peru, Saudi Arabia, Senegal, Singapore, Sri Lanka, Sudan, Syrian Arab Republic, Tanzania, Togo (0.485), United Arab Emirates, Uruguay, Venezuela, Vietnam (0.145), Yemen, Zambia

(Contd...)

Table A1: ***(Continued)***

Country	Countries in control
Kenya	Albania, Algeria, Angola, Bangladesh (0.054), Benin, Bolivia, Cameroon, Congo, Dem. Rep., Congo, Rep., Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Hong Kong, Indonesia (0.059), Iran, Kuwait, Lebanon, Malaysia, Mongolia, Nicaragua, Nigeria, Oman, Pakistan, Panama, Paraguay, Peru, Saudi Arabia, Senegal, Singapore, Sri Lanka (0.106), Sudan, Syrian Arab Republic, Tanzania (0.781), Togo, United Arab Emirates, Uruguay, Venezuela, Vietnam, Yemen, Zambia
South Africa	Albania, Algeria, Angola, Bangladesh, Benin, Bolivia, Cameroon, Congo, Dem. Rep., Congo, Rep., Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Hong Kong, Indonesia (0.383), Iran (0.047), Kuwait, Lebanon, Malaysia, Mongolia, Nicaragua, Nigeria, Oman, Pakistan, Panama, Paraguay, Peru, Saudi Arabia (0.57), Senegal, Singapore, Sri Lanka, Sudan, Syrian Arab Republic, Tanzania, Togo, United Arab Emirates, Uruguay, Venezuela, Vietnam, Yemen, Zambia
Middle East and North Africa	
Egypt	Albania (0.089), Algeria, Angola, Bangladesh, Benin, Bolivia, Cameroon, Congo, Dem. Rep., Congo, Rep., Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Hong Kong, Indonesia (0.291), Iran, Kuwait, Lebanon, Malaysia, Mongolia, Nicaragua, Nigeria (0.295), Oman, Pakistan (0.176), Panama, Paraguay, Peru, Saudi Arabia, Senegal, Singapore, Sri Lanka, Sudan, Syrian Arab Republic, Tanzania, Togo, United Arab Emirates, Uruguay (0.148), Venezuela, Vietnam, Yemen, Zambia
Jordan	Albania, Algeria, Angola, Bangladesh, Benin, Bolivia, Cameroon, Congo, Dem. Rep., Congo, Rep., Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Hong Kong, Indonesia, Iran, Lebanon (0.032), Malaysia, Nicaragua (0.392), Nigeria, Oman, Pakistan, Panama, Paraguay, Peru, Saudi Arabia, Senegal, Singapore (0.163), Sri Lanka, Sudan, Syrian Arab Republic, Tanzania, Togo (0.06), United Arab Emirates (0.071), Uruguay (0.282), Venezuela, Vietnam, Yemen, Zambia
Morocco	Albania, Algeria, Angola, Bangladesh (0.508), Benin, Bolivia, Cameroon, Congo, Dem. Rep., Congo, Rep.(0.152), Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Hong Kong (0.141), Indonesia, Iran, Lebanon, Malaysia, Nicaragua, Nigeria, Oman, Pakistan, Panama, Paraguay, Peru (0.114), Saudi Arabia, Senegal, Singapore, Sri Lanka, Sudan, Syrian Arab Republic, Tanzania, Togo, United Arab Emirates, Uruguay (0.084), Venezuela, Vietnam, Zambia
Tunisia	Albania (0.005), Algeria (0.005), Angola (0.005), Armenia (0.005), Azerbaijan (0.003), Bangladesh (0.008), Belarus (0.004), Benin (0.006), Bolivia (0.21), Bosnia and Herzegovina (0.006), Cameroon (0.006), Congo, Dem. Rep. (0.004), Congo, Rep. (0.009), Costa Rica (0.006), Dominican Republic (0.009), Ecuador (0.006), El Salvador (0.007), Georgia (0.004), Guatemala (0.006), Honduras (0.005), Hong Kong (0.183), Indonesia (0.004), Iran (0.005), Iraq (0.004), Kazakhstan (0.003), Kuwait (0.011), Kyrgyz Republic (0.004), Lebanon, Libya (0.005), Macedonia (0.005), Malaysia (0.005), Moldova (0.003), Mongolia, Nicaragua (0.006), Nigeria (0.004), Oman (0.004), Pakistan (0.005), Panama (0.006), Paraguay (0.005), Peru (0.137), Russian Federation (0.003), Saudi Arabia (0.004), Senegal (0.155), Serbia (0.003), Singapore (0.017), Sri Lanka (0.003), Sudan (0.004), Syrian Arab Republic (0.006), Tajikistan (0.003), Tanzania (0.003), Togo (0.004), Turkmenistan (0.003), United Arab Emirates (0.003), Uruguay (0.047), Uzbekistan (0.003), Venezuela, RB (0.006), Vietnam (0.004), Yemen, Rep. (0.008), Zambia (0.004)