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IMPACT OF FDI, ENERGY AND IMPORTS ON TOTAL FACTOR PRODUCTIVITY IN HIGH AND MIDDLE INCOME ECONOMIES

Muhammad SHAFIQ-UR-REHMAN* and Mohammed NISHAT**

Abstract

FDI (Foreign Direct Investment) and international trade have been noticeable characteristics of the world economy over the last few decades. The importance of trade and FDI has received considerable attention from policymakers and academic researchers. Against this backdrop, this study attempts to observe and compare the effect of FDI, imports and energy on growth in Total Factor Productivity (TFP) on high and middle-income economies by using two separate panel data sets from 1990 to 2019 by employing the Feasible Generalized least square method. Results suggest that FDI in both high and middle-income economies is positively and statistically significant and related to TFP. Moreover, the impact of imports and energy in middle-income economies is statistically significant, and they affect TFP negatively and positively, respectively. Results further manifest that in world economies, the transfer of proprietorship to private foreign hands is linked with productivity gains; however, imports are offsetting these gains in middle-income economies.

Keywords: Total Factor Productivity, FDI, Imports, Energy, Feasible Generalized Least Square.
JEL Classification: F21, O47, C23.

I. Introduction

It is quite familiar that economic growth results from the accumulation of factors of production, technology improvement (total factor productivity), or both. Technologies ensuing from research and development are spread worldwide via various channels. One direct channel is trade in technology, and other indirect channels of technology transfer are the movement of factors of production and trade in goods [Saggi (2001)].

Numerous factors have an important role in determining the productivity of a country; for instance, capital stock and size and quality of labour force are certainly

* Assistant Professor, Government National College, **Professor and Dean Management Sciences, SZABIST University, Karachi.

imperative, but large number of other factors such as FDI, energy consumption and imports also has their imperative roles [Khan (2006)]. In this background, this study assesses the impact of foreign direct investment (FDI), trade and Energy on TFP.

Capital flows from Cross-border have risen substantially with regard to FDI over the last forty years. FDI includes both greenfield investment and brownfield investment, whereas greenfield refers to the establishment of new production facilities, and brownfield refers to upgrading/procuring existing production facilities [Bayar (2017)]. As far as FDI is concerned, either brownfield or greenfield, its impact on TFP is supposed to be positive, as many researchers and strategists consider that FDI enhances aggregate productivity in developing economies through new advanced technology training of labour force and productivity or efficiency spillovers to local businesses [Herzer (2017)]. As employment of advanced technology along with improved labour skills, the productivity of local businesses tends to improve.

Fast globalization has led to recognition the importance of FDI as a growth engine for an economy [Adnan, et al., (2019)]. The inflows of FDI are mainly vital for emerging economies as they make a surge in local investment, offsetting the insufficiency of domestic savings [Dhrifi (2015)]. Foreign direct investment indicates that investment is made by a foreign country's investors in the host or receiving country. Businesses or foreign investors employ their management techniques and technology in the host country; consequently, it is beneficial for local businesses to opt for the same advanced technology, which ultimately enhances aggregate productivity.

Foreign Direct Investment is typically made through multinational companies in industrialized economies in emerging economies where the workforce is comparatively inexpensive and regulations are relatively relaxed. As a result, their production cost is lower in the host country for foreign investors. Besides that, it is a useful way to enter into the foreign markets. FDI is also beneficial to the receiving economy as it generates opportunities for employment for local labour and subsequently increases the welfare of society [Adnan, et al., (2019)].

Nevertheless, against the findings for advanced economies, the majority of firm-level analyses of unindustrialized economies find insignificant or even negative spillovers [Harrison and Rodriguez-Clare (2010)].

Insignificant impact might be because local businesses and less capable workforce are unable to acquire knowledge from MNCs or may be MNCs managed to effectively withhold their expertise [Görg and Greenaway (2004)].

Negative productivity effects of FDI might be due to the reason that (multinational corporations) MNCs have lower marginal costs as compared to local businesses. Because of this, it takes demand away from local businesses. As a result, local businesses decrease their production [Görg and Greenaway (2004)]. One more possible reason for negative productivity might be due to reason that MNCs use

fewer local inputs as compared to domestic firms, which leads to a decline in indigenous demand [Rodriguez-Clare (1996)].

Studies considering the effect of FDI on TFP in emerging economies are limited, and their findings vary. De Mello (1999) observed an insignificant impact on unindustrialized economies, whereas Woo (2009) found a positive and significant association between FDI and total factor productivity growth with regard to emerging economies. Last but not least, Wang and Wong (2009) indicate that FDI has a negative effect on TFP growth, having lower ranks of human capital, and it eventually becomes positive as human capital level augments.

Energy is one of the significant marketable commodities that play a principal role in international trade [Moghaddasi and Pour (2016)]. Energy has also played an important role in the economic growth of many countries. With regard to the impact of Energy on total factor productivity, the literature is very scarce and the studies previously conducted majority of them focus on agricultural productivity, as Karkacier, et al., (2006) have shown an effective connection between agricultural productivity and energy use in Turkey. Few biological economists consider that in the biophysical growth model, one of the vital growth factors is Energy, whereas Labour and capital are facilitating factors [Stern (1993)]. Furthermore, Altınöz (2021) has found that renewable energy consumption has a positive impact on TFP in the long run while examining the impact of both fossil fuel and renewable energy consumption on TFP in G20 countries. Nonetheless, a cheap and uninterrupted supply of Energy would facilitate the automation and advancement of machinery, which would probably enhance total factor productivity. However, greener or renewable Energy, which is environment friendly, may be prioritized for protecting against environmental degradation.

Besides FDI and Energy, Imports can also have a telling impact on TFP. Those economies that are involved in more international trade with advanced economies would probably have a better opportunity to equip themselves with technological advancement [Majeed, et al., (2010)]. Imports' impact on TFP can vary as imports can be related to technology transfers, which can be considered a medium of technology transfer [Acharya and Keller (2007)]. However, it is generally stated that liberalization in imports leads towards higher competition, and exporting firms usually have lower cost of production as compared to local businesses because these local entrepreneurs prefer to import and sell instead of manufacturing the same as a result forcing local businesses to decrease their production and ultimately it would affect negatively on TFP. Nevertheless, in order to improve TFP or benefit from technology transfer via imports, countries probably should concentrate on industrial imports, i.e. imports of machinery and equipment with advanced and state-of-the-art technology instead of luxury or consumable imports.

Against this backdrop, this study uses TFP growth with the objective of finding out the impact of FDI, Imports and Energy Consumption on world economies,

which has probably not been done previously. This study is perhaps the first study which examines the impact of FDI, Energy consumption, and Imports on TFP on both high-income and middle-income economies over the period of 1990-2019, by using both high-income and middle-income economies (Table A-1 in Appendix) separately, it enables to draw a comparison of their respective effects on TFP which also has not been carried out previously. The feasible Generalized Least Squares GSL method, which has SUR Cross-section specification, has been used in this study as it offers consistent estimates and corrects the potential presence of unobserved country-specific effects. Examining the world economies would make us infer whether FDI can cause productivity gains, i.e., is there any enhancement in total factor productivity? In addition to the above, the importance of the usage of Energy and imports on TFP will also be examined.

II. Empirical Model and Data

In order to assess the effect of FDI, Imports and Energy on the growth of TFP, the ensuing log-linear model has been applied in the Equation (1):

$$TFPG_{it} = \alpha_1 \, log(FDI_{it}) + \alpha_3 \, (M_{it}) + \alpha_3 \, log(EC_{it}) + \alpha_4 \, (T) + \varepsilon_{it} \qquad (1)$$

Where TFPG corresponds to the growth rate of total factor productivity, log (FDI) indicates the log of FDI flow per worker, *M* represents imports as a percentage of GDP, log (EC) shows the log of Energy consumption, and *T* indicates the time trend variable and ε shows the typical error term.

Furthermore, increasing panel data shows significant cross-sectional dependence that probably arises from mutual shock and unobserved parts that eventually turn into error term parts [De Hoyos and Sarafidis (2006)]. Overlooking cross-sectional dependence might produce significant effects in the estimation; hence, in this study, a cross-sectional dependence test has been performed through the familiar Breusch-Pagan (1980) LM Test (Table A-2 in Appendix), the test found cross-sectional dependence in the data, and in order to correct the same in this study, feasible Generalized Least Squares GSL method having SUR Cross-section specification has been employed.

The rationale for using FGLS with SUR is to overcome cross-sectional dependence; in other panel methods, fixed effect and random cross-sectional dependence tend to persist. Moreover, this method is applied because it provides consistent estimates and corrects the potential presence of unobserved country-specific effects. In those cases where the dimension of time is lengthier than the number of cross-sections, the usual technique regarding cross-sectional dependence is to consider seemingly unrelated regression (SUR) equations and estimate through Generalized Least Squares [Chudik and Pesaran (2013)].

In order to check cross-sectional dependence, the Breusch-Pagan (1980) LM (Lagrange Multiplier) Test has also been applied in this study to ensure the robustness of the results.

Like Herzer (2017) and Hall and Jones (1999), in this study, TFP has been estimated from the residuals of a Cobb-Douglas production function with Labour having augmented human capital instead of traditional Labour in the Equation (2):

$$Y_t = A_t \; K_t^{1-\alpha} \; Lh_t^{\alpha} \tag{2}$$

Setting log on either side of the equation, we obtain the following Equation (3):

$$log(Y) = log(TFP) + (1-\alpha \; log(K) + \alpha \; log(Lh) \tag{3}$$

After the rearrangement of the above equation we get the Equation (4):

$$log\,(TFP) = \; log(Y) - (1-\alpha) \; log(K) - \alpha \; log(Lh) \tag{4}$$

Here, *Y* represents Output; *K* indicates Capital and *Lh* shows human-capital augmented Labour. Human-capital augmented Labour is obtained by multiplying human capital per worker '*h*' with raw labour '*L*'. Alpha and 1 - Alpha corresponds to Labour and capital share of income.

1. Data

This study mainly obtains data from Penn World Tables version 10.01 [Feenstra, et al., (2015)]. For the calculation of TFP, capital and output are measured by capital stock and real GDP, respectively, at constant 2017 dollars, as provided in this version. Labour force is measured by L, which is measured as number of persons employed, α is the labour share of income i.e. Share of labour compensation in GDP and last but not the least h is the human capital per worker which is based on years of schooling and returns to education.

Data on Energy Consumption and Imports are taken from WDI through variables total final energy consumption and, imports of goods and services (percentage to GDP). Data on FDI flows is obtained from UNCTAD. Since UNCATD shows FDI flows with regard to GDP, resultantly, we multiply real GDP by the FDI/GDP ratio in order to construct real FDI flows. Furthermore, in order to obtain real FDI flows per worker (fdi) we divided the real FDI flows through number of employed persons, and data on the labour share is taken from Penn World Tables and ILO. The period of study taken in this paper ranges from 1990 to 2019.

III. Empirical analysis

In this section show the effect of FDI, Imports, and Energy on the total factor productivity growth rate of high—and middle-income economies. The results of high-income countries are presented in Table 1.

Results show that FDI is significantly and positively related to TFP, whereas the impact of Imports and Energy is insignificant. The estimated coefficient of FDI implies that 1 per cent increase in the per worker stock of FDI results 0.573 per cent increase in TFP. The positive sign of FDI indicates that in advanced economies transfer of proprietorship to private foreign hands is linked with productivity gains. In contrast, the insignificance of imports suggest that imports are not affecting TFP probably due to the fact that advance economies tends to import more from those economies which are lesser or rather at similar stage of technological advancement. The insignificance of energy consumption shows that advanced economies are already consuming modern, automated, energy-based sophisticated technology. As a result, it is also not influencing their TFP.

Results of middle-income countries have been presented in Table 2. The result indicates that FDI and Energy are significantly and positively related to TFP, whereas the impact of Imports is significantly negative. The estimated coefficient of FDI suggests that a 1 per cent increase in per worker stock of FDI would result

TABLE 1

Result of High-Income Countries

Variables	Model 1
C	-4.134**
	(-2.231)
ENE	-0.103
	(-0.744)
FDI	0.573*
	-20.554
IMP	0.001
	-0.325
@TREND	-0.032*
	(-14.051)
Durbin Watson	2.083

Source: Authors'estimation, *,** shows 1% and 5% significance. The bracket figures are t-statistics.

in a 0.213 per cent increase in TFP. The positive sign of FDI shows that, similar to high-income economies, middle-income economies also reap productivity gains from the transfer of a proprietorship to private foreign hands. The estimated coefficient of Energy Consumption implies that an increase in the use of Energy by 1 unit would increase TFP by 0.541 per cent; this shows a positive relationship between TFP and Energy. The significance of energy consumption indicates that there is still room left to enhance energy consumption via automated modern, sophisticated technology in order to achieve productivity gains. The probable reason might be that in developing economies, production methods are largely labour-intensive and, i.e., require relatively less Energy. As the country is moving towards transformation from labour-intensive to capital-intensive, the requirement of Energy in production methods is increasing, which results in an increase in TFP.

Lastly, the sign of imports is significantly negative in developing economies and the estimated coefficient of imports infers that a 1 per cent increase in imports would result in a 0.019 per cent decrease in TFP; it also reveals that middle-income countries are not benefiting from technology diffusion from imports and it shows that local firms are not advancing from transfer of technology via imports, probably they don't have the requisite capacity to benefit or deriving productivity gains.

Furthermore, Negative effects of imports may be due to the reason that liberalization in imports leads towards greater competition, and exporting firms tend to

TABLE 2

Result of Middle Income Countries

Variables	Model 2
C	-8.479*
	(-5.531)
ENE	0.541*
	(4.313)
FDI	0.213*
	(7.314)
IMP	-0.019*
	(-15.063)
@TREND	0.016*
	(2.806)
Durbin Watson	2.065

Source: Authors'estimation, * shows 1% significance. The bracket figures are t-statistics.

have a lower cost of production in comparison to local businesses because of the higher cost of production about imports, local businesses prefers to import the commodities instead producing the same. As a result, local production declines, ultimately negatively affecting TFP. Moreover, the negative signs of imports may be due to the fact that middle-income economies probably importing consumable goods, which are not aiding knowledge spillovers or technology diffusion. In addition to the above, FDI inflows from the home country usually also bring enhancement in imports from the same home country as foreign firms tend to use imported raw materials in their production, which results in a trade deficit, which ultimately hampers growth in Factor productivity.

IV. Conclusions

This study specifies that in world economies there is a positive connection among FDI and TFP. The study further shows that in world economies, the transfer of proprietorship to foreign private hands is linked with productivity gains. Furthermore, in this study, it has been observed that TFP growth in high-income economies has not been affected by imports and Energy consumption. Nevertheless, the TFP growth in middle-income economies is positively linked with Energy Consumption and negatively linked with Imports.

The significance of FDI cannot be ruled out for achieving sustainable productivity gains, and countries may formulate policies that encourage FDI in their country. These policies may contain incentives like tax exemptions and tax credits, etc., as well as the creation of a congenial and conducive regulatory environment. Besides that, partnerships either with the Government or with local businessmen can lead to productivity gains.

Imports are indispensable for any country as economies are interdependent with each other. This study suggests that middle-income economies can improve their productivity by reducing their luxury imports and focusing on the imports of industrial inputs. This may help in technology transfer and, subsequently, in TFP. Last but not least, Energy is imperative for productivity growth, particularly in middle-income economies, as they can augment TFP growth by supplying a cheap and uninterrupted supply of Energy.

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APPENDIX

TABLE A-1

List of Economies

S. No.	High Income	Middle Income (Upper & Lower)
1	Austria	Botswana
2	Australia	Cameroon
3	Belgium	China
4	Chile	Colombia
5	Canada	Costa Rica
6	China, Hong Kong SAR	Egypt
7	Denmark	Indonesia
8	France	India
9	Finland	Iran
10	Germany	Jamaica
11	Ireland	Jordan
12	Israel	Kenya
13	Italy	Malaysia
14	Japan	Mauritius
15	Netherlands	Mexico
16	New Zealand	Morocco
17	Norway	Nigeria
18	Portugal	Pakistan
19	Republic of Korea	Paraguay
20	Saudi Arabia	Philippines
21	Singapore	Senegal
22	Spain	Sri Lanka
23	Sweden	South Africa
24	Switzerland	Thailand
25	United Kingdom	Tunisia
26	United States	Zambia
27	Uruguay	Zimbabwe

Source: Authors'estimation.

TABLE A-2

Cross-Section Dependence Test
Breusch-Pagan LM

Test Name	Model 1	Model 2
Test Statistic	4.862	0.796
d.f.	351	351
Prob.	1	1

Source: Authors'estimation.

TABLE A-3

Descriptive Statistics - High Income Economies				
	TFPG	FDI	ENE	IMP
Mean	-0.24	10.14	14.29	44.31
Median	-0.08	10.20	14.08	32.05
Maximum	63.23	13.36	17.91	221.01
Minimum	-27.58	5.33	11.32	6.94
Std. Dev.	3.76	1.28	1.36	37.50
Skewness	5.11	-0.46	0.41	2.66
Kurtosis	112.25	4.47	2.98	9.91
Jarque-Bera	392831.70	97.83	22.49	2479.30
Probability	0.00	0.00	0.00	0.00
Observations	783	783	783	783
Correlation Matrix - High Income Economies				
	TFPG	FDI	ENE	IMP
TFPG	1.000	0.008	0.010	0.015
FDI	0.008	1.000	-0.260	0.663
ENE	0.010	-0.260	1.000	-0.449
IMP	0.015	0.663	-0.449	1.000
Descriptive Statistics - Middle Income Economies				
	TFPG	FDI	ENE	IMP
Mean	0.08	8.13	13.46	36.27
Median	-0.03	8.19	13.27	32.31
Maximum	84.83	10.87	18.15	100.6
Minimum	-32.53	3.29	10.00	8.49
Std. Dev.	6.26	1.32	1.77	17.5
Skewness	4.04	-0.43	0.34	1.08
Kurtosis	56.96	2.83	2.57	4.05
Jarque-Bera	97119.21	24.62	20.65	189.03
Probability	0.00	0.00	0.00	0.00
Observations	783	783	783	783
Correlation Matrix - Middle Income Economies				
	TFPG	FDI	ENE	IMP
TFPG	1.000	0.016	0.026	0.001
FDI	0.016	1.000	-0.152	0.489
ENE	0.026	-0.152	1.000	-0.477
IMP	0.001	0.489	-0.477	1.000

Source: Authors'estimation.