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Realization of Sustainable Development Through International Growth Strategies: Analysis of the Effect of BRI on Productivity of Investment in Ethiopia.

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Abstract:
To promote sustainable development, the Ethiopian government strategically focuses on the transformation of the agriculture-based economy to a manufacturing-dominated economy. One indicator of sustainable development strategies is assuring the productivity of investment in Ethiopia. This study examines the role of international development opportunities for the realization of sustainable development by focusing on the BRI's role in the productivity of manufacturing in Ethiopia. The main objectives of this study are to scrutinize the critical issues of sustainable development strategies and how the utilization of international opportunities for economic integration through both regional and global integration opportunities is effective. The argument is mainly indicating the strategies and priorities used by the country to realize sustainable development opportunities, focus the One Belt One Road Initiative (BRI). It is highly expected by the Ethiopian government that BRI improves the production and productivity of manufacturing firms. Using the qualitative research methodology, the paper examined the role of BRI from aspects of direct linkages and indirect spillovers. Data samples are about 400 firms from manufacturing sectors. The finding indicates that BRI has a positive effect on the productivity of directly linked firms. In addition, it is evidenced that the positive productivity effect from forward linkage with BRI-linked firms. The result of the study shows that the BRI has a positive role to improve the productivity of manufacturing firms in Ethiopia. Thus, this study reveals using BRI strategies implemented by the Ethiopian government has caused productivity gain for manufacturing firms in Ethiopia.

Keywords: *Sustainable Development; International Development Opportunities, Belt and Road Initiative (BRI), Productivity of Firms*

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I. Introduction

The development of China's BRI projects in Ethiopia is a success story of long-term investment. Now, the Chinese actors are in a win-win position in East Africa including Ethiopia. The research investigation pointed out that if China is in a losing position in any part of the country's special project, that means that the Chinese authorities will not break the investment. In this context, the Chinese are seriously committed to doing something extra to counter the other economic powerhouse on the African continent. China's eyes are on building stronger capabilities in entire African countries.

Ethiopia followed an industrial land and infrastructure cost-saving approach in its industrial development process. To create a conducive business environment for investment by providing key infrastructures, Ethiopia has been developing what Ethiopia calls "development corridors or development hubs," which include industrial and integrated agro-parks. While most of the industrial parks were initially inhabited by FDI firms, the government expected most of the investment linkages with the local economy to happen along these development corridors and around the industrial parks

The BRI initiative connected the world communities with China. Regional imbalances come in the way of development and the rate of production is continuously increasing after the BRI projects in Ethiopia. Chinese President Xi proclaimed that BRI shapes the way of economic cooperation in the world. He announced that the 'Silk Road Economic Belt and 'Maritime Silk Road' will know as the new name of the BRI in 2013 and is also called One Belt, One Road Initiative (OBORI). The BRI project is one of the key strategic plans to cooperate in the economic field from central Asia to Europe and South Asia to Africa. (Rimsky, 2015).

The Ethiopian economy is highly dependent on agriculture, which accounts for 45 percent of the GDP. The livelihood of the population, either directly or indirectly, is an agricultural product which that includes

around 80 percent of the population. In addition, agricultural exports are the main source of export of the country where agricultural exports account for over 80 percent of all exports, with coffee alone accounting for over 64 percent of foreign exchange earnings. Manufacturing, mining, trade, tourism, construction, services, and other sectors make up the remaining 55 percent of the GDP.

The Ethiopian government strategically focuses on the transformation of the agriculture-based economy to a manufacturing-dominated economy. This is intended for sustainable development goals. In the country, the unemployment rate reached a very severe level which accounts for a 45 percent rate of unemployment. In addition, an account balance deficit reached a worse condition that the economy is highly dependent on imports. The inflation rate reached a very severe level due to a shortage of supply. Currently, the inflation rate reached 27 percent which forces the government to focus on manufacturing development to solve the supply shortage and import dependence. Consequently, a sustainable development strategy mainly focused on the growth of the manufacturing sector of the economy. In line with this, the production and productivity of the manufacturing sector gained very high attention.

Therefore, it is expected that BRI will improve the productivity of directly and indirectly involving firms. The direct effect is for firms that use strategies developed following BRII and/or firms that directly work with firms that are direct utilizers of BRI opportunities for input purchase and output sales. In addition, it is expected that BRI improves the efficiency of firms because of input supply and accessibility of the output market. Further, it is expected that BRI will have an indirect effect on firms that are not directly linked with BRI or direct users through supply chain integration.

Thus, the purpose of this study is to analyze the effectiveness of the Effect of BRI on the Productivity of Investment in Ethiopia. This paper is designed to provide a more systematic examination of the BRI toward investment in Ethiopia. The argument is the direct effect is for firms that use strategies developed following BRII and/or firms that directly work with firms that are direct utilizers of BRI opportunities for input purchase and output sales.

The main question of the study is "What is the direct effect of BRI on the productivity of investment in Ethiopia? and What is the indirect effect of BRI on the productivity of investment in Ethiopia? The assessment of factors can contribute to contemplating the potential effects of BRI on the productivity of investment in Ethiopia.

This study deeply inquires how Ethiopia's overall development has geared up after the BRI projects came into force. The Ethiopian economic growth has been increasing since the Chinese investment in the country. There are several infrastructure development programs accelerated to an unprecedented level. Thus, wide-ranging areas tremendously emerging in Ethiopia include industry, transport, energy, and manufacturing.

II. Literature Review of BRI on Productivity of Investment in Ethiopia

The sustainable development strategies focused on the attraction of foreign investment and development of the domestic investment. To attract both domestic and foreign investment, the country tries to use both local and international opportunities. Different economic incentives are provided for the manufacturing sector, for example, duty-free imports of domestic manufacturing inputs. Mainly, the country focuses on utilizing international opportunities for economic integration. The country works on both regional and global integration opportunities.

One indicator of sustainable development strategies is assuring the productivity of investment in Ethiopia. In addition to attracting new investment from foreign and domestic sources, the government provides high attention to improving the productivity of existing firms within the country. Among the main instruments focused on by the Ethiopian government is the utilization of international development opportunities availed by developed nations. Among the strategies used by the country to realize sustainable development opportunities, focus on One Belt One Road (OBOR) Initiative, currently, known as Belt and Road Initiative (BRI0 is among the main priorities. Currently, the government is providing high priority to OBOR. Connectivity, including infrastructure investment, can play a crucial role in promoting productivity and sustainable economic growth. Infrastructure investment is important for eradicating poverty. Infrastructure investment is also a crucial catalyst to accelerate the achievement of gender equality and empowerment of women and girls. Sustainable infrastructure is a cornerstone for achieving sustainable consumption and production patterns, and for combating climate change [1].

Ethiopia is also expected to reap significant benefits from the reduction of trade costs and border cost delays among the BRI countries. The expected welfare gain amounts to 1.9% by 2030 (relative to the baseline). A faster increase in imports (relative to the baseline) applies mostly to metal products, machinery and equipment, and transport equipment. Lower costs of imported inputs and higher demand from abroad lead to the expansion of exports in several sectors.

Ethiopia is expected to increase its exports of agricultural products, leather goods, and energy-intensive manufacturing. The business and hospitality services and metal products show a reduction in exports. The trade

changes impact output generating significant expansion of output in agriculture, processed foods, leather goods, and selected services sectors. Several other sectors exhibit a decrease in output, as resources are redirected to the most profitable sectors. This applies to paper products, energy-intensive manufacturing, and metal products. The structure of the economy seems to move towards the primary sector – agriculture, with manufacturing growing only slightly and services experiencing a decline.

OBOR initiative is a transformational development strategy and policy framework promoted by the Chines government to build sustained Chinese economic growth and development of economies of its strategic partners along the Belt and Road. RI is a development strategy suggested by China to focus on connectivity and economic cooperation amongst Eurasia, Central Asia, and East Africa to stimulate sustained economic growth by facilitating both domestic and foreign investments [2] [3].

It comprises two important elements; the Silk Road Economic Belt and Maritime Silk Road. The 'New Silk Road Economic Belt' connect central and western parts of China to Central Asia, the Middle East up to Western Europe through the Mediterranean Sea by developing road, railway, ICT, and energy infrastructures and strengthening economic interdependence and bilateral relations with strategic partners along the Road. The New Maritime Silk Road connects South China with the South Asia-pacific region, the Middle East, and African countries (East and South-Eastern and North) through the Indian Ocean and the Red Sea up to Western Europe through the Mediterranean Sea to meet the 'New silk Economic Road'.

BRI is a good international economic strategy intended at accelerating global economic growth and promoting orderly and free own allocation of resources and deep integration of markets. The issues of market integration demand and needs full association of other national actors in the global economy, therefore, through the BRI, China will encourage other nations along the belt and road to achieve economic policy coordination and carry out in-depth regional cooperation initiatives of higher standards[4]. It is expected that the initiative yields positive results as at least 50 countries had welcomed and supported the strategy. The development strategy promises to develop infrastructure along all the routes it cuts through. Therefore, it is expected that the initiative will be beneficial to the countries it is targeting. Realizing the logic of economic interdependence, China appears to have developed BRI to connect the supply side of production with the demand side. It looks to have realized that it has to be connected to the markets and sources of raw materials for it to sustain its growth. This initiative, therefore, is seemingly connected to the need to distribute wealth and stimulate global economic development.

BRI aimed at lessening barriers to trade to encourage a free flow of allocation of resources and deep integration of markets by developing necessary infrastructure supporting market and regional integration [5] [6] [7]. It strengthens economic relationships that will encourage domestic firms to access new markets, assisting diplomatic support, facilitating access to credit, and simplifying the standards of international expansion of trade. Chen [8] suggests that market and regional incorporation requires joint efforts to open up trade corridors and economic growth, thus it becomes important for global players along the maritime and economic Silk Road to effectively cooperate in the construction of the roads [9].

In Ethiopia, sustainable development strategies, in link with the BRI initiative focused on the development of infrastructure and industrial projects for improving connectivity among BRI partners. Infrastructure development directly focuses on roads, railways, sea ports, and airports. Industrial park development is also an integral part of the initiative adopted by Ethiopia. In Ethiopia, industrial parks have covered a broad range of diversified parks, including integrated, agro-business, sustainable and green industrial parks. The main objective development of industrial parks is to improve the sustainability and resilience of economic growth. BRII in Ethiopia is intended to enhance the contribution of manufacturing to the national economy, stimulate exports and foreign direct investment; alleviate foreign exchange shortages; reduce borrowing-funded government and State-Owned Enterprises (SOE) investment, and transfer the lead of growth from the public to private sector. Specifically, increasing production and improving the productivity of the manufacturing sector are among the main focus of sustainable development strategy in Ethiopia.

Industrial park development is also an integral part of China's One Belt One Road Initiative, which aims to promote connectivity between Asian, African, and European countries. the establishment of dedicated industrial zones/areas or parks is regarded as the most efficient and effective instrument to stimulate a country's innovation and growth by clustering enterprises, attracting foreign direct investment, transferring technology know-how, increasing exports, and creating employment[10].

BRII results in the development of links to the global value chain (GVC) and attracts investment through the availability and quality of transport infrastructure and services that link to the GVC. It expands opportunities for trade and foreign investment. Domestically, OBORI addresses wasteful investment, increases consumption and innovation, and lifts the productivity growth of firms[11].

As the OBORI focuses on increasing trade flows and network connectivity, improving the network and capacity of railway transport and port will dramatically reduce travel costs and time and have a significant impact on the flow of commodities globally [12]. Infrastructure advancements could promote and attract more

investment in different economic sectors. Due to better infrastructure connectivity, increased economic capacity may increase domestic productivity and foreign investment, leading to reduced costs of doing business. Indeed, the growth in SEZs with a low-cost environment for manufacturing firms has raised Ethiopia's profile for investment attracting investors from different parts of the world. For example, Europe's H&M store has set up an assembly line in Ethiopia for exports to Europe [13]. Infrastructure projects have been a source of employment as they help promote higher productivity in the regions [14].

Regarding the effect of infrastructure on firm-level output, Eifert et al., (2008) analyzed the cost of doing business in Africa using data from the World Bank Enterprise Surveys. They found that indirect costs (related to infrastructure and services) accounted for a relatively high share of firms' costs in poor African countries and posed a competitive burden on African firms. Escribano et al. (2010) carried out an empirical assessment of the impact of infrastructure quality on the total factor productivity (TFP) of African manufacturing firms.

The results showed significant heterogeneity in the effects of infrastructure on African countries. Poor-quality electricity affected mainly poor countries, and likewise losses from transport interruptions affected mainly slower-growing countries. There was also some heterogeneity among countries in the infrastructure determinants of the allocative efficiency of African firms. Tidiane et al. (2011) studied firm productive performances in five Middle East and North African (MENA) economies and eight manufacturing industries. They found that regarding labour productivity, enterprises in MENA performed poorly in contrast to the average for middle-income countries. Average low performances of MENA countries were linked to deficiencies in the investment climate that handicapped manufacturing competitiveness. Differences in the quality of various infrastructures, the experience and level of education of the labour force, the cost and access to financing, and several dimensions of business-government relations explained firm performance discrepancies. Moyo (2012) analyzed the effect of infrastructure on African firms using firm- level manufacturing data from 10 African countries. The results showed that inadequate infrastructure in the form of customs, transport, electricity, and water had a negative significant effect on export intensity and participation.

III. Materials and Methods

Our analysis uses data surveyed by Ethiopian Central Statistical Authority (ECSA) from 2015 to 2021 about manufacturing firms in Ethiopia. It includes both domestic and foreign own manufacturing firms. The analysis included data from 2015 for productivity estimation. Thus, our analysis does not use data from firms in the year 2015 for further analysis, and prediction of BRI on estimated productivity.

We grouped the study periods, from 2016 to 2021, to pre-BRI (2016-2018) and post-BRI (2019-2021) which include 3 years each. Period, pre-BRI and post-BRI, is a time variables included in our empirical estimations. Our analysis included 400 manufacturing firms where 172(43%) of firms are directly linked with BRI or firms that use BRI through their supply chain. These are manufacturing firms that involve in exporting, importing, or production by using strategies developed in Ethiopia following BRI and/or the manufacturing firms that are directly linked with BRI strategies. In addition, 228(57%) of the samples are indirectly linked with BRI and firms that are directly linked with BRI.

In each period, our analysis included 400 manufacturing firms where 330 (82.5%) of the firms are domestic and 70(17.5%) firms are foreign-owned provide descriptive statistics about samples included in the study and presented in Table 1. It is about the proportion of firms that are directly involved in BRI adopted in Ethiopia.

Table 2: BRI links with sector

	Sector	**Percentage**
Industry	10: Food products	47.4
	13: Textiles, Wearing apparel and Leather and related products	64.3
	16: Wood and products of wood/cork	48.1
	20: Chemicals and chemical products	41.2
	22: Rubber and plastics products	62.5
	25: Fabricated metal products	19.6
	27: Electrical equipment	59.4
Firms	Domestic	42.7
	Foreign	44.3
Export	No Export	41.7
	Export	45.6
Import	No Import	18.2
	Import	56.8
Size	Small and Medium	38.3

Large	52.2

Empirical Estimations

We followed two stages to analyze effect of BRI on productivity of the firms. The first stage is about estimation of production function for purpose of predicting firm-level productivity. The second stage of our empirical estimation is about examining the effect of BRI on predicted productivity. Thus, this section presents the procedures we follow for production function estimation and analysis of the effect of BRI on productivity.

Production Function

The first step in our analysis requires that we estimate productivity for each firm in our sample. Estimating a production function and using the estimated parameters to back out a firm-specific measure of productivity is the standard approach. Estimation of production function by using OLS requires inputs to be computed independently for the efficiency level of a firm. In most cases, however, this is an unrealistic assumption that it is quite likely that unobserved productivity shocks are linked to the input choices of a firm. When the firm bases its variable input decisions on productivity shocks that the firm observes but not the econometrician, the OLS estimates of the coefficients on these inputs in the production function are biased.

Firms with higher productivity, for example, may elect to hire more workers, resulting in an upward bias in the labor coefficient if productivity is not taken into account. Higher productivity enterprises may use fewer labor inputs per unit of capital, resulting in a downward bias in OLS estimations of the labor coefficient. This is in line with the premise that as businesses get more productive, they become more capital-intensive. Where there is simultaneity, the capital coefficient will likewise be biased. The bias could be in either direction in both circumstances. Semi-parametric techniques, which impart some structure to a firm's underlying decision-making process, have become a common solution to solve these challenges. The most commonly applied approaches include [15] (OP), [16] and [17] (ACF).

These approaches account for endogeneity between variable inputs and unobserved productivity by using a set of assumptions about firm behavior in regard to how productivity changes over time and the timing of input selections. The model is estimated using the one-step GMM estimator (Wooldridge, 2009), which is more efficient than the traditional two-step technique. Our analysis has followed two stages. In the first stage, we estimated the production function and productivity. This stage is mainly implemented to predict the productivity of the firms in this study. We assume a Cobb–Douglas production function for empirical estimation of a production function. In reduced form, it is written in the following form.

$$y_{it} = \beta_{1l} l_{it} + \beta_k k_{it} + \omega_{it} + e_{it} \qquad (1)$$

Where y_{it} is the log of value-added, l_{it} is the log of the labor input, k_{it} is the log of the capital input, ω_{it} is unobserved productivity, and e_{it} is an unanticipated shock or random error term.

The production function is estimated by instrumental variables estimation with the instruments of kit and iit. After computing consistent estimators for βl and βk, we predicted productivity as;

$$\widehat{\omega}_{it} = y_{it} - \hat{\beta} l_{it} - \hat{\beta}_k k_{it} \qquad (2)$$

The output variable included in our production function is the value added computed using profits from production activities and wages deflated using an annual GDP deflator. Capital is measured as the deflated value of assets at the beginning of the year while labor is the total number of workers employed at the end of the year. We measure assets at the beginning and the number of employees at the end of the year given the timing of the input choices. Investment is measured as the change in the value of fixed and long-term assets over the year plus any accumulated depreciation.

Second Stage Estimations

Our main focus is to examine the effect of BRI on the productivity of manufacturing firms in Ethiopia. Thus, the second stage of our empirical estimation analyzed the direct and indirect effects of BRI on estimated productivity. In addition, we tried to identify the indirect effects of BRI by using indirect linkages with firms that are directly using BRI strategies implemented in Ethiopia. We consider three measures for the indirect effects; horizontal, forward, and backward spillovers. We captured the spillovers based on the proportion of revenue accounted for direct users of BRI strategies or directly linked with these firms.

We computed the horizontal spillovers by the proportion of total revenue accounted for by these firms in a sector; forward spillovers by the proportion of total revenue in upstream sectors accounted for by the firms; and backward spillover as the proportion of total revenue in downstream sectors accounted for by directly linked with BRI.

The challenge while analyzing the effect of BRI on the productivity of the firms is the existence of many potential confounding factors that affect using BRI opportunities in a sector and the productivity of a firm. Therefore, in the second stage model, we include time-varying firms' specific and fixed effect control variables.

Time-varying firm-specific control variables are the age of the firm, import of intermediate inputs, and export of output; and fixed effect control variables are sector and time-fixed effects. Our model is specified as;

$$\omega_{ijrt} = \alpha + \gamma_1 H_{jt} + \gamma_2 F_{jt} + \gamma_3 B_{jt} + \delta Z_{ijt} + \varphi D_{jrt} + e_{\text{ijrt}} \quad (3)$$

Where ωijpt is the productivity of fIrmi in sector j in region r in time t; Hjt, Fjt, and Bjt are the horizontal, forward, and backward indirect spillover measures; Zjt is a matrix of time-vary firm-specificity control variables; Djt is dummies for sector and time; and eijpt is a statistical noise term.

We tried to add direct effect of BRI on the productivity of firms by including direct involvement in using BRI opportunities and direct link with BRI opportunities using firms. Our dataset contains whether a firm is directly operating at BRI opportunities or directly linked with BRI using firms in its supply chain. Thus, we have used whether the firms have a direct linkage with BRI using firms as a customer or suppliers. The baseline empirical model we used to estimate direct linkage is presented as follows.

$$\omega_{it} = \alpha + \gamma_1 BRI_{it} + \delta Z_{it} + \varphi D_{jt} + e_{\text{it}} \quad (4)$$

Where BRI_{it} is using BRI by firm i at period t.

We examine the productivity effect of indirect spillovers due to the presence of direct linkage with the interaction of indirect spillovers and direct linkages. The estimation model is presented in equation (6) below.

$$\omega_{ijrt} = \alpha + \gamma_1 H_{jt} + \gamma_2 F_{jt} + \gamma_3 B_{jt} + \gamma_1 BRI_{it} + \lambda_1 H_{jt} \times BRI_{it} + \lambda_2 B_{jt} \times BRI_{it} + \lambda_3 F_{jt} \times BRI_{it} + \delta Z_{ijt} + \varphi D_{jrt} + e_{\text{ijrt}} \quad (5)$$

IV. Results

Production Function and Productivity Estimation

Descriptive statistics of variables used in production function estimation are presented in Table 4.

Table 4: Descriptive Statistics for variables in production function

Variable	2019	2020	2021
Output	36.194	115.416	253.34
Labor	115.813	78.790	102.528
Capital	8.13	47.417	44.253
Investment	2.258	6.026	4.788

In the empirical approach, at the first step the firm-level productivity is estimated by using only the local companies. validity of the instruments is confirmed by weak identification, under identification and the first stage F-tests. Overidentification is tested by using higher order terms of the instruments. Production function is estimated by using OLS and GMM models and we present the results of estimation in Table 5.

VARIABLES	GMM	OP	GMM	OP	GMM	OP	GMM	OP
Labor	-0.0264	-0.0373	0.227	0.105	-0.0989	-0.412	0.767***	0.690***
	(0.205)	(0.0876)	(0.139)	(0.135)	(0.314)	(0.540)	(0.146)	(0.182)
Capital	0.155***	0.390***	0.288***	0.329***	0.238***	0.422***	0.0564**	0.131***
	(0.0349)	(0.0334)	(0.0542)	(0.0765)	(0.0448)	(0.0393)	(0.0235)	(0.0108)
Obs	285	342	280	336	135	162	510	612
Groups	57	57	56	56	27	27	102	102
Labor	0.866**	0.551*	1.353***	0.406**	0.982***	0.966***		
	(0.391)	(0.321)	(0.280)	(0.182)	(0.231)	(0.329)		
Capital	0.156***	0.350***	0.192***	0.292***	0.0721*	0.208***		
	(0.0525)	(0.0750)	(0.0309)	(0.0492)	(0.0407)	(0.0230)		
Obs	120	144	510	612	160	192		
groups	24	24	102	102	32	32		

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Under the estimations, the coefficient of capital is lower when the estimation is conducted by using GMM than OLS. This suggests the capital choice of the firms is positively correlated with productivity and estimating production function by using OLS will lead to an upward bias in the capital coefficient. In addition, the OLS estimation coefficient on labor is smaller when compared to the GMM estimation which suggests labor and productivity are positively correlated causing upward bias in the labor coefficient if OLS is used to estimate production function. On the other hand, GMM estimates a higher coefficient for labor suggesting that labor and productivity are negatively related. This is similar to the hypothesis that smaller units of labor are employed per unit of output at more productive firms. Overall, OLS estimates the coefficient of labor in opposite direction to estimation through GMM. This is similar to Ackerberg[17] that states, in the first stage, multicollinearity hampers the estimation of the coefficient of labor. Overall, OLS leads to an underestimation of productivity due to lower returns to scale when a production function is estimated by using OLS instead of GMM. Therefore, for the second stage, we computed productivity estimates by using GMM.

Productivity Estimation

By assuming that firms within a sector use similar technology, we computed average productivity from the production function estimated. It is evidenced that the most productive sector is Rubber and plastics products. On the other hand, Fabricated metal products are the least productive sector. The average productivity for each sector is presented in Table 6.

Table 6: Average productivity

Sector	Mean
10: Food products	10.04
13: Textiles, Wearing apparel, and Leather and related products	10.3
16: Wood and products of wood/cork	9.67
20: Chemicals and chemical products	10.48
22: Rubber and plastics products	10.62
25: Fabricated metal products	9.15
27: Electrical equipment	9.46

BRI and Productivity of Firms

We analyzed the direct and indirect involvement of BRI in the supply chain of manufacturing firms in Ethiopia. The direct effect of BRI is captured as a firm is either using the infrastructures developed following BRI or a firm has a direct link with a firm that uses infrastructures developed following BRI in Ethiopia. The indirect effect is measured by using spillovers in a supply chain with direct users of BRI. We summarized a number of firms that have a direct linkage with BRI or firms that are directly linked with BRI. We present the descriptive statistics of indirect linkage in Table 3. Table 3: Direct Linkages and Indirect Spillovers

Over	2019	2020	2021
Horizontal	.2088704	.2999711	.2927188
Forward	.2164746	.2123604	.2095553
Background	.383583	.3379985	.2653343

We suggest that the effect of BRI on the firm level must be examined by following the supply chain via linkages and spillovers. Thus, the direct effects of BRI must be disaggregated from indirect effects.

The summary result about horizontal spillovers indicates 20.9% of the revenue share is by BRI-directly linked firms within a sector. On the other hand, for vertical spillovers, 21.6% of the outputs of BRI-linked manufacturing firms are sold to manufacturing firms in a country, and 38.4% of the inputs of the purchases from manufacturing firms in Ethiopia. this indicates that BRI-linked firms have strong integration with manufacturing firms in Ethiopia.

We mainly conducted this analysis to examine the role of BRI on the productivity of manufacturing firms in Ethiopia. We begin our analysis with indirect spillovers based on equation (3) and the result is presented in Table 7.

The result of our empirical estimation shows that BRI-linked firms have more productive than firms that are not linked with the initiative. This association evidenced that BRI has a positive effect on the productivity of manufacturing firms in Ethiopia (β = 0.772, p<0.01). The coefficient is interpreted as, on average, the productivity of BRI linked is 0.77 percentage units higher than firms that are not linked with the BRI. This suggests BRI is an important instrument for sustainable development in the country by increasing the productivity of firms.

Regarding the indirect effects, the horizontal spillover has no impact on productivity (β = 0.0243). Partially we evidenced that competition from BRI-directly linked firms positively affects the productivity of

domestic firms. In addition, forward spillover has a weak positive impact on productivity *(β* = 0.172*)*. The coefficient of indirect spillover through forward spillover shows that a one percent increase in the proportion of the supply of inputs from BRI-linked firms in upstream sectors, on average, increases the productivity of firms in a sector by 0.172 units. The impact of backward spillover is negative and insignificant on productivity *(β* = *-0.0739)*. Further, the coefficient of backward spillover indicates a one percent increase in the percentage of inputs purchased by BRI-linked firms, on average, leads to 0.07 percentage units decrease in productivity.

Table 7: Direct and Indirect of Effects of BRI

VARIABLES	Direct Effect	Indirect Effect
BRI	0.772***	
	(0.0972)	
Hjt		0.0417
		(0.335)
Fjt		0.742
		(0.872)
Bjt		-0.137
		(0.202)
Sz	0.858***	0.917***
	(0.106)	(0.116)
For	0.451***	0.420***
	(0.126)	(0.139)
X	-0.0249	-0.00846
	(0.0512)	(0.0513)
M	0.233***	0.319***
	(0.0604)	(0.0598)
Observations	1,200	1,200
Number of firms	400	400

To unravel the indirect effect, we analyze the direct effect of BRI-linked firms on productivity based on firm-level indicators. We estimated this effect based on the model provided in equation (4) and the result is presented in Table 7 in column 2. BRI-linked firms earn a positive role from linkage with BRI the coefficient of BRI is positive and significant ($\beta = 0.812$, $p<0.01$). The coefficient of this indicates that firms that are directly linked have 0.812 percent higher revenue than firms that are not directly linked with BRI.

We extend impacts from indirect spillovers and direct linkage to consider the impacts through interaction between direct links along the supply chain and indirect spillovers. This is intended to examine the effects of direct linkages on traditional spillovers. We estimate this based on equation (5) and the results are presented in column 3 in Table 7.

Table 8: Technology transfer and productivity

VARIABLES	(7) fpo
0b.obor#c.hjt	0.481
	(0.341)
1.obor#c.hjt	-0.129
	(0.429)
0b.obor#c.fjt	0.115
	(0.956)
1.obor#c.fjt	1.654*
	(1.003)
0b.obor#c.bjt	-0.324
	(0.238)
1.obor#c.bjt	-0.0757
	(0.284)
0b.obor#c.sz	0.706***
	(0.162)
1.obor#c.sz	1.054***
	(0.140)
0b.obor#c.for	0.450**
	(0.179)
1.obor#c.for	0.453**
	(0.181)
0b.obor#c.X	-0.116*
	(0.0672)
1.obor#c.X	0.0724
	(0.0761)
0b.obor#c.M	0.137*

	(0.0739)
1.obor#c.M	0.469***
	(0.0963)

In column 2, we included the interaction of indirect spillover with direct linkage with BRI and BRI-linked firms are not significant for horizontal and backward linkages. But the effect of indirect forward linkage is significant for BRI-linked firms ($\beta = 1.654$, $p<0.1$). The coefficient of the interaction of forward linkage is interpreted as one percentage unit increase in the proportion of output sold to BRI-linked firms resulting in a 1.654 percent increase in the productivity of the firms.

V. Discussion and Conclusions

In Ethiopia, BRI has been adopted as a strategic instrument for sustainable development since 2018. The adoption of the strategy is intended for the improvement of production and productivity in the country. It is implemented through the development of industrial zones and linking domestic markets with BRI strategies. As a result, industrial parks are constructed based on BRI, and roads and railways are developed to link with BRI infrastructures in Djibouti and Kenya. But the level of implementation is at a low level. regarding the manufacturing industries, it is applied in only seven industries with various levels of application. Its existence is mainly indicated in the textile industry and rubber and plastic industry which includes 64.3% and 62.5% of the firms within the industry are linked with BRI respectively. In addition, BRI is mainly linked with foreign-owned firms where 44.3% of the foreign-owned firms used the opportunities linked with BRI. Furthermore, sustainable development strategies in Ethiopia developed with regard to BRI favor manufacturing firms with higher export, import, and large sizes.

Ethiopia mainly focuses on building the capacity of domestic firms for sustainable development in the country. BRI is mainly considered for this purpose to link investments in the country with international markers. BRI is the core focus for capacity building through improved productivity and solving supply shortages in the country because of the low cost of production, and import intermediate inputs and export outputs. The result of our analysis shows that BRI has a positive contribution to sustainable development in Ethiopia by improving the productivity of manufacturing firms. This effect is based on directly linked firms. But BRI has no productivity contribution for firms that are not directly linked. We find no evidence that there is horizontal spillover or externalities to manufacturing firms due to BRI-focused strategy development in Ethiopia.

From the perspective of the forward indirect effect, we identified there is a positive effect from the interaction of direct and indirect effects. BRI-linked firms earn productivity improvement in their output market.

Although these findings are consistent with other studies, it is not easy to suggest practical implications for the work. Literature suggested that the positive forward spillover effect from downstream firms on the productivity of upstream firms will be due to direct knowledge and/or technology transfers along the supply chain, or indirect spillovers through efficiency improvements by increased competition among input suppliers competing for foreign customers or scale economies due to a greater demand for domestically produced inputs.

Some shreds of evidence are provided about productivity spillovers for indirectly linked firms from backward linkages with downward stream firms. But little shreds of evidence are provided about this linkage. Our result suggests evidence that linkage with upstream firms is the source of productivity of manufacturing companies in Ethiopia. This is a condition only for firms that are directly linked with BRI-linked firms in the supply chain. The positive productivity impact from forward spillover is increased due to direct linkage.

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