EFFECTS OF LAND, LABOUR AND ENERGY ON ECONOMIC GROWTH IN ASIA'S EMERGING MARKET AND DEVELOPING ECONOMIES (EMDEs)

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Abstract

Asia's emerging markets have been a growing force in the world economy since 2003, and currently remain a bright spot in the global picture. This paper investigates the impact of land use, labour supply and energy consumption with relation to gross domestic product (GDP) per capita and technology transfer in economic growth of Asia's Emerging Market and Developing Economics (EMDEs). The work covers 12 countries with 20 yearly samples provided for the period 1995 to 2014. Two stage least squares (2SLS) of panel data analysis determines the GDP growth function. Empirical results show, with high statistical significance, a marked increase in economic growth as a result of energy use, while land use has a significant positive effect on GDP. However, there is no impact of labour supply on GDP, and this might be due to entrepreneurs employing more technology and machinery rather than human labour. The results indicate that energy use and land use have an important role to play in decision-making policy with a view to improving economic efficiency within Asia's EMDEs.

Keywords: land use, labour supply, energy use, economic growth,
Asia's Emerging Market and Developing Economics (EMDEs).

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Overview

The global development that occurred two years ago appears to have peaked and become less synchronized across economies, though remaining steady for most emerging economies through 2018. Among such emerging economies, the highest growth was reported in Asia by maintaining resilience and being less effected by financial market turbulence than elsewhere (see Figure 1). As a result, the International Monetary Fund (IMF, 2018) predicted Asia's economy to grow by 5.6 percent in 2018 and 5.4 percent in 2019. In addition, Singapore's central bank chief confirmed that emerging markets in Asia are in a more robust position than others because of solid economic growth prospects, low inflation and strong reserve buffers (Businesstimes, 2018). However, being inhibited by availability of natural resources, labour supply, and local energy is likely to limit potential output growth of Asia's Emerging Market and Developing Economies (EMDEs).

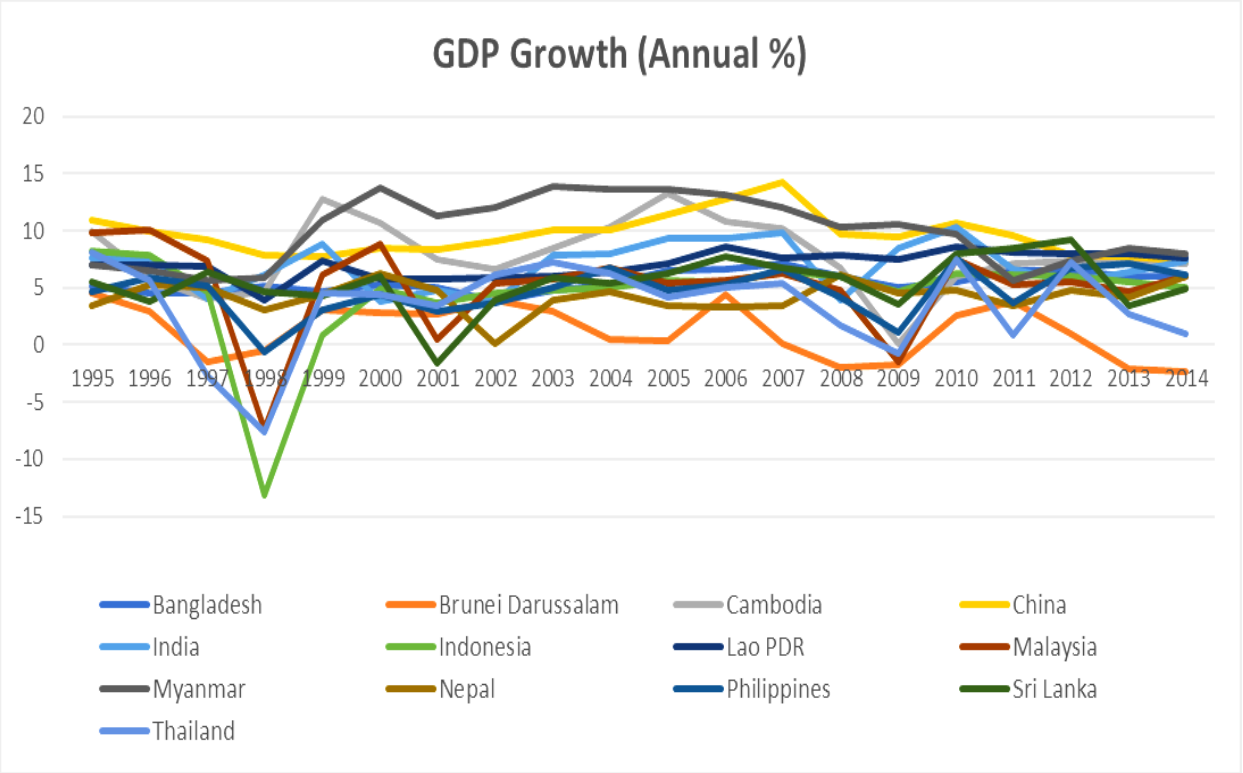

Figure 1 : GDP Growth in Asia's Emerging Market and Developing Economies

Source : data from the World Bank

Hubacek and van den Bergh (2002) found that land use changes are most often directly linked with economic decisions. Because of the importance of land use in agricultural economies, Asian farmers light fires to clear land for crop cultivation, currently resulting in major concerns for environmental welfare. Walmsley et al. (2015) mentioned that East and South-East Asia will face major demographic changes over the next few decades with many countries' labour forces starting to decline. Furthermore, economic growth since the industrial revolution has been driven largely by reducing energy price due, in part, to the discovery of inexpensive fossil fuel resources (Ayresa and Voudouris, 2014). Such energy efficiency has a positive impact on macro economic factors, which can drive Asia's economic growth (Sharma et al., 2014).

This paper investigates the effects of land use, labour supply and energy consumption with relation to gross domestic product (GDP) per capita and technology transfer in Asia's economic growth in EMDEs. The 12 countries in this study include Bangladesh, Brunei Darussalam, Cambodia, China, India, Indonesia, Malaysia, Myanmar, Nepal, Philippines, Sri Lanka and Thailand. The data are provided by the World Bank, consisting of yearly data for the 20 years encompassing the period 1995 to 2014, with such data subjected to panel data analysis.

Literature Reviews

EMDEs have played an important role in the global economy during recent years, and they account for more than 75 percent of global growth in output and consumption for 2017 (IMF, 2017). According to forecasts from IMF, Asia's developing economies are poised to expand an average of 6.5 percent in 2018, which is 4.9 percent for all emerging markets (Karunungan, 2018). Therefore, it is interesting to investigate what factors affect economic growth in Asia's EMDEs. Conventional economists usually believe that capital, labour and land availability are the primary factors of production, while goods such as fuels and materials are the intermediate inputs (Stern, 2004).

The role of land use in economic theory is mentioned in both a conceptual and historical perspective. In classical economics, land is one of three important factors of production, along with labour and capital, and it is also an essential input for housing and food production (Wu, 2008). Even though neoclassical core economic theory paid less attention to land use, specialized sub-fields such as regional and urban economics met the demand for land use considerations. Recently, awareness of environmental issues and resource problems has been the catalyst for new frames of reference and understanding regarding land under economic analysis (Hubacek and van den Bergh, (2002). IMF reported there was strong evidence that, in terms of initial conditions, including equality of land, some East Asian countries were significantly better off than countries with similar levels of income (Sarel, 1996). Arable land availability can be the backbone of agricultural economies, such as Asia's EMDEs, and is, therefore, an important indicator of economic growth.

The basic economic growth model founded on the work of Solow (1956) describes a constant-sized labour force using manufactured capital producing output in terms of GDP. If labour supply grows at a fixed rate over time, the total capital stock and the total of GDP will increase (Stern, 2004). The neoclassical theory explains that, when mandated wage goes beyond the market-clearing wage, with a reducing labour demand scenario, firms cut back on the amount of labour called for (Leonard, 2019). For East and South-East Asia, Walmsley et al. (2015) reported that many countries will face major demographic changes over the next few decades with labour supply beginning to decline. Asia's EMDEs need to overcome key challenges in the ability to extract the maximum mandated wage, while seeking the optimal balance between labour supply and economic growth.

Understanding the relationship between economic growth and energy consumption remains a major concern for policy makers. Numerous ideas and views are put forward to explain the role of energy in economic growth. Stern (2004) supported the idea of a strong relationship between energy use and the level of economic activity. Hannesson (2009) found that there was a significant positive relationship between growth in energy use and growth in GDP for 171 countries in the period 1950 to 2004. The result of a study by Rathnayaka et al. (2018) indicated a long run bidirectional causal relationship between energy consumption and economic growth in China. In addition, Sharma et al. (2014) confirmed a link between energy efficiency and macro economic factors in Asia, with causal implications for economic growth. Hence, energy use of Asia's EMDEs poses important policy considerations for economic development.

With regard to the importance of GDP per capita and technology transfer in energy use, Hannesson (2009) indicated that growth in energy use decreases with GDP per capita, for any given growth in GDP. In addition, European Environment Agency (EEA, 2016) reported that there is correlation of energy consumption and GDP per person. According to Stern and Kander (2012), a role is still played by labour-augmenting technological change becoming the dominant factor driving economic growth though energy use. Futhermore, Stern (2004) confirmed that technology change is one of the key factors that could reduce the linkage between energy use and economic activity over time. In relation to the percentage of service communications, computer activity, imports etc., BoP from the World Bank is employed to be the proxy for technology transfer in this paper.

Methodology

This study investigates the effects of land use, labour supply and energy consumption on economic growth for EMDEs in Asia. Two stage least squares (2SLS) of panel data analysis is employed to determine the gross domestic product (GDP) growth function, while controlling for unobserved cross section heterogeneity (Baltagi, 2013). A panel data model is constructed conferring two dimensions (year and country) upon the variables. There is a cross-sectional unit of observation, which in this case is country (*i*), and there is a temporal reference (*t*), which in this case is the year. This paper employs 2SLS panel estimators with regard to pooled ordinary least squares (pooled 2SLS), fixed effects (FE-2SLS) and random effects (RE-2SLS). The Hausman test (1978) is used to compare random effects versus fixed effects (Green, 2008).

- Empirical Models

The pooled 2SLS estimator makes use of variation of both time and cross-sectional units to estimate β by stacking data over *i* and t into one long regression with NT observations, and estimating by ordinary least squares (OLS). The GDP growth models can be shown as follows:

Model 1

$$GDP_{it} = \beta_0 + \beta_1 LA_{it} + \beta_2 LS_{it} + \beta_3 EU_{it} + \sum_{p=1}^{s} \gamma_p z_{p,i} + \varepsilon_{it,1} \quad (1)$$

where

$$EU_{it} = \alpha_0 + \alpha_1 GPPP_{it} + \alpha_3 TEC_{it} + \sum_{p=1}^{s} \gamma_p z_{p,i} + \varepsilon_{it,2} \quad (2)$$

Model 2

$$GDP_{it} = \beta_0 + \beta_1 LA_{it} + \beta_3 EU_{it} + \sum_{p=1}^{s} \gamma_p z_{p,i} + \varepsilon_{it,1} \quad (3)$$

where

$$EU_{it} = \alpha_0 + \alpha_1 GPPP_{it} + \alpha_3 TEC_{it} + \sum_{p=1}^{s} \gamma_p z_{p,i} + \varepsilon_{it,2} \quad (4)$$

GDP (percent of annual) stands for the dependent variable which is economic growth. There are three observed variables. These are *LA* (hectares per person) which stands for arable land growth, *LS* (percent of population aged 15 to 64 years) which stands for labour supply growth, and *EU* (kg of oil equivalent per capita) which stands for energy use growth. In addition, *z* stands for unobserved variables (for example, natural disasters and political unrest), α_0 is the intercept which represents the individual-specific constants, β_1 is a parameter, γ is an s-dimensional column vector of parameters, and ε is an error term. However, *EU* is an endogenous variable. There are two instrumental variables. These are GDP per capita growth (*GPPP*) being current US$, and technology transfer growth (*TEC*) being percent of service communications, computer activity, imports etc. These instruments are correlated with *EU*.

- Data

In this empirical study, the data set for the 12 Asian EMDEs countries comprises yearly data for the 20 years from 1995 to 2014 provided by the World Bank. This data set includes GDP, LA, LS, EU, GPPP and TEC. Total maximum observations are 240 (12 x 20). Table 1 shows a summary of the key variables used in the analysis.

Table 1: Descriptive Statistics

Descriptive Statistics (1995-2014)					
Var	Obs	Mean	S.D.	Min	Max
GDP	240	6.088	3.453	-13.127	14.231
LA	240	-.999	6.956	-74.785	48.154
LS	240	.562	.424	-.426	2.621
EU	239	2.576	6.293	-21.740	43.467
GPPP	234	8.520	12.395	-56.382	56.890
TEC	228	3.227	48.061	-86.611	647.375

Source: The World Bank
Note: Var, Obs and S.D. indicate variable, observations and standard deviation respectively.

Results and Discussion

- Panel Unit Root Tests

The panel unit root test derives from the time series unit root test. Using the panel method noticeably increases the power of the test relative to the time series Augmented Dickey–Fuller (ADF) tests (Levin et al., 2002). Because the data set is strongly balanced panel data, this study employs the Levin-Lin-Chu test to check stationarity for GDP, LA and LS, while employing the Im, Pesaran and Shin Test (IPS) to check stationarity for EU, GPPP and TEC. The results show that all variables are stationary (see Table 2). In order to remedy the problem of non-stationarity, this paper estimates the models with first differences.

Table 2: Panel Unit Root Test Results

	Levin-Lin-Chu test (LLC)			**Im, Pesaran and Shin Test (IPS)**		
	Level	1st diff	Concl	Level	1st diff	Concl
	c	c		c	c	
GDP	-5.496***		I(0)			
LA	-5.237***		I(0)			
LS	-1.338	-7.972***	I(1)			
EU				-5.707***		I(0)
GPPP				-4.559***		I(0)
TEC				-6.718***		I(0)

Notes: (1) The null hypothesis of a unit root is rejected for large values of χ^2 statistic (*** rejects at 1%).
(2) Concl denotes conclusion number of unit root, while c indicate that a constant term is included in the regression.

- Panel Data Analysis

Table 3 gives the estimation results of GDP by the three estimation methods. For Model 1 and Model 2, the results show that EU has a highly significant positive effect, and LA has a significant positive effect on GDP, for POLS, fixed effects and random effects. However, there is no effect of LS on GDP.

Table 3: Panel Data Model Estimator Results of GDP

	Panel Data Analysis					
	POLS		**Fixed**		**Random**	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
ΔLA	.274**	.273**	.283**	.283**	.274**	.273**
	(.130)	(.129)	(.137)	(.137)	(.130)	(.129)
ΔLS	-.339		-.281		-.339	
	(4.481)		(4.706)		(4.481)	
ΔEU	1.341***	1.340***	1.358***	1.357***	1.341***	1.340***
	(.481)	(.479)	(.506)	(.505)	(.481)	(.479)
Constant	-.009	-.005	-.006	-.003	-.009	-.005
	(.770)	(.766)	(.800)	(.795)	(.770)	(.766)
σ_μ	0	0	.795	.796	0	0
σ_ε	11.520	11.486	11.520	11.486	11.520	11.486
ρ	0	0	.005	.005	0	0
Observations	209	209	209	209	209	209

Notes: (1) For Model 1, instrumented is *ΔEU*, and instruments are *ΔLA*, *ΔLS*, *ΔGPPP and ΔTEC*

(2) For Model 2, instrumented is *ΔEU*, and instruments are *ΔLA*, *ΔGPPP and ΔTEC*

(3) Standard errors in ( )

(4) *** illustrates significance at 1% level, and ** illustrates significance at 5% level

(5) Intraclass correlation $\rho = \frac{\sigma_\mu^2}{\sigma_\mu^2 + \sigma_\varepsilon^2}$

- Hausman Test

The Hausman test (1978) is employed to compare random effects versus fixed effects (Green, 2008), basically determining whether the unique errors (μ_i) are correlated with the regressors - the null hypothesis being that they are not. The results of Model 1 (Prob > X^2 = 0.996) and Model 2 (Prob > X^2 = 0.974) show failure to reject the null hypothesis leading to the random effects estimation being accepted (Dougherty, 2011). Standard linear panel estimators give similar results for Model 1 and Model 2. The random effects results show that a rise of 1% in arable land growth gives a significant result of GDP growth by about 0.27%. In addition, a rise of 1% in energy use growth gives a highly significant result of GDP growth by about 1.34%. Even though, from Model 1, there is a negative impact of labour supply growth on GDP growth, the estimation is not statistically significant.

- Discussion

Following expectation, the 2SLS of panel data analysis results show that an increase of energy use gives a highly significant result of increasing economic growth to Asia's EMDEs. Therefore, these economies can still get a weaker growth impulse from energy price, which has a negative relationship with electricity demand. In addition, an increase of arable land gives a significant result of rising economic growth. However, rather than increase the amount of land use, sustainable land management can promote the efficient use of land by motivating owners through the benefit of proper management and farm development. The fact that there appears no effect of labour supply growth on economic growth in Asia's EMDEs might be due to entrepreneurs employing more technology and machinery rather than human labour.

Conclusions

This paper explores the effects of land use, labour supply and energy consumption on economic growth for EMDEs in Asia, through 2SLS of panel data analysis. The study involves data from 12 countries, with 20 yearly samples from the period 1995 to 2014. The results show, with a high level of statistical significance, that increases in energy use and arable land deliver a pronounced enhancement in economic growth for Asia's EMDEs. However, there appears no effect of labour supply on economic growth. Such a finding provides affirmation that, for EMDEs in Asia, energy and land can be instrumental in markedly assisting the national economy. Because of increase in income and technology transfer, it is difficults to reduce energy demand for developing countries. Policy makers would be wise to encourage economic growth to continue or last longer by reducing energy prices through promoting energy market integration and renewable energy.

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