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KNOWLEDGE SPILLOVER AND DOMESTIC PRODUCTIVITY ACROSS COUNTRIES: THE ROLE OF ECONOMIC OPPORTUNITIES

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ABSTRACT

This study analyses the effect of international knowledge spillover on total factor productivity (TFP) in 24 sample countries from 1996 to 2020, focusing on the role of economic opportunities in sustaining this relationship. The purpose of the research is to shed light on the relationship between knowledge transfer and TFP, particularly as it relates to the role of economic opportunities. Knowledge spillover, total factor productivity, and economic opportunities are investigated by using Cross Sectionally Augmented Autoregressive Distributive Lag (CSARDL) econometric approaches to analyses panel data from a wide range of countries. The study's results show that international transfer of knowledge increases total factor productivity. Knowledge transfer via routes like trade and FDI is crucial to raising total factor productivity. However, it is evident that the import-related spillover is more effective than inward FDI in affecting total factor productivity in sample countries. Moreover, Knowledge spillovers via imports and incoming FDI are also found to have a substantial complementary link. The study also indicates that the extent of the knowledge spillover effect on TFP is heavily influenced by economic opportunities. Knowledge spillover is most beneficial to economically advanced nations with thriving business climates, and well-connected infrastructure. These nations provide a setting that encourages the integration of new ideas and practices, which boosts their productivity. However, it is difficult for less developed nations to reap the benefits of knowledge spillover due to their lack of economic opportunities. Poor institutions, a lack of basic infrastructure, and constrictive business environments all limit their ability to effectively use new knowledge to improve productivity. The study emphasizes the policy importance of these results. By prioritizing economic opportunities, countries can increase their capacity to absorb and leverage foreign knowledge, which in turn promotes total factor productivity growth and long-term economic development.

Keywords: Import Related Spillover; Inward FDI; Total Factor Productivity; Economic Opportunities

INTRODUCTION

Research Background

The prominence of R&D in nation's productivity growth is extensively discussed in literature. Maddison, (2005), Malecki, (2009), Berndt et al., (1992), Liu et al., (2013) concluded that despite the country's own domestic R&D efforts, the R&D activities performed in rest of the world are also contributing to country's domestic productivity growth. R&D activities in a foreign country are diffused to the domestic country through the channel of knowledge spillover. Thus, Knowledge spillover is considered to be a vital source in affecting domestic productivity. Considerably bulk of literature have analyze the nexus of knowledge spillover and domestic productivity, see for example, Romer (1986), Agarwal et al., (2004), Coe and Helpman (1995), Bernstein and Mohnen (1998), Zhang (2017). Besides this, literature on the

effectiveness of technological advancement in output expansion of an economy is also well documented. Abelson (1998), Romer (1986), Romer (1990), Lucas (1988). Additionally, entrepreneurship is also an essential for achieving economic progress, Such that dynamic entrepreneurship can help in elevating the economy (Desai et al., 2009). Innovations in the presence of effective entrepreneurs convert inputs into profitable outputs (Andersson and Tollison 1982). However, adequate level absorptive capabilities are required for technological dissemination to have meaningful influence on total factor productivity.

Over the last three decades, the highly performing Asian economies (HPAEs) especially, Hong Kong, Singapore, South Korea, and Malaysia showed an astonishing economic performance. The TFP in these economies showed a continuous increase over the years. The key determinant of success in economic performance of these HPAEs is their great achievement in innovation and new technology. The success of each of these (HPAEs) is different from each other's. For example, China has been experiencing an exponential increase in R&D while Korea and Singapore have made a progress in such technology at which they are better off. Contrariwise, the South East Asian economies remains bellow far in terms of utilizing the existing technical know-how and in creating new R&D. The technological advancement by these HPAEs made it possible for them to catch up the growth rate of industrial economies. The common characteristic of all these HPAEs who made a remarkable progress in technology is their exponential increase in international trade. Though the literature on the nexus of technological transmission and productivity growth is evident, but the absorptive capacity of the firm at the recipient's end is crucial in the technological transmission led productivity growth nexus. Even though, Japan and USA remain major source of knowledge spillover for China, Malaysia, Korea, Taiwan and Singapore. Korea and Taiwan benefited more from knowledge spillover from Japan and USA, due to the fact that they have strong absorptive R&D capabilities as compared to China and Malaysia.

Knowledge produced by developed economies can be transferred to developing countries through various channels. Such as, imports, multinational firms, the immigration of highly skilled workers, foreign direct investment (FDI) and international patent collaborations are considered important sources of international knowledge spillovers. Global trade has been shown to reduce the geographic localization of international knowledge diffusion (Singh 2007). Local firms improve productivity through knowledge spillovers from the channel of FDI (Javorcik 2004). Moreover, technologically intensive multinational firms import inputs from their home countries. Therefore, FDI, in addition to being a source of knowledge itself, is also expected to facilitate knowledge flows by importing technologically intensive goods. The case study of HPAEs growth witnessed, that these economies got remarkable advantages from R&D of developed economies. Malaysia who acquired advance production technology from the multinational companies operated in Malaysia. Moreover, the local firms also able to understand the paradigm of international market, which helped them tremendously in attaining sustainable productivity growth. FDI is not only a source of investment to developing countries but it is also a vital channel of knowledge spillover to developing countries. Similar to FDI, imports of highly technological and medium highly technological inputs also play a significant role in transferring knowledge and technology to developing countries. Japan and Korea for example, emphasized on the imports of highly technological products rather than FDI from industrial economies of the world. They imitate that technology from imports which helps them immensely to acquire sustainable and high growth. Take an example of Japan's Sony company, who got the technological license from USA, and then outdone the America's RCA in global market.

Existing literature reveals that FDI and imports are not the only channels of knowledge spillover. Besides these, human mobility (student's inflow/outflow), publications, conferences and licensing are also a major source of knowledge spillover around the globe. For example, many developed countries subsidized higher education for the students of less developed countries. Students from less developed countries get knowledge in education institutions of the developed countries, which help them to abreast of modern thinking and knowledge. However, there are complications that

involve in the data collection of these knowledge spillover channels.

Knowledge Spillover, Economic Opportunities, Entrepreneurship and Total Factor Productivity

Doing business is predicated on the idea that all economic activity is enhanced by the existence of well-defined and uniform regulations that protect property rights, streamline the resolution of disputes, and shield contractual parties from unfair treatment. When these regulations are effective, transparent, and easily accessible, they can do a better job of encouraging development and progress. How societies divide up the gains of development initiatives and cover their associated expenses is also heavily influenced by the laws' robustness and breadth. Rules that encourage new entrants with drive and inventive ideas to establish businesses and productive firms to invest, develop, and generate new employment are good for the economy as a whole (Klapper et al., 2006). One of the main focuses of the Doing Business statistics is the impact of government policy on the day-to-day operations of small and medium-sized domestic enterprises. The goal is to promote regulation that is effective, clear, and simple to apply so that businesses can flourish and contribute to societal and economic development. Domestic and foreign manufacturers alike benefit from a business climate that is friendly to their operations. Considering that foreign companies would not only create new jobs but also introduce cutting-edge technologies to a country, it's easy to see why indigenous enterprises would be preferable (Fritsch & Noseleit, 2009)

One of the most studied aspects of business regulation is the rules surrounding new company formation. According to research by Olival (2012) there is a correlation between strict entry requirements and a rise in the number of unofficial firms and jobs. Reforms that made it easier to register a business raised the number of registered businesses by 5% and the number of paid jobs by 2.2%. As a further consequence of these changes, 14.9% of previously unreported business owners joined the formal economy. According to research by Singh, G. (2015), the number of new businesses established grew by 17%, and seven new jobs were created for every 100,000 people in the population every month as a result of reforms that shortened the time and reduced the cost of formalising a company. These new businesses were more likely to be owned by women, to be smaller in size, and to be led by less experienced and less educated entrepreneurs than their counterparts, indicating that the change produced a more welcoming atmosphere for would-be business owners. Investigation of Ani's (2015) Productivity relies on rules that don't stifle business but do what's best for them. As shown by a study conducted in India, inefficient licencing and size limits reduce total factor productivity (TFP) by allowing inefficient enterprises to stay in business and preventing efficient firms from growing to their optimal size. As a result of our research, we know that relaxing these regulations would increase TFP by 40–60%. Recent research by Block (2016) shows that when firm-level distortions brought on by uneven rules and a poor business climate are eliminated, significant productivity improvements are realised. 19 Further studies demonstrate that a 30% increase in TFP can be achieved through a rise in bank loans to large enterprises if bankruptcy law efficiency in certain OECD high-income economies is raised to that of the United States. Although the Doing Business index focuses on how regulations influence domestic enterprises, some studies find that more favorable regulations have a positive effect on foreign direct investment. Foreign direct investment's effect on home investment can be moderated by the host country's business-friendly entry regulations. Foreign direct investment (FDI) has been shown to discourage domestic investment in economies where setting up a company is difficult and expensive. In general, international market integration is better in economies where new businesses may be formed more easily (Pinheiro-Alves & Zambujal-Oliveira, 2012). More than 0.5% of per capita income is added when trade volumes grow by 1%, but this correlation disappears when entrance requirements are more stringent. According to the results of (Ranis et al., 2000), countries with a lot of rules and regulations make it less likely that consumers will benefit from import competition.

To sum up, Knowledge spillover has been regarded as a key source of domestic productivity. But the question arises as that why some countries and not all are benefited more from knowledge spillover? The observed cross country disparities observed over the past few decades could be largely attributable to

complementarity policies of the host countries. In other words, it is not knowledge spillover that enhanced domestic productivity, but is complementarity with other factors that stimulate growth. Hence, this study expect that countries with more economic opportunities will benefitted more from knowledge spillover as compared to those countries who lack these opportunities. This is the central query which we discovered in this study.

Hypotheses of the Study

In regard to the findings, the initial step of this investigation is to identify the main knowledge spillover channels. This study testified to the following hypothesis:

Hypothesis 1

Imports and FDI are the two main spillover channels in explaining total factor productivity.

In order to find out which channel of knowledge spillover is more effective in sample countries, this study hypothesized:

Hypothesis 2

Import channel is more effective than FDI channel in terms of affecting total factor productivity

Hypothesis 3

Knowledge spillovers through imports and inward FDI jointly affect total factor productivity.

Hypothesis 4

Ccountries with greater economic opportunities get more benefits from knowledge spillover.

Further, this study hypothesizes:

Hypothesis 6

The knowledge spillover productivity nexus is based upon the initial conditions of the host nation.

Hypothesis 7

There is a threshold for complementary policies over which increased knowledge spillover has a positive effect on productivity.

REVIEW OF LITERATURE

Knowledge and Innovation Spillover Effects

Knowledge and modern technologies are inevitable for sustainable growth in rapidly changing global economy (Abramovitz, 1986; Corredoira and Rosenkopf 2010). Empirical literature on knowledge creation, accumulation and transfer has assist in locating and explaining differences in productivity and efficiency between different types of organisations, activities, enterprises, and even countries in terms of their knowledge potency and their ability to absorb and use new information (Crespo and Fontoura, 2007). According to Trachuk (2012), the acquisition of learning and the constant creation of new knowledge based on established competences, abilities, and expertise are examples of knowledge as a capital, a particular capital susceptible to creating massive outward spillover effects, or externalities. In addition, knowledge entails “learning effects” necessary for improvement of society as a whole (Nicoletti and Scarpetta, 2003). This availability and transfer of knowledge across economic entities (both individual and/or entire organization) can be labeled as knowledge spillover. Trachuk (2012) further argued that knowledge absorption and borrowing is a crucial source of developing an underdeveloped technological and intellectual base of firms. However, the internal effects of knowledge spillover and borrowing from external sources may vary in nature and direction depending upon the absorption capabilities of firms as well as countries.

The importance of knowledge spillovers for boosting total factor productivity growth of host country has become a highly debated topic among the economists over the last few decades. A number of studies (Pietrucha, & Żelazny, 2020; Fischer et al., 2009; Lin Zhang, 2017; Hanel, 2000) have investigated the importance and knowledge spillover led TFP. A study by Yunus (2014), shows positive knowledge spillover led TFP growth in 5 countries including US, UK, Japan, France and Germany, where knowledge spillover played significant role in increasing total factor productivity growth in higher R&D and skill intensive industries in these countries. Scientific evidence supports the view that knowledge absorption and technological transfer especially from the advanced industrialized nations complement the domestic knowledge and technological capabilities in host countries. In this regard, a study of Wang and Wang (2015) found out significant positive effect of R&D spillover on TFP growth of host country, where the trade between these countries was an important channel of knowledge spillover. Similarly, a study by Sami & El Bedawy (2019), analyzed the impacts of knowledge spillover through the channel of imports on total factor productivity (TFP) of Indonesian economy. The results of the study revealed positive impacts of knowledge spillover from industrialized

economies on labor productivity, learning, high technology inputs as well as overall productive capacities of Indonesian economy. Moreover, another study by Autant-Bernard et al., (2013) assessed that international knowledge diffusion and R&D spillover through high technological imports channels positively affects TFP of less developed countries. Foreign direct investment (FDI), however, has no effect on overall factor productivity growth of less developed countries; however, it has significant effect in case of developed economies.

Empirical studies on knowledge spillovers across countries and its transmission channels have gained significant impetus particularly after the emergence of endogenous growth theory (Wang and Blomstrom 1992; Glass and Saggi 1998). Earlier research on the global impact of R&D has have attributed the remarkable and sustained economic growth in industrialized nations of the world to high degree of presence of spillovers. In this regard, an influential study by Coe et al., (1997), have also indicated the investment in research and development's potential to spark positive knock-on consequences for developing nations. However, most of these studies assumed trade between partner countries as a key transmission route for innovations in research and development over the world (Keller, 1998), while ignoring the role of complementarities and absorptive capabilities of developing countries (Evinson and Singh, 1997).

Interrelationships between Knowledge Spillover, Economic Opportunities and Productivity

Literature is divided on whether or not a positive business climate is a necessary condition for fostering new venture creation, technological advancement, and overall economic expansion (Desai et al., 2003; Klapper and Love, 2009). Since the World Bank's report on doing business was released, there has been widespread interest in this topic from politicians and academics. EO are crucial for creating new business ventures and employment opportunities as well as encouraging entrepreneurship (Andersson and Noseleit, 2011; Fritsch and Noseleit, 2009; Li et al., 2011; Klapper et al., 2006; Block 2016) that contribute to innovation, increased productivity and growth (Hallen and Eisenhardt, 2012;). Similarly, there is a positive relationship between ease of doing business and private sector development as well as employment opportunities (Klapper et al., 2006). Current literature on knowledge spillover shows that FDI and Imports are the major channels of international technology transfer. However, the positive benefits from FDI and high-tech imports are enjoyed by countries, where private sector and business ventures are strong. Therefore, efficient management of existing knowledge spillovers and technology transfer require strong economic opportunities in the form of lowering the cost of doing business.

Economic diversification is one of the crucial determinants of total factor productivity by increasing the economic opportunities across the domestic economy. According to Goya (2014) lack of diversified export structure is the primary impediment in most of the lower and middle income countries to increase economic opportunities and income generation. Several theoretical propositions have been forwarded by economists in support of economic diversification and it is generally accepted among them that it is dependent on various dynamics of preference structure both inside and outside the country's borders, innovation and knowledge spillovers and risk spending strategy. Economic diversification leads to an increase in income and change in the preferences and choices of economic agents (Krugman, 1981).Research on economic diversification and knowledge spillover shows that economies which depend on domestic productivity tend to diversify its domestic product portfolio in order to fulfill demand for variety of products. On the other hand, in an open economy, a country also faces demand from consumers around the world in a much more competitive environment; this not only motivates countries to diversify but also to compete with internationally desirable products at competitive prices. To allow domestic firms to successfully compete with rivals on the international market, policy makers are urged to facilitate the diversification process, as both an import-substitution and export-promotion strategy.

Summary of Literature Review

Over the last few decades, the nexus of knowledge spillover and productivity growth has attracted much attention from academia and researchers. Some of the influential studies that R&D plays crucial role to increase the output growth in less developing

countries. It has been evident from the literature review that knowledge creation, accumulation and transfer has increased the possibility to identify and explain the performance and productivity gaps across organizations, activities, firms and even countries that have knowledge potentials and knowledge absorption capabilities. R&D transfer from developed countries to developing countries is one of the major determinants of developing an underdeveloped technological and intellectual base of firms. However, the internal effects of knowledge spillover and borrowing from external sources may vary in nature and direction depending upon the absorption capabilities of firms as well as countries. The ability of a country to create new ideas and adapt old ones greatly depends on the education level of labor force and their accumulated stock of human capital. The recent phase of globalization and transformation in the global economy has created enormous avenues for developing countries to integrate with economically advanced nations of the world. The most important enabling factors of this increasing integration of the world's economies are foreign direct investment and finance, knowledge and trade. In this regard, studies on the channels of knowledge transfer have also gained great momentum. So far, international trade/imports in particular and FDI have been identified as the main channels through which international R&D spillovers occur. External sources of knowledge can serve as an attractive alternatives for firm facing the challenge of innovation, which requires both financial and intellectual capital. Similarly, trade is vital in raising domestic productivity through an exchange of intermediate inputs, manufactured goods and capital equipment. Similarly, it enables trading partners to enhance cross-border communication as well as learning and exchange of foreign technologies, materials, production processes. Knowledge embodied in imported products, for instance, can be appropriated by domestic firms through imitation and reverse engineering, creating domestic productivity gains and growth in the long run. The extent and magnitude of foreign technology transfer depend on the trade openness and economic stability of a country. Similarly, the country with which trade is conducted is also crucial for knowledge spillover, because for a country to be able to enjoy the benefits from trade and transfer of advanced technology the trading partner should be able to provide it with such technology and knowledge.

In spite of the obvious role of knowledge spillovers and knowledge stock in promoting long-term economic growth, literature suggests that mere accumulation of external knowledge stock and innovative technologies cannot ensure economic stability and development. It clearly indicates the importance of socio-economic factors and absorptive capacities in host countries for taking full advantage of R&D spillovers. In this regard, the remarkable success story of many Asian economies Japan, South Korea, Taiwan and Singapore in the aftermath of World War II, and relatively poor performance of the rest of developing countries, in spite of massive FDI influx and knowledge transfer to these countries has revealed the role of complementarities in guaranteeing sustainable growth patterns. Therefore, current studies have focused on the role of complementarities as intermediary variables responsible for difference in growth performance among a number of countries. With the accumulation of knowledge stock and technology, it is equally crucial for a country to be able to absorb and diffuse this external knowledge throughout the economy.

ECONOMETRIC METHODOLOGY

Model and Theoretical Approach

This study examines the impact of knowledge spillover on total factor productivity. The baseline model is given as:

$$TFP_{i,t} = \alpha_{0+}\, \alpha_1 Yo + \alpha_2 R\&D_{i,t} + \alpha_3 KS_{i,t} + \alpha_4 X_{i,t} + \mu_{i,t} \quad (3.1)$$

In this case, i and t stand for "country i" and "time t," respectively. Total Factor Productivity (TFP), R&D Expenditures (R&D), Knowledge Spillovers (KS), and Determinants of TFP (X) Knowledge spillover is separated into import spillover and FDI spillover for the sake of this study's baseline model construction because these two channels of knowledge spillover are compared and contrasted in terms of their contributions to TFP.

The model is given as:

$$TFP_{i,t} = \alpha_{0+}\, \alpha_1 Yo + \alpha_2 R\&D_{i,t} + \alpha_3 ImportSpill_{i,t} + \alpha_4 FDISpill_{i,t} + \alpha_5 X_{i,t} + \mu_{i,t} \quad (3.2)$$

Where,

$$TFP_{i,t} = \frac{Y_{i,t}}{Y_{i,t-1}} Q_{t,t-1} \quad (3.2.1)$$

Where $Q_{t,t-1} = \frac{1}{2}(\beta_{t,t-1} - \beta_{t-1})\ \frac{K_t}{K_{t-1}}) + [1 - \frac{1}{2}(\beta_{t,t-1} - \beta_{t-1})]\ ln \frac{L_t}{L_{t-1}}$

The following equation describes how to determine Import Spillover:

$$ImpSpill_i = \sum_{j=1}^{n-1} \frac{Imports_{i,j}}{Y_i} Log\ R\&D_j \quad (3.2.2)$$

Where the subscript j represents host country.

The following formula is used to determine the FDI Spillover effect.

$$FDISpill_i = \sum_{j=1}^{n-1} \frac{FDI_{i,j}}{Y_i} Log\ R\&D_j \quad (3.2.3)$$

To estimate the joint effect of FDI and IMPKS, model 2 is extended as:

$$TFP_{i,t} = \alpha_{0+} + \alpha_1 Yo_{i,t} + \alpha_2 R\&D_{i,t} + \alpha_3 ImportSpill_{i,t} + \alpha_4 FDISpill_{i,t} + \alpha_5 X_{i,t} + \alpha_6 (ImportSpill * FDISpill)_{i,t} + \mu_{i,t} \quad (3.3)$$

Model 3.3 is then extended as follows in order to determine whether the SUP of the host country influences the relationship between IMPKS and TFP

$$TFP_{i,t} = \alpha_{0+}\ \alpha_1 Yo_{i,t} + \alpha_2 R\&D_{i,t} + \alpha_3 ImportSpill_{i,t} + \alpha_4 + \alpha_5 (ImportSpill * SUP)_{i,t} + \mu_{i,t} \quad (3.4)$$

The descriptive statistics are given in table 1.

Table 1

	SUP	TSB
Mean	10.71	49.42
Median	10.00	31.00
Maximum	23.00	230.00
Minimum	2.00	1.500
Std. Dev.	4.43	51.37
Skewness	0.51	1.68
Kurtosis	3.29	4.70
Jarque-Bera	28.86	358.40
Probability	0.00	0.00
	SUP	**TSB**
SUP	1	**0.73**
TSB	**0.73**	1

There has been a lot of discussion in economics about how knowledge spillover affects total factor productivity (TFP). Knowledge spillover is the unintentional sharing of information between individuals, companies, or nations that leads to an increase in efficiency and creativity. Understanding the connection between knowledge spillover and TFP is grounded in neoclassical growth theory, which was inspired by Robert Solow's work. Technology and knowledge are viewed as essential factors in neoclassical growth theory. TFP is a useful indicator of economic efficiency and technological development in this context. Several pathways exist for the dissemination of new knowledge. To begin, there is the geographical proximity effect, which says that information is more likely to spread between nearby institutions. Agglomeration economies, in which businesses and academic institutions congregate to reap the benefits of information spillover, lend credence to this idea. Trade and FDI are other pathways through which knowledge can spread. Technology can be shared across borders through international trade. Foreign direct investment (FDI) promotes the spread of information by making possible the transfer of cutting-edge industrial methods, managerial expertise, and technological know-how. Important consequences for total factor productivity (TFP) might result from the interplay of trade, FDI, and knowledge spillover. The effect of knowledge spillover on total factor productivity is also highly dependent on a company's or country's absorptive ability. The ability to identify, absorb, and effectively apply new information is known as absorptive capacity. Factors that affect absorptive capacity include a high stock of skilled workers, a commitment to R&D, and the presence of institutions that foster creativity and teamwork. An important part of this study is determining how economic possibilities influence the effect of knowledge spillover on TFP. The potential for knowledge spillover to boost productivity is conditional on economic factors including market openness, access to financing, and encouraging policies. Knowledge-intensive industries, new forms of enterprise, and an atmosphere conducive to innovation are more likely to settle in economically prosperous nations or areas. The effect of knowledge spillover on total factor productivity (TFP) among countries has been the subject of empirical research.

Knowledge spillover effects are measured in this research using a variety of approaches, such as panel data analysis, cross-country regressions, and quantitative models. The findings stress the significance of knowledge spillover in describing variations in national TFP. It is crucial for policymakers and economists to comprehend the impact of knowledge spillover and economic possibilities on TFP. Understanding the processes by which information travels and is used can help governments develop policies and programmes that boost domestic and international productivity and innovation. This type of study aids in our overall comprehension of economic expansion and sheds light on the forces that motivate innovation and productivity in today's knowledge-based economy.

So far, most of the important articles that have looked into the link between TFP and knowledge spillovers have pointed to trade as the main way that knowledge is shared and used. Contrarily, Ali et al. (2020) investigates the stability of CH outcomes, and he disputes the notion that trade is a driving factor in international R&D spillovers. The Monte-Carlo experiment investigates the effects of foreign R&D spillovers on pairs of randomly selected trading partners, allowing for a direct comparison between the simulated and actual outcomes. The results raise questions about the importance of international trade patterns in knowledge spillovers, as they show that the findings of Coe and Halpen remain unchanged irrespective of whether the business partners are randomly chosen. That's why it's recommended that, going forward; models should accommodate international technology dissemination that has nothing to do with trade. Knowledge transfer as a result of foreign direct investment and its effect on national productivity is thus studied in a second body of literature that also incorporates foreign direct investment is an extra route for the global dissemination of knowledge. Piekkola, (2007) replicate the findings of the CH study by observing that R&D activity at home and abroad has a sizeable impact on national output. Furthermore, it is found that the link between FDI and foreign R&D is stronger than the link between R&D that results from trade, meanwhile the inclusion of FDI considerably lowers the effectiveness of trade pertaining overseas R&D. When the R&D factors are coupled with trade openness, they lose their relevance, the scholar discovers. In the author' view, this means that FDI and trade do lead to technological spillovers, albeit to varying degrees, regardless of how open an economy is. Knowledge spillovers can occur in both directions, According to studies by Sylwester, (2001), who analyzed patent citations from Japanese corporations in the US patent office to determine the scope of technology diffusion via FDI; Japanese companies have a significant impact on the technological landscape in the United States. The findings suggest that FDI is beneficial for both the native country and the investing enterprise as an outcome of the native knowledge base, which is supported by the fact that the results are robust due to technical alliances between the United States and Japan. Some studies go deeper by investigating spillovers via backward and forward connections at the firm level.

DATA

The sample consists of 24 different countries from all around the world and spans the years 1996-2020. These 24 nations are further classified into three groups, those with the highest, median, and lowest per capita incomes. The data regarding start up procedures and other variables such as, macroeconomic stability and investment are gathered from WDI.

ANALYTICAL TECHNIQUE

Tests of Cross-Sectional Dependencies

Knowledge spillover, which is more likely to be cross-sectional dependent, is used as the main variable in this study. Increased knowledge spillover leads to cross-sectional dependency on several factors, since multiple channels are opened up. This study uses the CSD tests developed by Pesaran (2015) to accomplish this goal.

Test for Homogeneity Slope

For the purpose of assessing whether or not the models under study had slope heterogeneity, this study employed the slope heterogeneity test popularised by Pesaran and Yamagata (2007). The expression is as follows:

$$\tilde{\Delta}_{SH} = (N)^{\frac{1}{2}}(2k)^{-\frac{1}{2}}\left(\frac{1}{N}\tilde{S} - k\right) \quad (3.7)$$

$$\tilde{\Delta}_{ASH} = (N)^{\frac{1}{2}}\left(\frac{2k(T-k-1)}{T+1}\right)^{-\frac{1}{2}}\left(\frac{1}{N}\tilde{S}-2k\right) \quad (3.8)$$

Panel Unit Root Test

To identify the unit roots of the variables, this study employs a method devised by Pesaran (2007) termed the Cross-Sectionally Augmented Im, Pesaran and Shin (CIPS) unit root test.

Cointegration Westerlund Test (2007)

Westerlund's (2007) methodology can be used in this article to investigate the effect of knowledge spillovers on TFP in different nations and the function of economic opportunities. Westerlund employs cointegration analysis and panel data approaches, which are frequently used to examine the interrelationship between variables across time and between countries, as central tenets of his methodology. The first step in Westerlund's method is to determine whether or not the variables are stationary by checking for unit roots. These matters because inference and regressions based on non-stationary variables are prone to errors. In order to determine whether or not the variables are stationary, Westerlund suggests employing unit root tests for panel time series, such as the Im, Pesaran, and Shin (IPS) test or a Fisher-type test. Westerlund proposes using panel cointegration techniques to investigate the long-run link between knowledge spillover, TFP, and economic possibilities once the stationarity features of the variables have been established. When working with panel data, panel cointegration analysis shines because it takes into account both the time series and cross-sectional dimensions of the data. Further, this research uses sophisticated econometric methods like CSARDL to probe the connection between international knowledge sharing, total factor productivity, and economic growth. Knowledge spillover has a significant effect on productivity and economic growth, and this method helps us understand the nature of that effect and the factors that contribute to it by identifying long-run equilibrium relationships, short-run dynamics, and causal ties between these variables. The test statistic for cointegration is given as:

$$G_t = \frac{1}{N}\sum_{i-1}^{N}\frac{\acute{\alpha}_i}{SE(\acute{\alpha}_i)} \quad (3.9.1)$$

$$G_\alpha = \frac{1}{N}\sum_{i-1}^{N}\frac{T\acute{\alpha}_i}{\acute{\alpha}_i(1)} \quad (3.9.2)$$

$$P_T = \frac{\acute{\alpha}}{SE(\acute{\alpha})} \quad (3.9.3)$$

$$P_\alpha = T\acute{\alpha} \quad (3.9.4)$$

Cross-sectionally Augment Distributive Lag (CS-ARDL)

This study utilized CSARDL method advanced by Chudik and Pesaran (2013a), to investigate the long run relationship between the variables of interest. The panel data analysis problems of cross-sectional heterogeneity and endogeneity are addressed by using the CSARDL econometric technique, which is the primary emphasis of this research. Knowledge spillover, total factor productivity, and economic opportunities can all be better understood due to the CSARDL method, which allows for the detection of both short- and long-run linkages. This method improves upon the conventional ARDL framework by including lagged dependent variables, allowing for more precise estimation. There are a number of benefits to using the econometric method known as cross-sectionally augmented autoregressive distributed lag (CSARDL) to examine relationships between variables, especially in the setting of panel data analysis. Endogeneity problems can occur when there are correlated individual-specific effects, and the CSARDL solves this problem. Improved estimating efficiency and more precise inference are made possible by CSARDL's use of lagged dependent variables as extra explanatory variables. In addition, panel datasets with variation across cross-sectional units can benefit from CSARDL's effective controls. This guarantees a more precise depiction of the real connection between variables. Furthermore, CSARDL offers a structure for modelling both transient and persistent associations. To fully grasp how variables change and interact over time, it records both immediate and delayed impacts. Because it considers both lagged dependent variable terms and lagged explanatory variables, CSARDL is useful for determining the optimal lag length in the model. This reduces the possibility of incorrect model definition and leads to more accurate estimations. Additionally, CSARDL provides more effective parameter estimation by including lagged

dependent variables as well as extra constraints. Coefficient estimations and corresponding statistical tests benefit from this efficacy as they become more accurate and trustworthy. When dealing with limited data, CSARDL shines because of its enhanced capacity for statistical inference and estimation. Lagged variables improve the data's information content and mitigate the possibility of misleading connections. In addition, cointegration analysis is built into CSARDL, so it can deal with non-stationary data. This allows us to look at how different factors have changed over time, which could be a key factor in deciphering more intricate economic occurrences. Moreover, CSARDL offers insights into the dynamic effects of policy interventions by including both short- and long-run dynamics, which is useful for policymakers. Because of this, a more informed and precise policy may be developed that takes into account all relevant factors. In conclusion, there are a number of benefits associated with using CSARDL, such as increased estimating efficiency, reduced sensitivity to small sample sizes, enhanced control over endogeneity and cross-sectional heterogeneity, and the ability to conduct dynamic analyses. These benefits ensure that the CSARDL method is an effective instrument for econometric analysis, particularly in the context of investigating intricate connections by means of panel data.

RESULTS AND DISCUSSION

Results of Slope Heterogeneity Test

The result of Pasaran and Yamaguta (2007) slope heterogeneity test (reported in table 2) indicate that model is suffering from slope heterogeneity.

Table 2

Models	Statistics	Values	P-value
Basic Model TFP= f (IMPKS FDI IMPKS*FDI R&D MES INV)	$\tilde{\Delta}$	14.963***	0.000
	$\tilde{\Delta}$adjusted	17.675***	0.000
Model 1a TFP= f (IMPKS R&D MES INV SUP)	$\tilde{\Delta}$	14.993***	0.000
	$\tilde{\Delta}$adjusted	17.670***	0.000
Model 1b TFP= f (IMPKS R&D MES INV SUP **IMP*SUP)**	$\tilde{\Delta}$	12.908***	0.000
	$\tilde{\Delta}$adjusted	15.653***	0.000

Results of Cross-Sectional Dependency Test

The results of CSD test (reported in table 3) show that model is suffering from cross sectional dependency.

Table 3

Variable	CD-test	Correlation
TFP	2.08*** (0.000)	0.487
IMPKS	7.27*** (0.000)	0.772
FDI	66.640*** (0.000)	0.816
Y	69.270*** (0.000)	0.736
SUP	22.850*** (0.000)	0.578

Results of Panel Unit Root Test

The results of CIPS and CADF unit root test (reported in table 4) suggest that the variables are mixed order integrated.

Table 4

Cross-Sectionally Augmented Dickey-Fuller (CADF)			
TFP	-1.431	-2.886***	I(1)
IMPKS	-2.136**	----------	I(0)
FDI	-1.786	-3.202***	I(1)
Y	-1.599	-3.723***	I(1)
SUP	-2.355**	----------	I(0)
CIPS			
TFP	-1.532	-3.311*	I(1)
IMPKS	-2.140***	---	I(0)
FDI	-1.119	3.246*	I(1)
Y	-3.335	4.212*	I(1)
SUP	-2.842 *	---	I(0)

Note: ***, **, * represents significant at 1, 5 and 10% respectively.

Results of Westerlund's Panel Cointegration Test

The results of Westerlund (2007) cointegration test (reported in table 5) suggest the long run relationship between the variables of interest.

Table 5

Models	G_t	G_a	P_t	P_a
Model-1	-8.742***	-14.114*	-19.775***	-14.812***
Model-2	-9.423***	-15.221**	-20.574***	-15.339***
Model-3	-9.112***	-13.772**	-18.668***	-14.915***
Model-4	-8.334***	-12.882**	-19.228***	-15.224***

TFP: Total factor productivity, IMPKS: Knowledge spillovers via channel of imports, FDI: Stock of foreign direct investment, SUP: Start up procedures (numbers)

Results of CS-ARDL

Once establishing that long-term equilibrium exists, discovering the cointegration vectors is essential. For this objective, the CS-ARDL cointegration approach is applied. Total factor productivity is regressed over knowledge spillover as well as other control variables, and thus model 1 is estimated. Base line regression findings are shown in Table 7 for the entire sample (24 countries) and for various income brackets. A knowledge spillover has had some very intriguing effects on total factor productivity, as shown in Table 7.

Table 7 provides an overview of the models' estimation outcomes. The results of CH are validated by Model 1, which is related to equation 3.1 in the methodology part. TFP in the sample countries goes up with increases in their domestic R&D capital stock. In a similar vein, import-related knowledge spillovers show a positive correlation with total factor productivity. The findings reveal (and are consistent with those of CH) that imports of high- and medium-technology products have a significant impact on TFP in importing countries corresponding to the HIC and MIC groups, even more so than domestic R&D activities. Similarly, if the TFP of local businesses reflects the knowledge embedded in multinationals, then FDI stock should increase TFP. Consistent with the aforementioned claims, our findings indicate that an increase in FDI stock leads to a rise in TFP in host nations corresponding to HIC and MIC groups. Similarly, and in keeping with hypothesis that, knowledge spillover also exhibits a favorable link with total factor productivity for HIC and MIC income categories. This implies that knowledge spillovers are crucial in raising long-run productivity due to opening up to foreign trade and investment which generates additional knowledge spillovers through interaction of domestic agents with foreign agents that have larger or different stocks of knowledge. Though, both channels of knowledge spillovers shows a significant effect on TFP in host countries included in HIC and MIC groups, but in case of LIC group, both import related and FDI related spillovers does not affect TFP, which is evident from the statistically insignificant coefficient of IMPKS and FDIS in case of LIC. Knowledge spillovers to an emerging economy can occur in a variety of ways. Foreign direct investment is one example. For instance, Malaysia's generous tax breaks and other incentives for foreign investment in the country's electronics industry have successfully attracted global corporations. Multinational corporations provide production techniques, knowledge of the worldwide market, and expertise in managing the global supply chain. However, despite being traditionally less receptive to FDI, both Japan and Korea have imported and improved upon technology from somewhere else. Sony of Japan, for instance, outsold its American rival RCA in the portable radio market by exploiting patents and other intellectual property licensed from RCA.

Moreover, the basic aim of this research is to establish whether the FDI-related knowledge spillovers or the import-related spillovers are more effective. The findings of his study demonstrate in Table 7 suggest that both channels of knowledge spillover have a significant positive effect on total factor productivity for the HIC and MIC group of countries. However, for both HIC and MIC income categories, import-related spillover coefficients are higher than FDI-related spillover coefficients. Thus, this study shows that the import channel of knowledge spillover is more effective than the FDI

channel of knowledge spillover. The result validates the hypothesis that the import channel of knowledge spillover is more effective than the FDI channel. The estimated result in this study reveals that import-related spillover (IMPKS) is a more effective channel of knowledge spillovers than FDI-related spillovers; therefore, this study uses import-related spillovers (IMPKS) as a proxy for knowledge spillovers for further estimation. Additionally, the joint effect of FDI and IMPKS (hypothesis 3) is put through additional testing in Model 1. There is conflicting evidence from research on the joint effect of imports and foreign direct investment (FDI), with some finding that highly technologically intensified multinationals import hi-tech merchandise and intermediate inputs from their native countries due to a lack of adequate manufacturing facilities in the host country, and others finding that rising inward FDI substitutes for imports of finished products and services. The current study helps us figure out what the precise association is. We already know that in the context of knowledge spillovers, when FDI brings in high-tech manufacturing goods, it not only helps bring in potential knowledge resources from outside but also spreads the expertise to use high-tech manufacturing goods. In keeping with this sort of logic, we anticipate that FDI and import-related spillovers will mutually benefit one another, and we use an interaction term between these two variables in the foremost model to test for this hypothesis. Obtaining a favorable and statistically significant coefficient of interaction is consistent with the complementarity hypothesis. Thus, the findings indicate that high- and middle-income nations benefit from both import-related spillovers and FDI, as their combined effect increases total factor productivity. The significant contribution of the study can be attributed to the confirmation of hypothesis 3. Given that the overall impact is positive in magnitude, we have come to the conclusion that there is a positive interaction impact; more specifically, that FDI and import-related spillovers are mutually beneficial to one another.

Moreover, the negative and statistically significant estimated coefficient of initial GDP per capita (Yo) confirms the argument of conditional convergence, which says that countries with low incomes may grow their economies faster than countries with high incomes. This implies that acquiring knowledge is more doable than creating anything new. This enables emerging economies to catch up developed economies and explains why wealthy nations cannot thrive (or expand) at 7% or greater growth rates. By imitating and enhancing British processes and ideas, Osaka's manufacturing industry exceeded Lancashire's mills, to use a broad overview. Even the façade of the 1883-established Osaka Weaving Company was constructed using imported Lancashire red bricks. Besides knowledge spillover and a lagging GDP per capita growth rate, the results demonstrate that domestic R&D capital stock, macroeconomic stability, and investment as a proportion of GDP all have a substantial effect on total factor productivity in the sample nations. Sensitivity analysis is used to ensure that all of the variables are stable, and it is discovered that they are all both significant and insensitive to instrumental selection. The findings in Table 7 further show that investment coefficient is statistically negligible for MICs, suggesting that investments have no effect on total factor productivity in this group of nations.

Table 7

Knowledge Spillover and Total Factor Productivity

	Full Sample (1)		High Income (2)		Middle Income (3)		Lower Income (4)	
Core Variable	Without interaction	With interaction	Without interaction	With Interaction	Without interaction	With interaction	Without interaction	With Interaction
IMPKS *Knowledge Spillover through Imports*	0.281*** (0.000)	0.298*** (0.000)	0.171** (0.031)	0.254** (0.021)	0.149** (0.025)	0.448*** (0.000)	0.141 (0.237)	0.255 (0.232)
FDIS *Knowledge Spillover through FDI*	0.018** (0.031)	0.057*** (0.000)	0.007** (0.024)	0.084** (0.034)	0.008*** (0.000)	0.017** (0.002)	0.009 (0.224)	0.076 (0.221)
Control Variables								
Yo	-1.732***	-1.003**	-1.856***	-1.756***	-0.503***	-0.333***	-0.413**	-0.233**

Transitional Convergence	(0.000)	(0.031)	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.001)
R&D *Domestic R&D stock*	-1.342*** (0.000)	-1.053** (0.002)	0.064** (0.003)	0.176** (0.002)	0.087*** (0.000)	0.154** (0.002)	1.277** (0.003)	1.690** (0.002)
MES *Macroeconomic stability*	-0.222** (0.002)	-0.121** (0.001)	1.442*** (0.000)	1.879*** (0.000)	0.067 (0.321)	0.229 (0.332)	0.095*** (0.000)	0.186*** (0.000)
INV *Investment (in percentage of GDP)*	0.405*** (0.000)	0.489*** (0.000)	0.213** (0.023)	0.545** (0.025)	0.113 (0.236)	0.287 (0.311)	0.241*** (0.000)	1.228** (0.002)
IMPKS*FDI	---	0.365*** (0.000)	---	0.258*** (0.000)	---	0.215*** (0.000)		0.147 (0.000)
Number of Countries	24		5		8		11	

*Dependent Variable Total factor Productivity: ***, ** and * indicates p-value less than 1, 5 and 10 percent. The values in the parentheses are P-values*

Interaction between Knowledge Spillover and Economic Opportunities (EO)

The description in regression added an interaction term between knowledge spillover and economic opportunity to examine the impact of economic opportunities on the linkage between knowledge spillover and total factor productivity. Because of this, the adverse and statistically significant coefficients of the interaction term between knowledge spillover and economic opportunities provide further evidence that the lack of economic opportunities in the sample countries negatively affects the total factor productivity of those nations. This finding lends credence to the theory that countries with more favorable economic conditions (i.e., those in which it takes a shorter time to launch a business) reap the greatest benefits from knowledge spillover. It implies that corporate environment conducive to entrepreneurship, innovation, and economic growth cannot be overstated. The result of this study Consistent with the findings of Andersson & Noseleit (2011), Klapper et al., (2006), Andersson & Noseleit (2011), Fritsch & Noseleit ((2009), Li et al., (2011), Klapper et al., (2006) and Block (2016)

In contrast, after Start-Up Process reaches a threshold of 13.0, the sign knowledge spillover changes to a negative value. Because of this, the significance of knowledge spillover varies among start-ups. Because a greater number of start-ups discourage entrepreneurs, total factor productivity can only rise with a higher degree of knowledge spillover if there are lesser start-ups. This means that knowledge spillover favours countries with lesser start of procedure. There is a negative correlation between the degree of regulation and the extent to which nations gain from international trade. In order to compete internationally, domestic businesses need to be able to operate more freely, but this is impossible in a regulatory environment that is too restrictive. It follows that in strict regulatory economies, a higher level of knowledge spillover is allied with lower total factor productivity. The result of this study Consistent with the findings of Chang et al., (2009), El Shoubaki,et al., (2020), Klapper & Love (2009). Additionally, the complementarity between knowledge spillover and economic opportunities across income brackets is tested in Table 5.8. Interaction terms are not statistically significant for high-income economies (HIC), (such as, Hong kong, Japan, Korea, Singapore and Malta) suggesting that such a link between knowledge spillover and total factor productivity in HIC is unrelated to barriers to business start-up. On the other hand, there is also a clear link between the start-up procedures in middle income and low-income nations and the knowledge spillover and total factor productivity linkage. In both high- and low-income nations, the computed coefficient of the interaction term IMPKS*EO is substantial and negative. These negative and statistically significant coefficients suggest that a rise in IMPKS results in a larger boost to total factor productivity when entrance regulatory costs are low. Based on this evidence, it was found that low- and middle-income economies would

benefit more from reforms that make entrance regulation less expensive and more effective at boosting the positive effects of IMPKS on increasing TFP and growth than would high-income economies

Assessment of the Marginal Effect (SUP)

To evaluate the marginal effect of IMPKS on TFP in light of the economic opportunities of the host economy, we consider the partial derivative of TFP with respect to IMPKS.

dTFP/dIMPKS = 0.2468 – 0.0189* EO (4.1)

The threshold level of SUP is 13.0 (from equation 4.1) and only 9 of the 24 countries in the study have less than the minimal SUP requirement.

Threshold level of complementarities (SUP)

Figure 1 depicts the complementary between knowledge diffusion and the start-up procedure. Our analysis of the graph yields some surprising findings. Knowledge sharing and economic opportunities are shown to be mutually supportive in this three-dimensional graph. High knowledge spillover and low start-up procedures lead to rapid productivity for a country. On average, nations with high knowledge spillover and low SUP prospered faster than those with neither. Therefore, sample countries' economic success suffers because of a lack of economic opportunities. At the highest of the starting procedure, the cumulative impact of IMPKS is minimally favorable on productivity, despite the negative size of the overall effect.

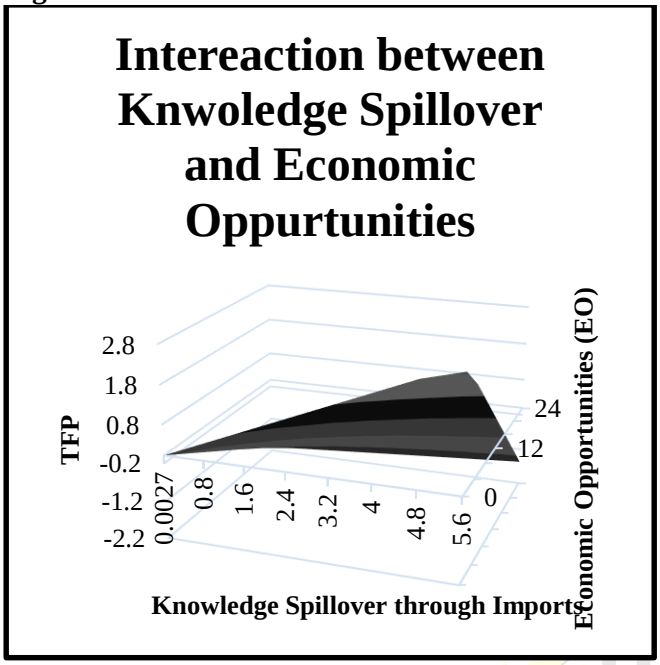
Table 8

Knowledge Spillover, Economic Opportunities and TFP

	Full Sample		High Income Group		Middle Income group		Lower-Income Group	
	Without Interaction	With Interaction	Without Interaction	With Interaction	Without Interaction	With Interaction	Without Interaction	With Interaction
Core Variable								
IMPKS *ImportsSpillover*	0.075 *** (0.000)	0.2468 (0.086)	0.032* (0.000)	0.009 (0.317)	0.072** (0.043)	0.033 (0.511)	0.088*** (0.000)	0.367** (0.029)
Control Variables								
Yo *Transitional Convergence*	0.320*** (0.000)	-0.029** (0.032)	0.233*** (0.000)	0.311*** (0.000)	0.191*** (0.000)	-0.189** (0.042)	0.668*** (0.000)	0.679*** (0.000)
R&D *Domestic R&D stock*	0.131*** (0.000)	0.354*** (0.000)	-0.079** (0.041)	0.054*** (0.000)	0.019 (0.623)	0.011 (0.399)	2.567*** (0.000)	2.953*** (0.000)
MES *Macroeconomic stability*	0.029*** (0.000)	0.041*** (0.000)	-0.020 (0.719)	-1.156** (0.032)	1.422** (0.027)	1.310*** (0.000)	-0.007 (0.922)	-0.004 (0.192)
INV *Investment (in percentage of GDP)*	0.153*** (0.000)	0.147*** (0.000)	0.134*** (0.000)	0.122*** (0.000)	0.062*** (0.000)	0.058*** (0.000)	0.321*** (0.000)	0.304*** (0.000)
Variables of Interest								
EO *Economic Opportunities*	-1.033** (0.002)	0.087*** (0.000)	-0.351** (0.003)	1.597*** (0.000)	-0.858* (0.000)	1.981*** (0.000)	0.353*** (0.000)	-1.334 (0.154)
Interactive terms								
IMPKS *EO		0.0189** (0.004)	---	-0.006 (0.176)	---	-0.008* (0.086)	---	0.098*** (0.000)
Number of Countries	24	24	05	05	08	08	11	11

*Dependent Variable: Total factor productivity (TFP). ***, ** and * indicates p-value less than 1, 5 and 10 percent*

Figure 1



Conclusion and Policy Recommendations

This study has illuminated the critical role played by economic opportunities in facilitating the substantial impact of knowledge spillover on total factor productivity (TFP) across countries. This study's results provide credence to the idea that the dissemination of knowledge through channels like trade and FDI boosts total factor productivity. The study found that nations with greater exposure to knowledge spillover also had greater productivity. Because of this, it's clear that knowledge spillover is crucial to economic growth and international competitiveness in today's globalized world. The amount of the knowledge spillover impact on TFP has also been found to be affected by economic opportunities. It is easier for countries to absorb, adapt, and utilise foreign knowledge for productivity gains if they have favourable economic conditions, such as friendly business environment and access to infrastructure. However, developing nations struggle to completely benefit from knowledge spillover, which limits their ability to use novel knowledge to increase productivity.

From a policy standpoint, countries with weak policy complementarities need a plan to strengthen their underlying structure and government institutions. The returns to knowledge spillover in terms of productivity are likely to be lower than desirable without reliable institutions, a good level of living, and business-friendly regulations. Knowledge spillover alone cannot boost total factor productivity (TFP), but it can do so when combined with other institutional and economic variables. Knowledge spillover may also have varying consequences based on the overall level of economic development. Thus, in order for countries to gain from knowledge spillover, they must be developed. Moreover, technology transfer is just one facet of the narrative, the other concerns maximising benefits through technological transfer. That's why it's important for policymakers to prioritise strengthening underlying structural and institutional variables that pave the way for greater gains from knowledge spillover. Furthermore, the effect of technology transfer on productivity is sensitive to the extent to which the host country regulates businesses. Knowledge spillover benefits economies, but they can't be realised if they're stifled by red tape. Mandatory rules, or regulations, are rules that limit or prohibit certain behaviours. Businesses have to spend money on new tools and processes, shell out cash for workers and benefits, and hire experts to assist them stay in line with the law. Entrepreneurs have to spend time and energy complying with regulations, which slows down the economy and limits innovation and competitiveness. While it's true that a lot of rules and regulations end up helping people out, it's important to weigh those gains against the costs that come with them. Thus, in highly regulated economies, knowledge spillover is likely to have a negative impact on productivity. So, if countries want to get the greater benefits of knowledge spillover, they need to relax their rules and regulations.

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