Energy efficiency in transition: do market-oriented economic reforms matter?

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Abstract

Global climate change and security of supply concerns pose significant challenges for sustainable development as well as the need to improve energy efficiency in transition and developing economies. Meanwhile, economic theory suggests that market-based economic policies and reforms are crucial for accelerating energy efficiency in developing and transition countries. Hence, this paper analyses the impacts of several market-oriented economic reforms on energy efficiency in the transition countries. The transition countries experienced a rapid marketization process that saw their economies transformed from central planning towards more market based economies since the early 1990s. The econometric results from the bias corrected fixed-effect analysis (LSDVC) suggest that both large and small scale privatisation process has been the sole driver of energy efficiency in transition countries. However, the lack of suitable institutions to support overall-market reforms implies that other market based economic reforms remain ineffective in improving energy efficiency in transition countries.

Keywords: market reforms, energy efficiency, transition countries, institutions

JEL Classification: P28; Q54; C33

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1. Introduction

Since the early 1990s, the 'Washington Consensus'[1] became a standard package towards economic reforms for many crisis-ridden developing countries (Williamson, 1993). Many transition and developing economies adopted a market oriented approach to economic reforms since then. The overall structural changes in the economy implied that the energy sector also experienced marketization across the developing world. Many advanced economies (such as the OECD) and over 70 developing countries had introduced some market-oriented reform steps in the electricity sector by the end of 1990s (Bacon, 1999; Steiner, 2001; Jamasb et. al., 2005). While these counties are still pursuing reforms at different stages; the empirical evidence on the impacts of overall market driven economic reforms in the economy and energy efficiency[2] remains to be examined considering the twin concerns of growing global climate change and security of supply towards economic development.

In theory, market oriented reforms should promote substantial energy efficiency due to the adoption of more commercial policies and increased openness to private investment as generally believed by scholars (Anderson, 1995). Improvement in energy efficiency coincides with the overall economic aims of increasing productivity and competitiveness of the economy. The reliance on market, both, as a resource allocating agency and incentive mechanism can optimize energy allocation and incentivise consumers to reduce waste or choose the most cost-reflective energy saving equipment and appliances (Fan, et. al, 2007). While energy serves as a factor input, effective market signals in the form of cost-reflective energy prices implies that produces decrease energy consumption by switching to other substitutes when energy prices rise. It can also induce energy saving technologies and innovations (Jorgenson and Wilcoxen, 1993; Popp, 2002). In addition, best energy policies are often those aimed at making markets work better by eliminating market imperfections, mitigating market power through competition policies, and internalizing environmental externatilies (such as climate change impacts) using flexible market-based mechanisms (Joskow, 2001). Hence, it can be argued that energy efficiency improvement is strongly linked with policies aimed at strengthening the effectiveness of market forces in the economy (Meyers, 1998).

However, the success of market-oriented economic reforms can tremendously depend on the development of market-based institutional framework to support reforms (Hogan, 2001). The existence of proper institutional environment (so called rules of the game which can be explicit, formal or implicit, informal) and institutional arrangements, (so called governance structures are crucial for the reinforcement of market-based reforms to produce its desired consequences (North, 1971; Williamson, 1996). Thus,

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[1] The term 'Washington Consensus' was coined by John Williamson in 1989.
[2] The definition of energy efficiency varies. At the aggregated (macro) level, it is defined as a ratio of energy consumption to GDP while energy efficiency is defined as mean energy services provided per unit of energy input at a disaggregated product level (see Jaffe et.al. 2004). This paper uses the macro approach towards understanding energy efficiency.

similar approaches to economic reforms can lead to different outcomes depending upon the existing levels of formal and informal institutions in each country (Hirschhausen and Waelde, 2001).

Nonetheless, the quantitative evidence on the linkage between markets-oriented economic reforms and energy efficiency remains relatively unexplored in the economics literature. This paper, thus, aims to contribute towards the relatively scarce literature studying the impacts of various market-oriented economic reforms on energy efficiency. We consider the popularly termed 'transition economies' (TECs hereafter) comprising twenty-nine countries[3] of Central and Eastern Europe and the Former Soviet Union (FSU) for this purpose. These countries, being highly energy intensive prior reforms, initiated economic transformation from central planning towards marketization since the early 1990s. Hence, this paper analyses the impacts of different market oriented economic reforms on energy efficiency in two decades of market driven reforms in the transition countries using panel data econometrics.

The paper is organized as follows. Section 2 provides an overview of the transition countries including the evolution of energy efficiency over-time. Section 3 discusses the relevant theoretical and empirical literatures used in this study. Section 4 includes the data and econometric methodology while section 5 discusses the results. Finally, Section 6 concludes.

2. The Transition Countries: An Overview

The systemic change of early 1990s marked the end of central planning and paved the way for economy wide market-oriented reforms in the TECs as a part of pervasive political and economic transformation. The market oriented reforms included aspects such as the expansion of competitive markets in all sectors of the economy, more wide spread private ownership, adoption of appropriate institutions, laws and policies to facilitate market functioning and efficiency, setting standards for good corporate governance and business conduct (EBRD, 2000). The pace and order of these reforms varied across the TECs primarily reflecting the constraints on any government's ability and resources. Some countries such as Lithuania, Russia and Slovak Republic opted for instant large scale privatisation without appropriate legal framework as a 'shock therapy' which often resulted in significant economic and social costs. In contrast, Belarus and the Caspian countries (e.g. Turkmenistan) have exhibited great reluctance towards economic reforms and have not started with the initial reform process of liberalization, small scale privatization and the creation of an environment supportive of private investment. However, the transformation of the power sector was one of the

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[3] The countries can be divided into three distinct groups Central Eastern Europe and Baltic States (CEB), South Eastern Europe (SEE), and Commonwealth of Independent States (CIS) based on European Bank of Reconstruction and Development (EBRD) areas of operation. See Table A in the Appendix.

prominent components of this economic transformation because of the economic characteristics of the sector which involved large sunk investments operated by regulated monopolies with alleged significant links with national income and output (Nepal and Jamasb, 2011).

A fundamental characteristic common across all TECs was that these countries were highly energy intensive (i.e. high energy inefficiency). The legacy of central planning in the absence of any effective market signals, excessive reliance on energy intensive industries and the inefficiency of energy use spurred by lower power prices contributed to high energy intensity in the region. Furthermore, the distorted energy prices and soft budget constraints for industry (e.g., being debt free) also led to high energy use in the TECs[4]. Historically, the energy consumed per unit of GDP in the transition economies was estimated at four to eight times that of OECD countries and the United States (Gray, 1995).

However, the energy intensities of the TECs have declined since the start of the transition process although the extent of this decline varies greatly across countries (Cornilie and Frankhauser, 2004). The CIS countries being the most energy intensive have reduced their energy intensity by about one-third since 1994 (EBRD, 2008). Likewise, these countries still use three times more energy as compared to Western Europe to produce a unit of GDP in terms of purchasing power parities (PPP). Hence, there is a significant potential in the TECS to be more energy efficient and eventually converge at a similar levels with the OECD countries in terms of per capita electricity consumption.

The evolution of energy intensity is also of greater importance from a policymaking perspective because: a) it allows us to know how energy demand responses to changes in economic system and structure; b) it contributes to the active policy debate within the transition counties on the link between total energy use growth and GDP growth and c) it allows the policymakers to identify the measures to reduce the energy-efficiency gap. The energy-efficiency gap exists due to differences in the actual and optimal energy use (Jaffe and Stavins, 1994). Figure one below shows CIS countries such as Uzbekistan and Turkmenistan have high energy intensity of GDP indicating the greatest potentials for energy-efficiency gap reductions while countries like Latvia, Lithuania, and Hungary have similar levels of energy intensities as compared to EU-15, OECD and the US in 2008.

Thus, it is clear that overall market-oriented economic reforms have resulted in declining average energy intensities across the transition region as national energy intensities have declined after the transformation process. However, the nature and

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[4] Please see Schaffer (1998) for details concerning soft-budget constraints among firms in transition economies.

magnitude of impacts resulting from different market driven economic reforms on energy efficiency is not clear. This paper exactly aims to cover this gap by identifying the drivers of energy efficiency improvement in the transition countries during the last twenty years' of overall market oriented-economic reform process.
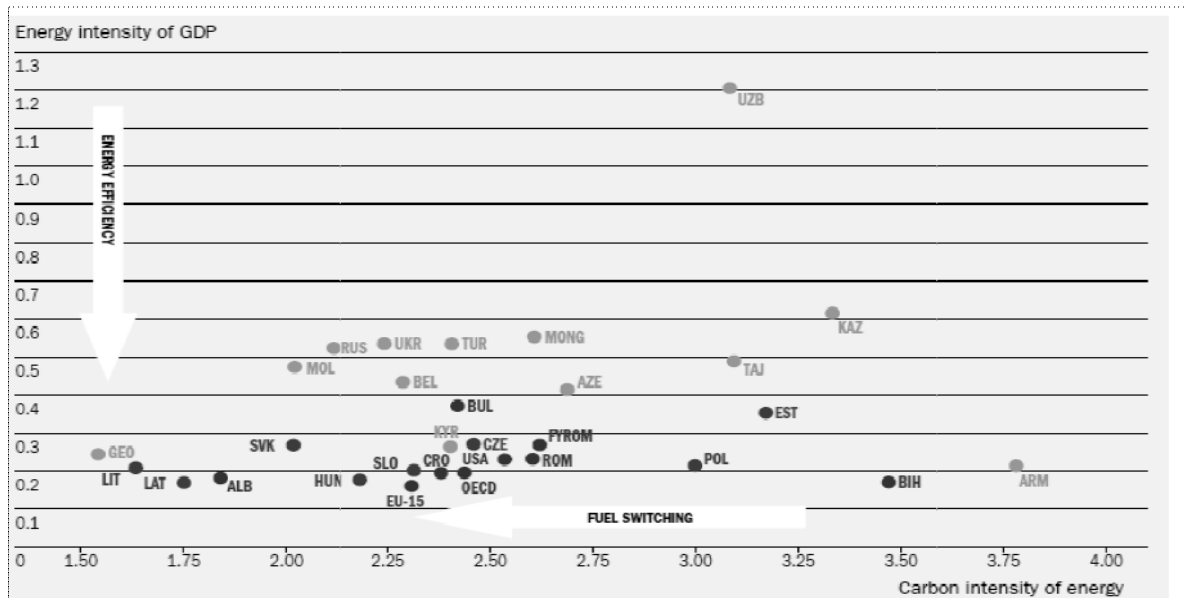

Figure 1: Energy intensity versus carbon intensity of GDP in 2010 in TECs
Source: Adapted from EBRD (2008)

3. Review of the Literature

A number of studies have studied the impacts of market-oriented economic reforms on energy efficiency in the international context. Seabright et. al (1996), in general, argued that the promotion of open and competitive markets, removal of subsidies on energy prices and market based-energy conservation programs in many countries contributed to improvements in energy efficiency. China, being one of the rapidly growing economies, has gathered considerable attention among researchers on this subject. A study by Sinton and Fridley (2000) concluded that energy efficiency improved in China since 1996 as a result of the shift from state-owned to collective, private and foreign invested ownership. Fisher-Vanden (2003) also argued that the implementation of market reforms can facilitate the shift towards less energy intensive production in the Chinese context using a dynamic computable general equilibrium analysis (CGE). Similarly, Fan et. al. (2007) concluded that accelerated marketization contributed substantially to energy efficiency improvements in China by estimating the change in energy own-price elasticity, as well as the elasticity of substitutions between energy and non-energy (capital and labour) in China during the periods 1979-1992 and 1993-2003.

In the regional context, two studies are of notable importance. Cornilie and Frankhauser (2004) study the evolution of energy intensities in the transition countries by decomposing the energy data and using panel data model based on random effects to identify the main factors driving improvements in energy intensity. The study concludes

that energy prices and progress in enterprise restructuring are the two most significant drivers for efficient energy use. Similarly, another study by Markandya et al. (2006) investigates the relationship between twelve countries of Eastern Europe and the European Union (EU) members to examine any evidence of convergence in energy intensities across them. A two way fixed effects model is used to study the convergence in income and energy intensity between the advanced (EU 15) and the transition countries. While some evidence of convergence in energy intensity exists among the EU members and the transition countries; the findings suggest that the rate of convergence in energy intensities varies across countries. Hence, both studies, to some extent, confirm to the notion that the transition towards a more market driven economic reforms contributed to a fall in energy intensities among the transition countries.

However, the empirical results obtained from these studies are debatable because it is well established in econometric literature that an individual-specific fixed effect model engenders biased estimates in the absence of a large and comprehensive dataset. This is because a static fixed effect model is typically designed for dataset with large 'N' and small 'T' (Cameron and Trivedi, 2009). Thus, there is a need to correct for such biasness in the estimates when the sample size is small. It is also highly likely that individual country specific characteristics that are unobservable and non-measurable such as culture, legal origin, geographical location, history etc. and are fixed over time are likely to be correlated with the various economic reforms and thereby contradicting the use of random effects. Likewise, the limited number of cross-sections 'N' used in the above studies implies that the data represents a finite sample and not actually a random sample. Moreover, the use of a static model in itself is not valid as the effects of economic reforms on outcomes are not instantaneous but rather lagged. Hence, this paper uses a bias-corrected fixed effect (LSDVC) analysis to study the impacts of various market reforms on energy efficiency since 1990 till 2010 in the transition countries.

4. Data and Econometric Methodology

The paper investigates the drivers of energy efficiency considering various market-driven economic reforms in the transition countries since the start of the transition process (i.e. 1990 till 2010). Hence, this paper uses the 'Transition Indicators' developed by the European Bank for Reconstruction and Development (EBRD) that measures the progress in transition through a set of indicators. The reform assessments are made in nine areas encompassing 1) small scale privatization, 2) large scale privatization, 3) governance and enterprise restructuring, 4) price liberalisation, 5) trade and foreign exchange system, 6) competition policy, 7) banking reform and interest rate liberalisation, 8) securities markets and non-bank financial institutions and 9) infrastructure includes electric power, railways, telecommunication, roads, water and waste water. The measurement scale for these indicators ranges from 1 to 4+, where 1 represents little or no change from a rigid centrally planned economy while 4+

represents the standards of an industrialized market economy. For example, a score of 4+ in the power sector reforms would imply that electricity tariffs are fully cost-reflective and provide adequate incentives for efficiency improvements, the presence of large-scale private sector involvement in the unbundled and well-regulated sector and fully liberalised sector with well-functioning arrangements for network access and full competition in generation (EBRD, 2001; EBRD, 2008).

The paper constructs the following economic reform indicators from the set of nine indicators to summarize the different types of market driven economic reforms in the transition countries:

- *Privatisation Reform Index (PRI)*: composite index based on un-weighted average of small scale privatisation and large scale privatisation reforms.
- *Governance Reform Index (GRI)[5]*: composite index based on un-weighted average of competition policy and corporate governance and enterprise restructuring reforms.
- *Overall Market Liberalization Index (OMLI)*: composite index based on un-weighted average of reforms in price liberalization and trade and foreign exchange reforms.
- *Other Infrastructure Reform Index (OINFRI)*: composite index based on un-weighted average of reform scores in roads, water and waste water and telecommunication.
- *Financial Reform Index (FRI)*: composite index based on un-weighted average of banking reform and interest rate liberalization and securities markets and non-bank financial institutions.
- *Electric Power Index (EPI)*: electric power reform index alone.

The reform progress in railways is excluded due to many missing observations while the reform progress in the power sector is considered as a separate reform variables from other infrastructural reforms. This is because the importance of the sector meant that the reforms in power sector were critical in determining the pace and direction of overall economic reforms in the transition countries. Similarly, the paper uses the energy intensity (a ratio of total energy consumption and GDP) as a measure of energy efficiency (EI) across the transition countries. The data on energy intensities were obtained from the World Development Indicators (WDI) and EBRD. Furthermore, the energy intensities estimates are adjusted for purchasing power parities (PPP) which as a currency conversion technique eliminates the price level differences levels across countries. The logarithmic transformed energy efficiency estimate is denoted by LEI. Table B in Appendix includes the variables included in this study.

The period of analysis ranges from 1990-2010 (i.e. 20 years) covering 27 countries. Some of the transition countries have already obtained a membership at the EU while some are in the process of being an EU member and have the potential for joining EU. Table A in Appendix shows the status of the countries included in the sample in terms of

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[5] The governance reform index can be used as a proxy of institutional reform index in this study.

EU accession and that 15 out of 27 countries included in our sample are associated with the EU as shown by Table 2. Turkey and Montenegro[6] are excluded from the sample of countries studied due to data unavailability on the predictor and criterion variables respectively.

The dataset thus comprises an unbalanced panel comprising 27 cross-sections (N) with short time series (T) of 20 years observed from period 1990-20010. Each cross-section represent a diverse set of countries with its own economic, political, cultural, etc. system and history allowing every possibility for individual country-specific characteristics to influence the behaviour of other. However, panel data econometric methods consisting fixed effects (FE) and random effects (RE) estimators can account for unobserved heterogeneity as established in econometric literature. The FE and RE estimators differ in their assumptions about the unobserved heterogeneity. The RE estimator assumes that the composite error term (i.e. also containing the individual specific effect) is uncorrelated with the explanatory variable and requires to be treated as if they were a part of the error term. Conversely, FE estimator uses a dummy for every individual country[7] and thus taking the unobserved heterogeneity into account. Hence, the FE estimator is a special case of the RE estimator. The RE estimator where applicable (i.e. provided the assumptions[8] on the error term are met) is more efficient as it has the lowest variance amongst unbiased estimators. Likewise, the FE estimator is always consistent implying that the estimator converges in probability to the true value of the parameter. The use of a Hausman Test can make an appropriate choice upon applying RE and FE. This paper, however, uses the FE estimator as unobserved heterogeneity such as culture, legal origin, geographical location, history etc. that are fixed over time are likely to be correlated with several economic reforms. This is because the countries included in our sample are not identical to each other. It implies that the fundamental assumption of RE model is violated and not useful in this context. Further, the data used in this study does not represent a random sample as 'N' is limited but represents a finite sample allowing the use of FE estimator[9].

However, the relationship between overall economic reforms and energy efficiency is likely to be a complex one as the implementation of economic reforms does not instantaneously lead to improved energy efficiency. The behaviour of the dependent variable(s) can depend upon the past values of itself along with a set of independent and

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[6] Montenegro became an independent state from 3 June 2006.

[7] An alternative way to understand FE estimation would be to assign country specific dummy while performing a pooled Ordinary Least Squares (OLS) regression. On the other hand, a FE estimator takes into account the temporal (i.e. within) variation of the relevant variables and hence produces appropriate results when applied to variables that vary considerably over time. The FE estimator is also known as the Least Squares Dummy Variables (LSDV).

[8] The RE estimator is applicable on the assumption that the individual unobserved heterogeneity must be uncorrelated with the regressors (explanatory variables).

[9] A static FE model can be specified as $y_{it} = \beta_0 + X_{it}\beta + \alpha_i + \epsilon_{it}$ which can be estimated using commands 'xtreg' or 'xtregar' for AR (1) estimates in STATA.

control variables (Bruno, 2005). Thus a dynamic specification of the panel model can be expressed as $y_{it} = \beta_{0} + \rho y_{it-1} + X_{it}\beta + \alpha_i + \epsilon_{it}$ where 'ρ' is the coefficient of the lagged value of the dependent variable while '$X_{it}\beta$' represents the matrix of explanatory variables and coefficients.

However, it is well established in econometric literature that a dynamic LSDV model with a lagged dependent variable generates biased estimates when 'T' is small as in our case (see for e.g. Roodman, 2006). The estimates obtained from a dynamic LSDV become meaningless unless corrected for bias in small samples. Kiviet (1995) devised a bias-corrected LSDV estimator applicable only for balanced panels which is understood to have the lowest Root Mean Square Error (RMSE) for panels of all sizes (Bun and Kiviet, 2003). Based on these previous works, a version of bias-corrected LSDV estimate (LSDVC) has been developed by Bruno (2005) which can be applied under two fundamental assumptions: a) it has a strictly exogenous selection rule and b) the error term 'ϵ_{it}' is classified as 'an unobserved white noise disturbance'. The approximation terms are of no direct use for estimation as they are all evaluated at the unobserved true parameter values. Hence, the true parameter values are replaced by estimates from some consistent estimator to make them work (Bruno, 2005). The preferred estimator is then plugged into the bias approximations formulae while the resulting bias approximation estimates β_{i_hat} are subtracted to derive the corrected LSDV estimator as LSDVC$_i$=LSDV- β_{i_hat} where i=1 in STATA by default that indicates the accuracy of the bias approximation[10]. The consistent estimator to be chosen to initialize the bias corrections could vary, for example, between the Arellano-Bond (AB) and Blundell-Bond (BB) estimators. The AB estimator is a GMM estimator for the first differenced model relying on a greater number of internal instruments (Arellano and Bond, 1991). The BB estimator assumes that the first differences of the instrumental variables are uncorrelated with fixed effects and augments the AB estimator by allowing for introducing more instruments and improve efficiency of the estimates (Blundell and Bond, 1998).

An alternative to dynamic LSDV panel estimates would be to use other consistent Instrumental Variable (IV) and Generalized Methods of Moments (GMM) estimators as proposed in econometrics (Roodman, 2006). However, the relative performance evaluation of LSDVC in comparison to LSDV, AB and BB estimators by Bruno (2005) for unbalanced panels with small 'N' concludes that the STATA computed LSDVC version outperforms all other estimators in terms of root mean square errors (RMSE) and bias. We thus use the LSDVC model as shown in equation one to examine the impact of several market driven economic reforms and energy efficiency in transition countries and accordingly report the results for all the estimators used to initialize the bias corrections (AB and BB).

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[10] Using 'xtlsdvc' command in STATA, the estimator first produces uncorrected LSDV estimates which then approximates the sample bias of the estimator using Kiviet's higher order asymptotic expansion techniques (Bruno, 2005). The estimation also includes one lag by default.

$$LEI_{it} = \beta_0 + \rho LEI_{it-1} + \beta_1 PRI_{it} + \beta_2 OINFRI_{it} + \beta_3 GRI_{it} + \beta_4 FRI_{it} + \beta_5 OMLI_{it} + \beta_6 EPI_{it} + \alpha_i + \epsilon_{it} \qquad (1)$$

The use of EBRD indexes based on individual components score as regressors largely confirms to the exogenous selection rule as a requirement for performing LSDVC. The standard test statistics along with the Arellano-Bond test for first and second order autocorrelation is reported in Appendix (see Table G). Under the null of no autocorrelation, the presence of second order autocorrelation would imply that the estimates are inconsistent. In addition, the estimates of the Sargan test of overidentifying restrictions reported by the Blundell Bond estimator should test significantly different from zero to reject the null that overidentifying restrictions are valid[11].

Table 1 below reports the descriptive statistics and behaviour of the dependent and independent variables used in the study. In general, the transition countries are still a distant apart from fully meeting the economic reform standards of an industrialised economy in all sectors. Thus, market-based economic transformation is an ongoing process in the transition countries. It can be inferred that liberalizing the economy as a whole (i.e. opening up trade, liberalising foreign exchange and price liberalization in the economy) has been on high agenda of reforms across all transition countries though the extent of progress considerably varies across them. The incentives to join the EU and the underling motives to benefit from regional integration have resulted in increased economic openness in the region. However, overall price liberalization in the economy has not been necessarily applied to the power sector as all groups of countries considered are still a distance away from achieving cost-reflective pricing of electricity as suggested by the mean reform score[12]. Likewise, the governance reforms (including competition policy and corporate governance and enterprise restructuring reforms) which are also a proxy measure for institutional reforms seems to have progressed the least but at similar levels across the transition countries considered in this study. The low governance scores, to some extent, also explain the widespread corruption that these countries faced during the yesteryears (EBRD, 2001). Privatisation reforms (both large scale and small scale), which is often perceived as a cornerstone of this economic transformation process, has advanced ahead as compared to reforms in the financial sector and reform in the electric power sector on average. Meanwhile, Table C in Appendix shows the correlation coefficients among the dependent variables used in this study.

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[11] As an example, Sen and Jamasb (2010) use the LSDVC estimator in an econometric analysis of the determinants and impacts of electricity reform in India.

[12] A score of 4 and above would imply that the existence of cost-reflective electricity tariffs.

Variable	Mean	Standard Deviation	Minimum	Maximum	No. of Observations
LEI	5.76	0.61	4.51	7.45	563
PRI	2.93	0.98	1	4.17	567
OINFRI	2.02	0.80	1	3.89	567
GRI	2.00	0.70	1	3.67	567
OMLI	3.47	1.02	1	4.33	567
FRI	2.13	0.82	1	4	567
EPI	2.25	0.94	1	4	567

Table 1: Descriptive statistics of the variables (up to two decimal places)

5. Results and Discussions

The aim of this paper is to examine the impacts of several market-oriented economic reforms on energy efficiency in the transition countries during the last twenty years' of marketization. By doing so, the paper empirically analyses whether market-driven economic reforms matter in addressing energy efficiency. The regression method involves a bias corrected fixed effect analysis initialised by AH and BB estimators while the standard errors are bootstrapped[13] and obtained from 100 repetitions which largely depended on the number of observations. Bootstrapping allows us to generate an estimate of the sampling distribution of almost any statistic using very simple methods (Varian, 2005). Hence, the bootstrapped standard errors (SE) are reported. The AB tests of autocorrelation and BB test of over identifying restrictions was also performed for the econometric estimations[14]. Table 2 below reports the results obtained from the regression analysis based on equation one.

The results show that the lagged term of energy efficiency is highly significant. This indicates that last year's energy efficiency had an effect on previous years' energy efficiency across the transition countries. However, progress in governance reforms (which is a proxy for institutional reforms) has no significant effect on energy efficiency. This might be because the reforms have been too slow (see table one) while the reforms have advanced more in theory than in practice. The finding is consistent with the views that that the enforcement mechanisms of economic reforms were weak as the state's

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[13] Bootstrap is a computer-based method for assigning measures of accuracy to sample estimates (Efron and Tibshirani, 1994).
[14] The results can be provided upon request. Likewise, we also performed an OLS and FE (i.e. LSDV) estimations and compare the results to determine the nature of bias for each hypothesis. In all cases, we observed bias as OLS and FE does not take endogeneity into account.

legal and judicial capacities were limited during the transition process as argued by Stiglitz (1999). The policymakers initially failed to understand that reforms in different sectors of the economy in the transition countries is closely interlinked with broader legal and institutional contexts throughout the economy. This eventually led to a decade long of neglecting institutional differences across countries in implementing power sector reforms (Hirschhausen and Waelde, 2006). In turn, the lack of appropriate institutional framework to support market-based reforms also explains the insignificance of reforms in the power sector (which includes tariff adjustments, unbundling and the introduction of more commercialism); overall market liberalisation reforms (a highly pursued reform area in transition countries); reforms in other infrastructures and financial sector reforms on energy efficiency in transition countries.

LSDVC Dynamic Regression (Bootstrapped SE)	Arellano-Bond (AB)	Blundell-Bond (BB)
LEI. L1	0.925*** (0.025)	1.052*** (0.014)
GRI	0.011 (0.023)	0.008 (0.023)
OMLI	-0.006 (0.009)	-0.001 (0.009)
OINFRI	-0.010 (0.017)	-0.001 (0.018)
EPI	-0.005 (0.012)	0.003 (0.012)
FRI	0.010 (0.020)	0.016 (0.020)
PRI	-0.036*** (0.012)	-0.028*** (0.012)

Table 2: Impacts of economic reforms on energy efficiency
*, **, *** denotes significance at 10%, 5% and 1% respectively
Numbers in ( ) reports the SE

The transition countries are still a distant away from achieving cost-reflective electricity pricing as suggested by table 1. For example, the electricity tariffs across CIS countries are well below the cost recovery levels and are only gradually adjusted removing any incentives for households and industries (in particular) to use the energy efficiently. The industries in these countries continue to benefit from soft budget constraints either through state subsidies or tolerance of tax and utility arrears coupled with non-payment of energy bills in non-industrial sectors (Cornillie and Frankhauser, 2004). Thus, reforms in the power sector might not have produced any significant impact on energy efficiency. On the other hand, although market oriented power sector reforms advanced in theory in many transition countries; the implementation in practice remained too weak to influence any outcomes relating to energy efficiency significantly (Nepal and Jamasb, 2011).

The legacy of central planning may have translated into slow willingness and commitment towards implementing market-based economic reforms leading to insignificant impacts on energy efficiency. This is because the collapse of central planning was not a choice of any country or government but rather a consequence of dysfunctional political and economic system of early years. The first post-communist governments in some SEE (Belarus) and many CIS countries (Turkmenistan and Uzbekistan) were led by the same political elites under communism delaying the progress in transition. Likewise, in countries like Bosnia and Herzegovina, FR Yugoslavia and Tajikistan; overall economic reforms has been slow as these countries had to do some 'catching up' due to civil war and ethnic-conflicts. Regional integration via EU membership also catapulted economic reforms in countries like Latvia, Slovakia and Slovenia, Bulgaria, Romania, etc. However, the lack of proper institutions in these countries meant that international integration was not always in line to complement domestic economic reforms. As such, the inability to effectively understand the functioning of a market economy coupled with the misunderstandings of the market-reform process itself explains the insignificance of various market-based reforms on energy efficiency in transitions countries.

However, the transfer of ownership to the private sector (both small scale and large scale) has a significant effect on energy efficiency. This result is in line with the theoretical motives of privatisation involving improvements in economic efficiency and efficient resource allocation (see Vickers and Yarrow, 1988). The state-owned firms were operationally and technically inefficient before the start of the transition process. Privatisation could have spurred efficient energy use and the adoption of energy efficient technologies in the process of minimizing waste and maximising profit. Furthermore, the increase in profit can also trigger a wider adoption of energy saving technologies. The profit maximisation objectives under privatisation might have also increased the energy prices (even though electricity still remains to be highly subsidised) prompting efficient energy use among the price sensitive consumers. In addition, it also underscores the importance of hard-budget constraints including the adjustment of tariffs to appropriate levels as well as the need to reduce the excessive price support through government subsidies in improving energy efficiency in the transition countries.

6. Conclusions

This paper analysed whether market-driven economic reforms matter or not in driving energy efficiency by analysing the impacts of various market-based economic reforms on energy efficiency across the transition countries. Improving energy efficiency is crucial in mitigating the adverse economic, social and environmental impacts of climate change. Energy efficiency also promotes energy conservation and thereby strengthening the security of energy supply. Moreover, climate change and security of supply issues

pose significant threats for sustainable development as well as highlight its needs across the developing regions and economies in systemic transition.

The results from the bias-corrected fixed effect analysis (LSDVC) suggest that privatisation has been the lone driver of energy efficiency in the transition countries. Other market-based reforms failed to produce any significant impacts due to the lack of appropriate institutional support to complement those reforms as suggested by the results. As such, creating proper intuitions to buttress the market-based reforms is necessary in transition and developing countries. However, the results can vary among different country groups (SEE, CEB and CIS) which is not analysed in this paper due to small sample size. Likewise, the EU members included in our sample can have greater institutional endowment than non EU members which can produce different results. Moreover, the potentials to reduce the energy efficiency-gap exist among all transition countries.

This can be achieved by more market based mechanisms and privatisation in the presence of appropriate institutional arrangements. However, it is necessary for the policymakers to understand that the markets as well as the institutions to support them are not perfect. Thus, the resulting market imperfections can lead to market failures which require appropriate government interventions to offset the effect of market failures. In addition, two major messages are clear from the results for market-based economic reforms to produce significant impacts on energy efficiency in the transition countries: a) the need to harmonize reforms in 'theory' or paper with reforms in 'practice' and b) the need to support overall economic reforms with other related institutional reforms in the economy. Likewise, it is also necessary to ensure adequate government support to address both the demand-side and supply- side constraints of promoting energy efficiency is desirable in the light of overall market oriented economic reforms.

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Appendix:

<div align="center">

Table A: Countries included in the study
Source: EBRD (2001)

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Central Eastern Europe and Baltic States (CEB)	South Eastern Europe (SEE)	Commonwealth of Independent States (CIS)	Others
Croatia**, Estonia*, Hungary*, Latvia*, Lithuania, Poland*, Slovak Republic* and Slovenia*	Albania***, Bosnia and Herzegovina***, Bulgaria*, FYR Macedonia**, Serbia, Romania* and Montenegro***	Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine and Uzbekistan	Turkey** and Mongolia
*EU members, ** EU candidates and *** Potential EU candidates			

<div align="center">

Table B: List and description of variables
Source: Own compilation

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Type	Variables	Description	Units	Source
Dependent Variables	LEI	Energy Intensity (log transformed)	Energy Use per $1000 GDP (PPP adjusted)	WDI and EBRD
Independent Variables	EPI	Electric Power Reform Index	Scaled from 1 to 4+	EBRD
	PRI	Privatisation Reform Index	Scaled from 1 to 4+	EBRD
	OINFRI	Other infrastructure Reform Index	Scaled from 1 to 4+	EBRD
	FRI	Financial Reform Index	Scaled from 1 to 4+	EBRD
	GRI	Governance Reform	Scaled from 1 to	EBRD

| | | Index | 4+ | |
| | OMLI | Overall Market Liberalization Index | Scaled from 1 to 4+ | EBRD |

Table F: Correlation matrix for the independent variables

	PRI	OINFRI	GRI	OMLI	FRI	EPI
PRI	1.00					
OIRI	0.43	1.00				
EGRI	0.38	0.54	1.00			
OMLI	0.47	0.58	0.46	1.00		
FRI	0.48	0.66	0.59	0.34	1.00	
EPI	0.29	0.24	0.32	0.20	0.35	1.00

Table G: Tests of Overidentifying Restrictions

Estimator	Test	H0	
AB	1st order autocorrelation	No autocorrelation	Z=-7.16 Prob>z=0.000
	2nd order autocorrelation	No autocorrelation	Z=-2.76 Prob>z=0.316
	Sargan Test of Overid. Restriction		Prob>Chi2=0.005
BB	AB test for AR(1) in first differences	No autocorrelation	Z=-4.56 Prob>z=0.000
	AB test for AR(2) in first differences	No autocorrelation	Z=-0.77 Prob>z=0.443
	Sargan Test of Overid. restrictions		Prob>chi2=0.324