

## KNOWLEDGE SPILLOVER AND TOTAL FACTOR PRODUCTIVITY ACROSS COUNTRIES: ROLE OF FINANCIAL DEVELOPMENT

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### ABSTRACT

*The general objective is to evaluate the impact of financial development on the connections between knowledge spillover and Total factor productivity (TFP). By using CS\_ARDL econometric techniques the results shows that knowledge spillover promotes productivity expansion, as shown by the baseline regression, which holds true regardless of the structural and institutional elements included in the models. Moreover, our study hypothesis, that knowledge spillover affects TFP in nations with better financial system, is corroborated by our results. The findings indicate that the effects of knowledge spillover and financial development on TFP are mutually reinforcing. These results validate the idea that countries better financial system to successfully absorb foreign R&D will obtain the greatest benefits from knowledge spillover. According to the results, the disparities in national wealth shown over the past two decades may be the result of complementing policies adopted by different nations. Thus, greater total factor productivity and/or economic growth necessitate policy complementarity. A rise in knowledge spillover would not improve TFP and/or GDP growth in countries that have not implemented complementary reforms. Since these conditions are necessary for these countries to benefit fully from knowledge spillover, failing to provide them will result in a loss of potential gains.*

**Keywords: Knowledge Spillovers; Total Factor Productivity; Financial Development**

### INTRODUCTION

Technological advancement has a considerable contribution in bringing economic prosperity. Furthermore, it is considered as a major source of cross country income differences. Academia and policy makers both recognize the importance of innovation and technology in increasing total factor productivity and escaping poverty across nations. According to Maddison (2005), technology and innovation significantly raise world per capita income. Furthermore, technological advancement also improves production process and advances the way of doing business. Thus, advance Technology and economic prosperity are interlinked. For continuous economic growth, nations need to introduce innovations and improve technology. Essentially, the process of growth decelerates if the level of technology and innovation do not improve over time. Thus, innovation and technology are the key factors of rapid growth of developed economies. As stated by Malecki (2009), the generation, absorption and spillover of knowledge or advance technology are the key determinants of nation's development. Both capital accumulation and technology are essential for country's output growth. But capital accumulation can bring economic progress up to some extent, and then economic progress stops if there is no advancement in technology. Many researchers and policy makers consider technology as more vital than capital accumulation for continuous economic progress. A nation that spends more on R&D will tend to grow faster than those who spend less on R&D, even if they have higher capital accumulation.

Knowledge spillover through the import channel have been the subject of several empirical studies in developed nations (for examples, see Branstetter 2006, Wang & Blomstrom, 1992, Glass, & Saggi, 1998). Most of this research concluded that imports of foreign knowledge have a major impact on the level of TFP. Foreign direct investment (FDI) is widely recognized as a key mechanism for

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stimulating the creation of technology externalities and expanding product market competitiveness, both of which contribute to higher levels of productivity and economic growth. Knowledge spillovers through FDI have been shown to increase TFP, but the evidence is conflicting for OECD countries (Fosfuri et al. 2001). For a sample of 13 industrialised nations, the authors found that FDI increases productivity when a home nation invests in another nation with a high proportion of its GDP dedicated to research and development but has no effect when a foreign nation with a similar proportion of its GDP invests in it. When comparing the impacts of inward and outward FDI on productivity, Bitzer & Kerekes (2008) showed that the former has a much larger impact than the latter. There is a dearth of data on the relationship between TFP and either domestic or international R&D spending in emerging nations. According to research conducted by Le (2012), international trade continues to play a significant role as a means of technology transfer in 41 African nations between 1998 and 2006. Furthermore, there is evidence that international student mobility helps to spread technology from more developed to less developed African countries (Le, 2010). According to additional findings (Seck, 2012), knowledge spillover are easier to achieve through the import channel than through the FDI channel.

The prominence of R&D in nation's productivity progression is extensively discussed in growth related literature. Maddison, (2005), Malecki, (2009), Berndt et al., (1992) concluded that despite the country's own domestic R&D struggles, the R&D activities performed in rest of the world are also contributing to country's internal 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 a large number of studies have focused on 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 technical revolution 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 levels of financial policies are required for technological dissemination to have meaningful influence on total factor productivity.

## **REVIEW OF LITERATURE**

Numerous studies have shown that improved financial infrastructure contributes to a flourishing economy. There has been a lot of research done using cross-country data that shows a positive relationship between financial development and GDP growth. One of the most studied pathways through which credit might impact growth is the productivity channel (Estrada et al., 2010). Both theory and practice lend credence to the claim that access to credit can boost total factor productivity (TFP). The idea that a country's economic growth is tied to its level of financial development was first proposed by economist and businessman Joseph Schumpeter in 1912. The primary premise is that the financial industry contributes to increased productivity by redirecting resources from failing sectors to others with promising futures as part of the creative disrupting phase. For instance, the improper use of resources across productive units has been demonstrated to contribute to the lower TFP of poor countries (Guillaumont Jeanneney et al., 2006).

Numerous theoretical frameworks investigate the mechanisms through which financial frictions cause poor resource allocation. Business innovation and financial frictions are added to a neoclassical model by Gehringer, (2014), Capital deployment is hindered in their model since skilled and productive entrepreneurs cannot access the market without first acquiring capital to use as security and resolve financial frictions. The model created by Li, & Liao (2020), features tradable and non-tradable sectors with varying levels of fixed costs. They demonstrate that in the tradable sector, where fixed costs are larger, financial frictions have a disproportionately negative impact on total factor productivity. Their model says that when financial development is poor, capital is spread around inefficiently and is given more to sectors with low productivity.

Under the assumption that a company's investment can be broken down into short-term, low-risk investments in areas like R&D and marketing and longer-term, higher-risk investments in areas like improving productivity, Chee-Keong, & Sok-Gee (2011), demonstrated that financing limitations

cause companies to invest fewer in the long term. Since long-term investments can be disrupted by a liquidity shock that lowers the incentive to invest in disclosures in these kinds of investments, the business cycle is accentuated when financing is inadequate. This is especially true during recessions when funding is scarce. Platforms for the selling of equity securities and for hedging the risks of actual assets are the primary areas of study for Anwar, & Sun (2011). Both experiential learning and the compounding effect of technological investment can be used to model productivity. Their model says that companies won't invest in technology or train employees in-house because they don't have enough money to do so.

Overall, there is quantitative evidence in favour of these routes. Calderón, & Liu (2003), among many others, take use of a multi-nation growth regression model to demonstrate the significant and positive effect of FD on TFP. Investment levels are found to be unrelated to metrics of financial development. The results of this study imply that the benefits of financial development are not realized through the accumulation of money but rather via expenditures in sectors that boost productivity.

Some authors aren't quite as positive, arguing that the productivity channel only works at specific points in an economy's development. It has been argued, for instance, by Arizala, et al., (2013), that the mechanism via which financial development affects growth varies from country to country and that the productivity stream is largely limited to industrialised countries. These authors put the theory advanced by Alfaro, et al., (2009) to the test, which holds that a country's growth plan is distinct depending on its stage of development. The central argument is that developing nations pursue a strategy of capital accumulation marked by slower rates of innovation and productivity improvement. Capital accumulation in these countries is typically financed by the banking sector, which is used by larger, more reputable businesses. TFP might not change even if the capital stock is increased and productivity at work is increased. Considering firms in developed nations interact with those from other nations having similar capital stocks, there is a greater motivation to increase TFP through innovation and technological improvements. These nations' financial markets support new technologies, which in turn boost productivity. Using a sample of countries, Han, & Shen (2015) come to the conclusion that financial factors have a bigger effect on capital accumulation than on TFP in countries with better economies.

Researchers did not give enough thought to the fact that knowledge spillover and TFP go hand in hand until the very end of the 20th century. The importance of FD in the knowledge spillover led TFP nexus is rarely emphasized in the literature. The nexus of knowledge spillover and TFP was investigated in the study of Bolbol, et al., (2005), along with a number of structural indicators. The growth effects of knowledge spillover are affected by the host country's financial system, as shown in Chee-Keong, & Sok-Gee (2011). This indicates the importance of financial development in considering the benefits of knowledge spillover. So, a more developed financial system is associated with a higher TFP because of a greater degree of knowledge spillover. Therefore, this study contributes to the existing literature by investigating the existence of complementarity between knowledge spillovers with financial development in affecting domestic productivity.

#### **Trends in financial development (DCP) across countries**

In this study, the connection between knowledge spillovers and TFP is moderated by financial development. Countries with a robust finance sector are thought to gain more from knowledge spillovers. Figure 1 depicts the financial development values of various nations. Domestic credit to the private sector (DCP) as a proportion of GDP signifies financial development.

Figure 1 depicts the domestic credit to the private sector (DCP) as a percentage of GDP for nations of varying socioeconomic levels. From 1996 to 2020, it is evident from the graph that nations in the high-income group have a greater DCP as a percentage of GDP than countries in the medium-income country (MIC) and low-income country (LIC) groupings. DCP as a proportion of GDP in high-income nations varies widely, ranging from 317.38 in Japan to 174.33 in Hong Kong to 135.30 in Malta to 131.93 in the Republic of Korea to 91.05 in Singapore. DCP as a percentage of GDP in MIC also varies widely, ranging from 170.70 in South Africa to 143.11 in China, 136.36 in Malaysia, 86.42 in Brazil, 34.69 in Argentina, 32.34 in Venezuela, 30.93 in Romania, and 14.05 in Botswana. In the case of lower-income countries (LIC), the DCP as a percentage of GDP varied widely, ranging from 19.22 in Algeria to 19.26 in Nigeria, 21.98 in Peru, 46.39 in Pakistan, 46.96 in Indonesia, 48.59 in Bangladesh, 49.49 in Iran, 55.53 in the Philippines, 87.34 in Egypt, and 145.54 in Thailand. When it comes to financing economic initiatives and projects, which would benefit the economy and development, a

strong and inclusive financial system and the availability of investable money play crucial roles. This is because businesses' growth and productivity are boosted when they have easier access to loans. Nonetheless, many small and medium-sized manufacturing enterprises in low-income nations lack access to credit because of the continent's relatively undeveloped financial system compared to that of high-income countries. Because of the vital role they play in propelling the actual economy, central banks around the world work hard to keep their financial systems stable and growing. It is widely accepted that a healthy financial system underpins a variety of positive macroeconomic indicators.

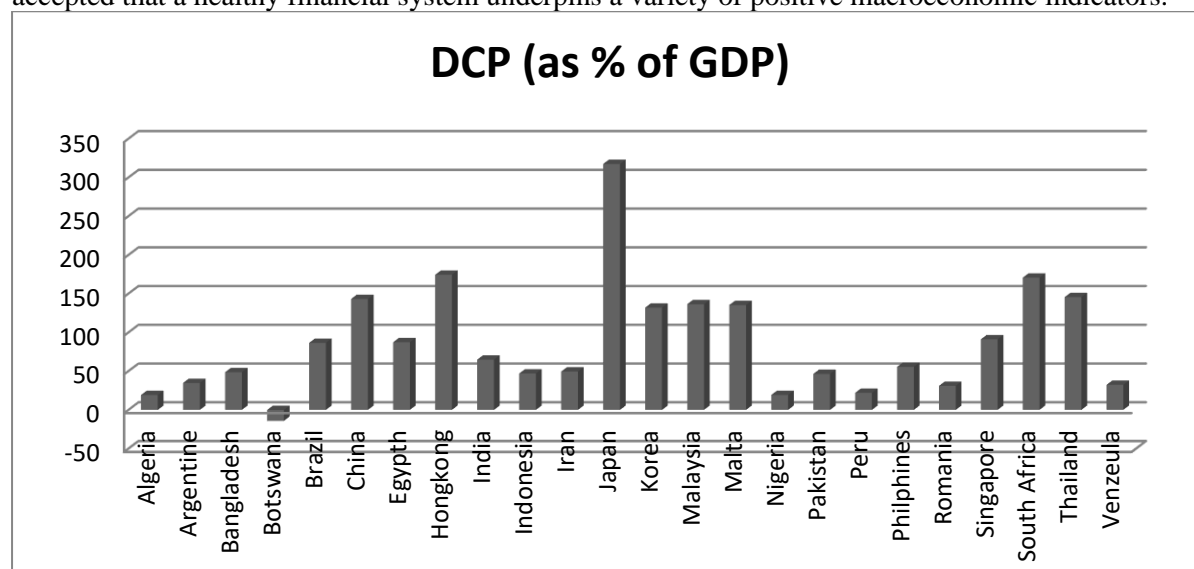


Figure 1: DCP (as percentage of GDP) from 1996-2020

## METHODOLOGY

### Model specification

To discover that whether the nexus between knowledge spillovers and domestic productivity depends on financial development of the recipient country, model 1 is further extended as:

$$TFP_{i,t} = \alpha_0 + \alpha_1 R\&D_{i,t} + \alpha_2 ImportSpill_{i,t} + \alpha_3 ImportSpill_{i,t} * DCP + \mu_{i,t} \quad (1)$$

This study included 62 countries as a sample, which covered the years 1996–2020. Panel data from 1996 to 2020 is used in this analysis for various countries around the globe. This study puts sample countries into three basic categories for analytical purposes. 38 of the 62 sample countries are OECD members, which account for a great deal of the dissemination of knowledge. In addition, the remaining 24 countries are classified into three groups based on income: those with high incomes, middle incomes, and low incomes. Table 1 lists the total number of countries used in the sample.

Table No. 2 Data Description and Correlation of Proxies of Financial Development

	DCP1	DCP2	DCP3
Mean	86.48840	68.30260	61.69871
Median	59.97434	40.46498	40.46498
Maximum	357.3186	233.3959	233.3959
Minimum	-79.09235	3.907417	3.904611
Std. Dev.	73.71366	56.04663	48.72373
Skewness	1.315301	0.855729	1.012458
Kurtosis	5.222186	2.549959	3.297478
Jarque-Bera	296.4545	78.29062	104.7195
Probability	0.000000	0.000000	0.000000
	DCP1	DCP2	DCP3
DCP1	1		
DCP2	0.91	1	
DCP3	0.78	0.94	1

A greater gain in productivity is the result of a well-functioning financial system. Investors and entrepreneurs will find it easier to do business in a country with a growing economy. With an established financial system, countries may be able to better allocate resources and spread risk, both of which benefit from cross-border knowledge flow. It is therefore hypothesized in this study that "knowledge spillover increases productivity when the financial system of the nation is more developed." Domestic Credit to the Private Sector (DCP) is one of the indicator of financial development, was found to be significantly correlated, because of the significant connection between DCP and other proxies. But in order to get robust results, this study uses DCF and DCP as stand-ins for financial development in the empirical models. The table no. 2 displays the descriptive statistics and pairwise correlation of financial development proxies.

### **Estimation Results**

The hypothesis for this research posits that there is a positive relationship between financial depth and total factor productivity. The fact that the coefficient of financial development is positive and significant provides support for the hypothesis that greater financial depth increases productivity. After controlling for initial GDP, knowledge spillover, domestic R&D capital stock, inflation, and investment, the findings indicate that there is a positive relationship between the competence of the financial market and total factor productivity. It is common knowledge that a suppressed financial system stunts productivity in the economy. This is due to the fact that financial inefficiencies can result in the inappropriate utilization of resources, resulting in considerably increased transaction costs associated with conducting business. On the other hand, an advanced financial system allows for the optimal allocation of resources by channeling foreign capital into the economy's key sectors. In the same foot, Productivity is sped up by improved financial facilities because they increase the reach and effectiveness of creative endeavors. Accordingly, financial repression reduces the services given by the financial system to savers, entrepreneurs, and producers, which stifles creative activity and inhibits productivity growth. These outcomes validate the findings of Levinsohn, & Petrin, (2003), and Levine & Zervos (1998).

The next step in developing this model is to consider how the interaction of knowledge spillover and financial development can improve productivity. The goal of this research is to conduct an investigation using empirical methods to determine the extent to which the diffusion of knowledge interacts with financial development to influence total factor productivity. This study tests the idea that the link between knowledge spillover and productivity changes as the depth of the financial sector grows.

Table 3 tests for the complementarity between knowledge spillover and financial development. The coefficients of IMPKS and cross term are positive, suggests that the level of financial development in the receiving economy amplifies the favorable effect of knowledge spillover on total factor productivity. Based on these findings, it appears that a structured financial network strengthens the link between knowledge spillover and increased productivity (confirmation of hypothesis 2). Another way of putting it is that the export-oriented industry can benefit from knowledge spillover because of the depth of the financial system. As a country's economy evolves, it becomes more inviting to foreign investment and new business formation. Specifically, a rather more developed financial system is associated with a significant rise in total factor productivity as a result of knowledge spillover. At least in part, these results could be explained by the fact that countries with more advanced financial systems are better able to benefit from knowledge spillover because they can better use their resources and spread out their risks. When looking at the middle-income countries, the interaction term's coefficient was negative and statistically significant, whereas the high-income countries' coefficient was positive but not statistically significant; the evidence suggests that the association between knowledge spillovers and TFP is not strengthened by financial depth exclusively in high-income economies. Moreover, High-income nations comprise the only ones for whom the interaction term (IMPKS\*FD) is positive and statistically significant. This finding suggests that economic financial depth increases the knowledge spillover-driven productivity link.

**Table 3 Total Factor productivity and the interaction between Knowledge Spillover and Financial Development**

	Full Sample		High Income Group		Middle Income group		Lower-Income Group	
	Without Interaction (53)	With Interaction (54)	Without Interaction (55)	With Interaction (56)	Without Interaction (57)	With Interaction (58)	Without Interaction (59)	With Interaction (60)
<b>Core Variable</b>								
IMPKS	0.243*	-		-				-
<i>ImportsSpillover</i>	** (0.00)	** (0.00)	0.072 (0.27)	0.065** * (0.00)	0.102 (0.14)	- 0.207** (0.04)	0.039** * (0.00)	0.301** * (0.00)
<b>Control Variables</b>								
Yo	0.883*	0.883*	0.188	0.188**	0.089**	0.057**	0.872**	0.856**
<i>Transitional Convergence</i>	** (0.00)	** (0.00)	(0.34)	* (0.00)	(0.04)	* (0.00)	* (0.00)	* (0.00)
R&D	-	-	-0.056	-	0.032	-0.013	-	-
<i>Domestic R&amp;D stock</i>	** (0.00)	** (0.00)	(0.37)	0.055** (0.04)	(0.34)	(0.24)	1.773** (0.03)	1.756** * (0.00)
INF	0.124*	0.128*	-0.102	-	0.110	0.111	0.029**	0.048*
<i>Lack of Macroeconomic stability(inflation)</i>	* (0.03)	** (0.00)	(0.34)	0.102** (0.03)	(0.35)	(0.46)	* (0.00)	(0.09)
INV	0.313*	0.313*	0.213	0.224**	0.103	0.116*	0.347**	0.343**
<i>Investment (in percentage of GDP)</i>	** (0.00)	** (0.00)	(0.15)	* (0.00)	(0.33)	(0.07)	* (0.00)	* (0.00)
<b>Variable of interest</b>								
FD	1.142*	0.004*	3.373	-	0.099**	-	0.131**	-
<i>Financial Development (in percentage of GDP)</i>	** (0.00)	** (0.00)	(0.49)	2.582** * (0.00)	* (0.00)	3.465** (0.02)	* (0.00)	3.243** * (0.00)
<b>Interaction Term</b>								
IMPKS*FD	---	0.0033*** (0.00)	---	0.851* (0.08)	---	-0.751 (0.42)	---	0.975 (0.39)
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

## CONCLUSION

The general objective is to evaluate the impact of various factors on the connections between knowledge spillover and TFP. Results show knowledge spillover promotes productivity expansion, as shown by the baseline regression, which holds true regardless of the structural and institutional elements included in the models. Our study hypothesis, that knowledge spillover affects TFP in nations with better financial system, is corroborated by our results, especially for middle-income economies. In contrast to middle-income countries, wealthy and poor countries saw a distinct result.

The findings indicate that the effects of knowledge spillover and financial development on TFP are mutually reinforcing. These results validate the idea that countries better financial system to successfully absorb foreign R&D will obtain the greatest benefits from knowledge spillover. According to the results, the disparities in national wealth shown over the past two decades may be the result of complementing policies adopted by different nations. Thus, greater total factor productivity and/or economic growth necessitate policy complementarity. A rise in knowledge spillover would not improve TFP and/or GDP growth in countries that have not implemented complementary reforms. Since these conditions are necessary for these countries to benefit fully from knowledge spillover, failing to provide them will result in a loss of potential gains. The results also support the idea that knowledge spillover is most beneficial to countries that already have a developed financial system.

The results also show that the knowledge spillover's effect on productivity is highly dependent on the initial condition of the economy in the chosen countries. Based on our research, we can say that the productivity effect of knowledge spillover may vary among sample countries based on their distinctive initial conditions. Knowledge spillover largely favors wealthy nations rather than poor ones. This suggests that knowledge spillover benefits wealthier nation's more than poor nations

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