

Financial Integration, Technology Transfer, Labor Productivity Growth and Economic Growth on Pre-and-During COVID-19 Crisis: Evidence from G20 Countries

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Abstract

This study investigates the role of financial integration, technology transfer, and labor productivity growth in economic growth pre-and-during the COVID-19 pandemic crisis. The data collected is panel data from 20 countries of the G20 in the period 2018Q4–2021Q1. By using fixed-effects regression, the results showed that foreign direct investment had a significant effect on economic growth during the COVID-19 crisis, while foreign portfolio investment did not. Furthermore, labor productivity growth has been proven to play a role in moderating foreign portfolio investment, foreign direct investment, and technology transfer in pre-crisis economic growth. However, entering into the COVID-19 crisis stage, labor productivity growth is no longer proven to be moderating, due to a major lockdown policy that led to a decline in labor productivity. This study contributes to helping policymakers with various considerations and sets realistic expectations about the role of financial integration and technology transfer in the recovery of economic growth due to the global crisis.

Keywords : economic growth; financial integration; global financial crisis; labor productivity growth; technology transfer

JEL Classification : F3, F4, O4, M16*

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1. INTRODUCTION

Coronavirus Disease 2019 (COVID-19) cases has forced many countries to introduce unprecedented lockdown policies such as travel restrictions, closure of schools, workplaces, and advice to stay at home. As a consequence, economic activity weakened and led to a global economic crisis (OECD, 2021). The global financial crisis due to this pandemic was recorded as threefold more severe than the previous global economic crisis in 2008, in terms of the lowest depth of the decline in Growth Domestic Product (GDP) (World Bank, 2021). In response to the crises of the last few decades, economists and policymakers continue to draw considerable attention to financial integration and stability (Eslamloueyan & Fatemifar, 2021). Departing from the standard neoclassical

framework, financial integration plays a role in facilitating risk sharing, increasing specialization in production, resources allocation, and economic growth (Acemoglu & Zilibotti, 2015; Obstfeld, 1998). Financial integration between countries can also improve the functioning of the domestic financial mechanism through the strengthen of firm competitions and imports of financial services, with positive growth effects (Klein & Olivei, 2008; Levine, 2001). Previous researchers, such as (Agénor, 2004; Babecky J et al., 2013; Guiso et al., 2004) argue that increasing financial integration leads to financial stability and growth through the facilitation of technology and capability transfer between countries.

Financial integration activities in the form of foreign source inflows, both foreign direct investment and foreign portfolio investment, are predicted to drive output productivity in the host country. This is to increase risk-sharing by tying the rate of return on external obligations to domestic macroeconomic conditions (Le Fort, 2000). In the recent literature, labor productivity growth appears to be the main explanatory variable for a weak (or conflicting) growth-financial integration relationship. Ilmakunnas & Piekkola (2014) argue that the inflow of foreign investment, both foreign portfolio investment and foreign direct investment as capital, is expected to encourage production factors that affect labor productivity growth. Finally, this effort to increase productivity is very important from a policy perspective because productivity is the main driver of GDP per capita growth (European Union, 2021). In addition, labor productivity growth is an indicator that can prove a high level of economic growth, competitiveness, and standard of living (Porter, 1985). Empirical findings related to financial integration in the form of foreign capital flows were revealed by Li et al. (2021) who state that specialized investment has a direct effect on labor productivity in the regions because of the growth in productivity of reallocation of resources. In other studies conducted by Azenui & Rada (2021) and Fons-Rosen et al. (2021), the results agree that foreign direct investment influences the productivity growth of the host country. Financial integration then also plays a role in encouraging investment inward in the form of knowledge and technology in the host country. Keller (2010) further finds that foreign sources in technology transfer contribute up to 90% of domestic productivity growth for most countries. That indicates the growth effect on labor productivity in the host country. Lastly, labor productivity growth has been reported to affect economic growth (Rey & Hazem, 2020; Narayana, 2015).

To better understand the nature of the relationship between financial integration and technology transfer on economic growth, this study highlights the importance of the host country's capability in managing foreign capital flows. In particular, our research emphasizes the importance of labor productivity growth in mediating the effects of financial integration and technology transfer on economic growth in the G20 countries. Our argument is based on the fact that the COVID-19 pandemic crisis has placed restrictions on activities that have led to a decline in labor productivity, but on the other hand, financial integration continues to be strengthened by most countries during the crisis to attract foreign capital inflows and technology transfers. Thus, the questions discussed in this paper are: how do financial integration and technology transfer affect economic growth pre-and-during the COVID-19 crisis? What is the role of labor productivity growth in mediating financial integration and technology transfer in economic growth pre-and-during the COVID-19 crisis? The Group of 20 (G20) is a forum containing the 20 largest economies in the world in terms of GDP. Statistical data shows

that the G20 has a balanced composition between the number of developed economies and emerging market countries. The G20 represents more than 80 percent of the world's GDP, 75 percent of international trade, and 60 percent of the world's population (G20, 2021). With its power to influence the direction of global mechanism, and potentially significant impacts on the global economy and environmental governance (Goldthau A, 2017; Martikainen, 2019). Therefore, the G20 can be responsible for the stability of the world economy. However, many researchers have focused on financial integration in (regional) blocks such as the EU, AFTA, ASEAN, EAC, etc. while non-regional financial integration such as the G20 is still rarely studied.

This study contributes as follows: First, expanding the literature on financial integration, where several previous researchers have highlighted financial integration activities related to the development of financial system, institutions and trade policies (Azman-Saini et al., 2010; Chee-Keong Choong et al., 2010; Rahman, 2021; Thanh et al., 2019), while this study focuses on the capability of host country resources in managing foreign capital flows. Second, this study reveals the role of financial integration and transfer technology in the recovery of economic growth due to the global crisis in developed and developing countries. These findings have important implications for future research and public policy decision-makers. The rest of the article is organized in the following way: section 2 reviews the theoretical arguments and empirical evidence of financial integration and technology transfer effects on economic growth. Section 3 consists of empirical methodology, sampling and data collection, estimations and measures. Section 4 empirically analyzes and discusses integration and technology transfer affect economic growth pre-and-during the COVID-19 crisis. The last section describes conclusions and implications.

2. HYPOTHESES DEVELOPMENT

Financial Integration and Economic Growth

Equity market liberalization gives firms primarily in emerging markets countries access to new financing channels, thereby lowering the cost of capital and increasing investment opportunities (Chari & Blair Henry, 2008; Hull & Tesar, 2001). Financial integration is useful as an agent of a wider source of financing and investment opportunities and allows the formation of a deeper and more liquid market (Kalemli-Ozcan et al., 2008). In addition, financial integration can also form financial efficiency to increase the economic growth of member countries, by increasing risk-sharing by tying the rate of return on external obligations to domestic macroeconomic conditions (Chai & Rhee, 2005; Fung et al., 2008; le Fort, 2000). However, entering a period of crisis, financial integration can have a negative impact because the more integrated elements that make up the financial system will expose the host country to high systemic risk due to the speed transfer of the crisis effects (Billio et al., 2012; Hoogduin et al., 2011). Undoubtedly, the macroeconomic characteristics of a particular country may be a prerequisite for the impact of capital flows, either leading to higher growth or increasing vulnerability to crises (Jinzhaoh Chen, 2014). In particular, several authors argue about the effect of financial integration on economic growth as proxied by foreign portfolio investment and foreign direct investment. Foreign portfolio investment has an important role as a catalyst for economic growth through its contribution to asset growth (Duasa & Kassim, 2009). The combined adjusted effect of stock flows from net investment income shows that investments have stable returns across countries (Adler & Garcia-Macia, 2018). On the other hand, foreign direct investment as capital flows is not volatile as other forms of

capital (eg, short-term capital), so it does not exacerbate the financial crisis (World Bank, 2013). The stabilizing effect of FDI during the crisis will also help reduce unemployment, which in turn reduces the government's need to increase fiscal spending to stimulate the domestic macroeconomy (Moon et al., 2011).

Empirical studies show different results regarding the effect of foreign portfolio investment on economic growth. Durham (2004) argues that foreign portfolio investment does not have a direct positive effect on economic growth. In contrast, Asamoah & Alagidede (2020) shows that foreign portfolio investment has a significant positive effect on the real growth of the sector. Next, empirical studies of foreign direct investment on economic growth. Previous studies found a significant positive effect of foreign direct investment on economic growth (Comes et al., 2018; Gui-Diby, 2014; Iamsiraroj, 2016; Rahman, 2021; Thanh et al., 2019). Against that, the findings by Azman-Saini et al. (2010) and Sokhanvar (2019) revealed that foreign direct investment does not have a significant positive effect on economic growth. Differences occur because the effect of foreign investment directly depends on the level of economic freedom in the host country. Entering the crisis stage, Hill & Jongwanich (2009) find that foreign portfolio investment tends to decline when entering a crisis period. Supported by Uctum & Uctum (2011), who also found that foreign portfolio investment flows were harmed by the domestic banking crisis and market volatility, resulting in a drop in foreign portfolio investment. Then, risk-sharing through foreign portfolio investment is not significant in emerging and developing countries during a crisis (Bergant, 2021). Further empirical studies, related to the effect of foreign direct investment on economic growth during the crisis. Moon et al. (2011) said that foreign direct investment had a negative effect on Change in Economic Growth (CEG) in 15 Asian countries during the crisis and the recovery of the Asian financial crisis in 1997-1998, its means that foreign direct investment had a recovery effect during the crisis.

H1_a: Foreign Portfolio Investment has a significant effect on Economic Growth Pre COVID-19 Crisis
H1_b: Foreign Portfolio Investment has a significant effect on Economic Growth During COVID-19 Crisis

H2_a: Foreign Direct Investment has a significant effect on Economic Growth Pre COVID-19 Crisis
H2_b: Foreign Direct Investment has a significant effect on Economic Growth During COVID-19 Crisis

Technology Transfer and Economic Growth

Financial integration is not only financial capital invested in the host country, but foreign direct investment also contributes to production efficiency through a transfer technology embedded in new capital goods (Nwaogu & Ryan, 2015). Fagerberg (1994) argues that differences in productivity are responsible for variations in income between countries, thus technology plays a key role in determining productivity. Indeed, technology transfer is assumed to be higher when the host country is relatively underdeveloped, which may lead domestic firms to adopt, adapt, and absorb foreign R&D activities to drive growth (Aghion et al., 2009). However, differences in technological development (technology gap) between countries will still be the reason for the technology transfer. Benzaim et al. (2021) said that OECD countries have the capacity to use and pursue foreign technologies.

Previous studies have shown that technology transfer is a driving factor in economic growth. The study findings of Ferreira et al. (2020) explain that sustainable technology transfer has a positive effect on economic growth. Supported by Xu & Chiang (2005), who also found that technology transfer by MNEs played a significant positive role in

developed countries and an insignificant role in developing countries. Thus technology transfer is an important foreign resource that drives the domestic economy.

H3_a: Technology Transfer has a significant effect on Economic Growth Pre COVID-19 Crisis

H3_b: Technology Transfer has a significant effect on Economic Growth During COVID-19 Crisis

The effect of Labor Productivity Growth on the relationship between Financial Integration and Economic Growth

Fons-Rosen et al. (2021) explained that foreign investment by foreign firms leads to higher productivity growth of acquired firms, including labor productivity. The level of labor productivity growth is generated by an increase in Total Factors of Production (TFP) including capital accumulation so that small growth in labor productivity doesn't mean weak investment (OECD, 2013). This means that the entry of foreign capital from financial integration activities affects the growth of TFP, but does not necessarily affect the growth rate of labor productivity. In the short run, labor productivity growth can boost production efficiency. But in the long run, the positive effect will be significant, labor productivity growth will reduce the cost per unit of output or the wage/productivity ratio and reduce unemployment (Rey & Hazem, 2020). Thus, increasing labor productivity growth has the opportunity to build economic growth host country.

The empirical findings that indicate the involvement of labor productivity growth in moderating the effect of financial integration on economic growth are shown by Acemoglu et al. (2006), a certain level of concentration in the industry may help to ensure a positive return on portfolio investment thereby increasing labor productivity. Next, Foreign direct investment is likely to increase the productivity of acquired firms because foreign owners may bring superior technical, marketing, and management skills to the acquired firm (Guadalupe et al., 2012; J. Wang & Wang, 2015). Labor productivity growth is thought to moderate financial integration on economic growth because labor productivity growth is also related to its effect on economic growth. Research by Rey & Hazem (2020) proves that labor productivity growth has a significant effect on economic growth.

H4_a: Labor Productivity Growth significantly moderates the relationship between Foreign Portfolio Investment and Economic Growth Pre COVID-19 Crisis

H4_b: Labor Productivity Growth significantly moderates the relationship between Foreign Portfolio Investment and Economic Growth During COVID-19 Crisis

H5_a: Labor Productivity Growth significantly moderates the relationship between Foreign Direct Investment and Economic Growth Pre COVID-19 Crisis

H5_b: Labor Productivity Growth significantly moderates the relationship between Foreign Direct Investment and Economic Growth During COVID-19 Crisis

The effect of Labor Productivity Growth on the relationship between Technology Transfer and Economic Growth

The existence of a large technology gap will encourage to increase in the effect of technology transfer on total factor production (UNCTAD, 2014; Wang, 2010). Foreign direct investment spillovers are that foreign-invested firms are technologically superior and that knowledge is transferred through their interactions with domestic firms, which leads to productivity improvements. They have the potential to be an important source of productivity growth as they can help the host country's domestic industry catch up with international technology (Newman et al., 2015). The effectiveness of sustainable technology transfer requires an understanding of the knowledge, projects, and

production systems that facilitate innovation and modification (Ockwell et al., 2008; UNCTC, 1987). Easterly & Levine (2001) argue that productivity growth is considered a source of economic progress, particularly growth through factor accumulation. This means that technology transfer plays a role in influencing labor productivity growth. Also, a reasonable rate of productivity growth is a prerequisite for a sound economic base and hence for designing policies for long-term development and welfare (Danquah et al., 2014; Mc Morrow et al., 2010).

Previous studies have not explained the relationship between labor productivity growth, technology transfer, and economic growth, especially in times of crisis. This research fills the gap. The empirical findings related to technology transfer on productivity growth found by Furman & Hayes (2004) and UNCTAD (2014) agreed that strong innovation and technology are key factors to overcome many problems, so technology transfer can drive productivity growth. Then, Rey & Hazem (2020) and Narayana (2015) found that labor productivity growth has an effect on economic growth in a country. Therefore, researchers have a presumption of the role of labor productivity growth in moderating technology transfer and economic growth.

H6_a: Labor Productivity Growth significantly moderates the relationship between Technology Transfer and Economic Growth Pre COVID-19 Crisis

H6_b: Labor Productivity Growth significantly moderates the relationship between Technology Transfer and Economic Growth During COVID-19 Crisis

3. METHOD, DATA, AND ANALYSIS

Sampling and Data Collection

The G20 is currently the strong global government. With its significant impact on the global economy, environment and society, the G20 advocates the dissemination of agreements regarding future development directions and current development focus. (Huang, 2014), thus the group has strong representativeness and analytical value in this study. We extract data about all G20 countries; Argentina, Australia, Brazil, Canada, China, France, Germany, Japan, India, Indonesia, Italy, Mexico, Russia, Saudi Arabia, South Africa, South Korea, Turkey, United Kingdom, United States, and European Union. The sample for this study selected the period from 2018Q4 to 2021Q1. Then divided into two different periods, covering 2018Q4 - 2019Q4 (pre the COVID-19 crisis) and 2020Q1-2021Q1 (during the COVID-19 crisis). Source of data obtained from CEIC Data; foreign portfolio investment, labor productivity growth, economic growth, and employment. Meanwhile, foreign direct investment, technology transfer, exports, and trade openness were obtained from OECD statistic sources.

Tabel 1. Data Sources and Measurement

Variables	Definitions	Measurement	Data Source
Economic Growth	Economic growth is measured by using changes in the volume of output or real income of the population.	US Dollars	CEIC Data
Foreign Portfolio Investment	An investment for purposes other than corporate control, and does not require the physical presence of employees or company products abroad.	US Dollars	CEIC Data
Foreign Direct Investment	Foreign direct investment refers to investments made by foreign investors with the aim of becoming a major shareholder in domestic companies.	US Dollars	OECD

Technology Transfer	Technology transfer which is defined as the import of technology from abroad or imports value of goods	US Dollars	OECD
Labor Productivity Growth	Labor productivity growth is measured by the ratio of the value of changes in economic output per hour worked during a certain period	Percentage	CEIC Data
Export	Activities in the international trade process in the form of transporting any number of domestic goods or services abroad	US Dollars	OECD
Employment	The number of people who already have a job at the legal age to work in a country.	Person	CEIC Data
Trade Openness	Trade Openness is the total of exports and imports of goods and services measured by divided of GDP.	Percentage	OECD

Source: Authors' Compilation

Estimations and Measures

This study first uses narrative statistics to describe the distribution and sample characteristics. Next, the hypotheses are modeled and analyzed with panel data regression analysis, and finally, the robustness analyzes are conducted. For this research Equation (1) is constructed, where the dependent variable is Real GDP to measure economic growth. The variables tested are foreign portfolio investment inflows, foreign direct investment inflows, and technology transfers as measured by technology imports from abroad or imports value of goods. Then the control variables used are export, employment, and trade openness as in the research (Bende-Nabende et al., 2010; Benzaim et al., 2021; Choe, 2003). Equation (1) is calculated based on two subsamples divided by the incidence of the COVID-19 crisis: fiscal 2018Q4 - 2019Q4 as the period pre the financial crisis (hereinafter pre-financial crisis), and 2020Q1- 2021Q1 as the period after the financial crisis (hereinafter post-financial crisis). Then, the coefficients of the test variables were compared. For example, foreign portfolio investment (β_1) from each regression is used to examine the difference in coefficients of foreign portfolio investment between the pre-financial crisis and the post-financial crisis, as well as the remaining predictor variables.

$$GDP_{i,t} = c + \beta_1 FPI_{i,t} + \beta_2 FDI_{i,t} + \beta_3 TTF_{i,t} + \beta_4 Control_{i,t} + \text{Country Fixed Effects} + \text{Quarter Fixed Effects} + \varepsilon_{i,t} \quad (1)$$

Next, Equation (2) is constructed as a continuation of Equation (1) to examine the moderating role of the labor productivity growth variable as measured by the ratio of the value of changes in economic output per hour of work during a certain period in a country. In this equation, the variable labor productivity growth is tested as a moderator variable for each independent variable, as follows:

$$GDP_{i,t} = c + \beta_1 FPI_{i,t} + \beta_2 FDI_{i,t} + \beta_3 TTF_{i,t} + \beta_4 (FPI_{i,t} * LPG_{i,t}) + \beta_5 (FDI_{i,t} * LPG_{i,t}) + \beta_6 (TTF_{i,t} * LPG_{i,t}) + \beta_7 Control_{i,t} + \text{Country Fixed Effects} + \text{Quarter Fixed Effects} + \varepsilon_{i,t} \quad (2)$$

4. RESULTS

Descriptive Statistics

Table 2. shows the summary statistics. Inflows of foreign portfolio investment in all G20 countries had a mean increase during the crisis, also happened in advanced economic

countries, but in emerging market countries the mean foreign portfolio investment decreased when entering a crisis. It is consistent with the study of Hill & Jongwanich (2009), who describes that portfolio investment increases during a crisis due to low stock prices, and bounces back when the crisis ends. Next, foreign direct investment inflows showed a decline in the mean during the crisis in all G20 countries and advanced. Therefore, there was a trend of foreign direct investment inflows to emerging market countries during the crisis. UNCTAD (2019) noted that of the total global foreign direct investment inflows in 2019, 54% went to emerging market countries. Then, in the technology transfer variable, there was a decrease in the mean during the crisis, including in the whole G20 countries, advanced economies, and emerging market countries. This is a direct result of restrictions on international trade activities during the crisis due to the COVID-19 pandemic. Similar to technology transfer, the impact of activity restrictions also causes a decrease in the mean labor productivity growth in all G20 countries, including emerging markets and advanced economic countries.

Tabel 2. Descriptive Statistics

Variables	Pre-Crisis			During-Crisis		
	Mean	Min	Max	Mean	Min	Max
G20 (All Member Countries)						
Economic Growth	1039719	87167	5385081	1028386	59785	5436848
Foreign Portfolio Investment	13728	-119302	239740	27286	-269960	350675
Foreign Direct Investment	17766	-9769	228739	11044	-41233	97956
Technology Transfer	21378	1099	141886	20329	894	150160
Labor Productivity Growth	1,08	-6,04	7,78	-0,89	-21,21	11,34
Export	210532	11209	1483390	202080	7330	1596340
Employment	113448	9408	775443	110078	9332	770115
Trade Openness	0,13	0,05	0,26	0,11	0,04	0,25
G20 (Advanced Economic Countries)						
Economic Growth	1452295	346475	5385081	1429622	307525	5436848
Foreign Portfolio Investment	22139	-119302	239740	47021	-269960	350675
Foreign Direct Investment	25512	-9769	228739	11571	-41233	97956
Technology Transfer	32487	5212	141886	30667	4677	150160
Labor Productivity Growth	0,30	-2,34	2,97	-2,30	-21,21	5,41
Export	313054	64918	1483390	294778	59568	1596340
Employment	59303	9408	200934	57893	9332	198101
Trade Openness	0,15	0,07	0,26	0,13	0,05	0,25
G20 (Emerging Market Countries)						
Economic Growth	627144	87167	3743709	627149	59785	4474085
Foreign Portfolio Investment	5316	-9249	44179	7551	-21830	110754
Foreign Direct Investment	10021	-5221	65337	10517	-3421	97610
Technology Transfer	10268	1099	53613	9991	894	63848
Labor Productivity Growth	1,86	-6,04	7,78	0,53	-9,20	11,34
Export	108010	11209	647973	109383	7330	844080
Employment	167593	11934	775443	162263	9546	770115
Trade Openness	0,11	0,05	0,22	0,09	0,04	0,18

Notes: (1) **Advanced Economic:** Australia, Canada, France, Germany, Japan, Italy, South Korea, United Kingdom, United States, and European Union (2) **Emerging Market:** Argentina, Brazil, China, India, Indonesia, Mexico, Russia, Saudi Arabia, South Africa, and Turkey.

Empirical Results

In the main estimation process, a correlation test is carried out, the result in Table 3. shows how the variables are correlated. However, the coefficient of correlation analysis for regressors reveals that there is no multicollinearity problem for all G20 countries together and in advanced economic and emerging market countries in the entire study period. The results of the Ordinary Least Square (OLS) models are presented in Tables 4-5. First, we analyze the effect of foreign portfolio investment inflows, foreign direct investment inflows, and technology transfers on economic growth. Then, we include labor productivity growth to test its role in moderating the effect of foreign portfolio investment inflows, foreign direct investment inflows, and technology transfers on economic growth.

Table 3. Correlation Matrix

Variables	[1]	[2]	[3]	[4]	[5]	[6]	[7]
[1] Foreign Portfolio Investment	1,00000	0.21790	0.36895	0.02664	0.30911	0.14399	-0.09977
[2] Foreign Direct Investment	0.21790	1,00000	0.6784	0.13563	0.65011	0.42702	-0.11716
[3] Technology Transfer	0.36895	0.67848	1,00000	0.01747	0.77922	0.36596	-0.05137
[4] Labor Productivity Growth	0.02664	0.13563	0.01747	1,00000	0.00617	0.26770	-0.10827
[5] Export	0.30911	0.65011	0.77922	0.00617	1,00000	0.40218	-0.04886
[6] Employment	0.14399	0.42702	0.36596	0.26770	0.40218	1,00000	-0.27181
[7] Trade Openness	-0.09977	-0.11716	-0.05137	-0.10827	-0.04886	-0.27181	1,00000

Notes: Table 3 reports the Pearson correlation between the main variables.

Table 4. Main estimation results (G20 Countries)

Variables	Pre-Crisis		During-Crisis	
	I	II	I	II
C	2192.9 (0.5236)	4047.2 (0.2329)	5115.9 (0.2054)	4726.7 (0.2071)
Foreign Portfolio Investment	-0.0579 (0.6299)	-0.2840** (0.0319)	-0.1363 (0.5533)	0.4825** (0.0774)
Foreign Direct Investment	-0.1924 (0.4477)	-0.7088** (0.0113)	4.7269*** (0.0000)	3.3045*** (0.0029)
Technology Transfer	-4.4770*** (0.0000)	-4.6589*** (0.0000)	-2.0801 (0.8666)	-1.6564 (0.9038)
Labor Productivity Growth		1.4772 (0.6605)		1.5994 (0.9739)
Foreign Portfolio Investment* Labor Productivity Growth		0.3142*** (0.0052)		0.1110 (0.1551)
Foreign Direct Investment* Labor Productivity Growth		0.71170***		0.0069

Technology Transfer* Labor Productivity Growth	(0.0000)	(0.9753)	-0.7617***	-1.3183***
	(0.0281)	(0.0004)		
Export	5.6682***	5.7610***	1.3094	3.8845***
	(0.0000)	(0.0000)	(0.2110)	(0.0029)
Employment	5.2535**	3.8185	4.2943	-0.6127
	(0.0243)	(0.1039)	(0.2313)	(0.8680)
Trade Openness	-59540	-14230	-20857**	-19371**
	(0.8842)	(0.9689)	(0.0232)	(0.0239)
Country Effect	Yes	Yes	Yes	Yes
Quarter Effect	Yes	Yes	Yes	Yes
R-squared	0.9994	0.9995	0.9942	0.9954
Adjusted R-squared	0.9992	0.9994	0.9922	0.9935
F-statistic	5559.2	6021.1	511.28	525.10
Prob(F-statistic)	0.0000	0.0000	0.0000	0.0000
N	100	100	100	100

Notes: *, **, *** represent significance at the 10%, 5%, and 1% levels (2-tailed), respectively. Figures in parentheses () underneath the coefficient estimates are p-value.

5. DISCUSSION

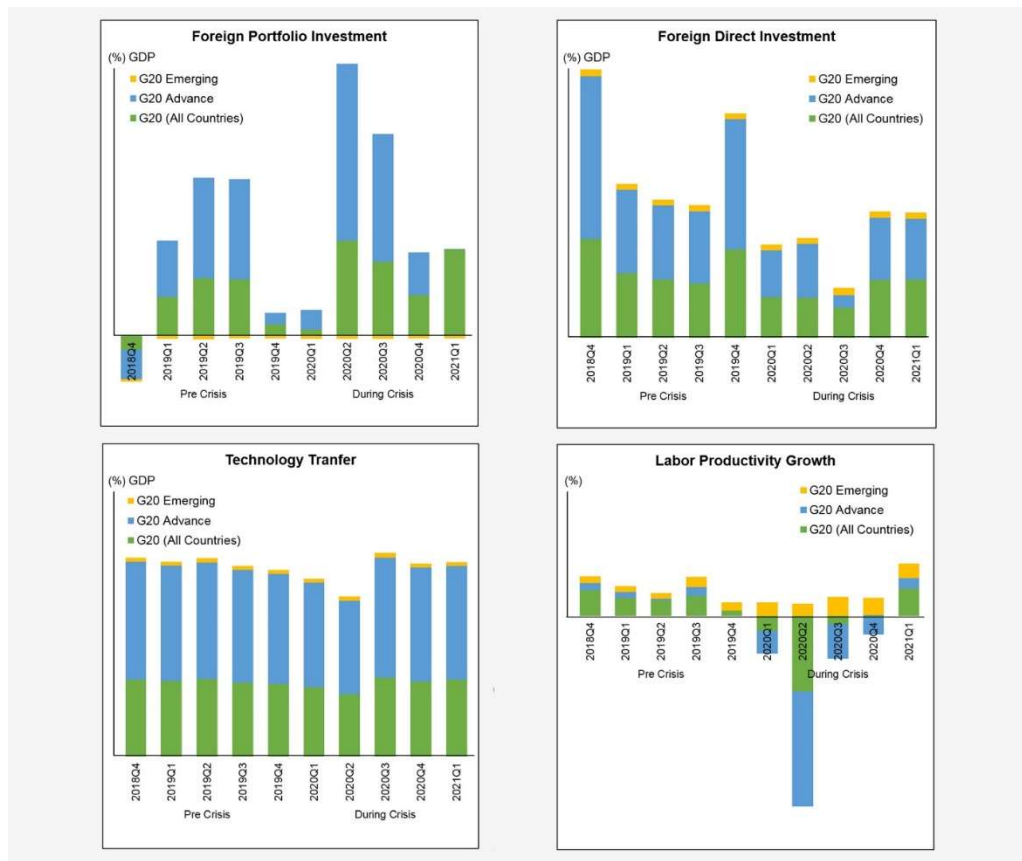


Figure 1. Contribution of foreign portfolio investment, foreign direct investment, technology transfer, and labor productivity growth on (% GDP)

Financial Integration and Economic Growth

As shown in Model I Table 4. foreign portfolio investment has no significant direct effect on economic growth pre-and-during the crisis. Foreign portfolio investment inflows in G20 countries are relatively small compared to nominal GDP, which may indicate that capital account openness in G20 countries was not wide open during this period. It is relevant to MacDonald (2015) who said that the nominal amount of portfolio investment is driven by capital account openness so that countries with greater capital account openness will experience a unidirectional movement between capital flows and growth. These findings validate previous research which found that portfolio equity and debt harm growth or don't affect economic growth (Agbloyor et al., 2014; Choong et al., 2010). In particular, due to the global crisis, portfolio investment will have a more destabilizing effect on the stock market, and fluctuate, known as the 'hot money syndrome'. As a result of the non-binding nature of the equity portfolio, foreign investors can easily withdraw their funds from the host country's economy if there are more attractive opportunities or when conditions host country's stock market falls. Research data shows an increase in the openness of capital accounts in the G20. It is consistent with the research by Hill & Jongwanich (2009) which reveals that portfolio investment increases during a crisis because low stock prices during a crisis become an opportunity to provide high returns when the crisis ends. Thus, this study rejects H1 and validates Bergant (2021) research which found that risk-sharing through foreign portfolios was not significant during the crisis, because it was proven to experience relatively small real GDP growth.

Financial Integration is then also proxied by foreign direct investment. The findings show that foreign direct investment has no significant effect on pre-crisis economic growth, so the H2_a is rejected. But this outcome is not a surprise, and this is in line with the findings of (Azman-Saini et al., 2010; Sokhanvar, 2019; Vujanović et al., 2021) who also discovered that foreign direct investment had no direct effect on economic growth. On the contrary, during the crisis, this research found that foreign direct investment is proven to have an effect on economic growth. During a crisis, this study accepts H2_b, which foreign direct investment inflows are more stable than portfolio investment because foreign direct investment pursues a long-term motive. Foreign direct investment flows attracted by the cheap effects of assets during a crisis where prices are lower in the domestic currency, the exchange rate depreciates and takes advantage of by-products which often occurs during crises (Hill & Jongwanich, 2009). The investment portfolio pursues short-term motives by being responsive to short-term risk profiles so that it can cause a wave of capital withdrawals for the host country. Moon et al. (2011) states that if foreign direct investment flows continuously into crisis-affected countries, then foreign direct investment can help reduce the negative impact of the crisis and contribute to economic stability. The results of this study support the research of Moon et al. (2011) and Simionescu (2016) who found a direct effect of foreign direct investment on economic growth.

These results support the theory of financial integration which explains that financial integration that is interrelated and widely accepted will bring more opportunities for risk-sharing and risk diversification, efficient capital allocation among investment opportunities, and higher growth potential (Baele et al., 2004). The COVID-19 pandemic crisis has indeed had a huge impact on the global economy, so this uncertainty has disrupted the circulation of foreign investment not only in emerging market countries.

Technology Transfer and Economic Growth

The results in Model I Table 4. suggest that technology transfer directly only had a significant effect pre-crisis and during the crisis, it did not, so H3_a was accepted while H3_b was rejected. The technology transfer process implies the movement of physical structures, knowledge, skills, organizations, values, and capital from the generation site to the recipient site (Mittelman & Pasha, 1997). In the context of international technology transfer, most technology transfers are guided by the profit motive. Therefore, the high potential for technology transfer is driven by capabilities (knowledge, skills, and organization). These findings also validate the Ferreira et al. (2020) study, which found that sustainable technology transfer has a positive impact on economic growth.

In addition, the results of this study indicate that technology transfer has no effect during a crisis. This is strongly suspected due to restrictions on various socio-economic activities in the community, and even restrictions on international trade, so that various technology transfer processes are hampered compared to the normal situation (outside the crisis). Therefore, during a pandemic crisis the technology transfer in the G20 countries experienced a decline. Finally, this study supports the findings (Ferragina & Mazzotta, 2014; Xu, 2000) which state that technology flows negatively affect the economic growth of host countries.

Effect of Labor Productivity Growth on the relationship between Financial Integration and Economic Growth

Blonigen et al. (2014), many heterogeneous and multinational companies finally choose to invest abroad because they are more productive than domestic companies. Then, inflow of capital is a driving factor for labor productivity growth because foreign investment is always expected to be a strong incentive to increase efforts in terms of innovation, which is important to encourage increased productivity and sustainable economic growth (Crafts, 2017). In addition, foreign investment flows can increase the liquidity of a company's capital in the capital market, leading to a deeper and wider international market (Levine, 2001). Thus, the positive benefits are increasing the efficiency of the company, thereby encouraging the growth of aggregate output.

Model II Table 4. shows that labor productivity growth is significantly moderate by strengthening the effect of foreign portfolio investment on pre-crisis economic growth, so the H4_a was accepted. The role of foreign portfolio investment as a source of capital has been strongly welcomed by labor productivity growth, resulting in economic growth in the host country. This is in line with the Li et al. (2021) findings, who explain that investments can increase the productivity of industrial workers through the growth of productivity in the reallocation of resources. Furthermore, this finding supports the findings of Rey & Hazem (2020), they found that the economy of the country of Algeria as a whole has performed quite well in terms of economic growth, caused by an increase in production factors, especially labor, although the number is limited. However, during the COVID-19 pandemic crisis, labor productivity growth is no longer proven to moderate the relationship between foreign portfolio investment on economic growth, thus the H4_b was rejected. The problem is the mean value of labor productivity growth (Fig 1. Appendix B) during the crisis in the G20 as a whole declined even grew negative during the crisis. The root of the problem lies in the lockdown policy which causes labor productivity to decline, and the high cases of COVID-19 in various countries which generally attack workers. Plus, the 'hot money syndrome' effect which is allegedly the culprit behind the reversal of capital

flows and causing financial shocks that are detrimental to the host country's economy (Aguiar & Gopinath, 2005).

The next finding in Model II Table 4. shows that labor productivity growth significantly moderates the effect of foreign direct investment on economic growth pre-crisis, so the H5_a was accepted. The benefit of the inflow of foreign direct investment is that existing corporate control (governance) can increase the productivity of the acquired company (Navaretti & Venables, 2020). Because foreign owners can bring superior technical, marketing, and management skills to the acquired company (Fons-Rosen et al., 2021). Therefore, the growth rate of labor productivity will increase and encourage economic growth, competitiveness, and a high standard of living (Porter, 1985). This study is relevant to Azenui & Rada's (2021) findings, which reported that foreign direct investment affected labor productivity growth and its components at the aggregate and sectoral levels. It also re-validates Rey & Hazem's (2020) study on labor productivity which proved significant to economic growth. This finding shows differences in results compared to during the crisis, where during the crisis labor productivity growth was insignificant in moderating the effect of direct foreign investment on economic growth, thus the H5_b was rejected. The main reason for labor productivity growth is no longer moderating because of the limitations of labor activity due to the pandemic which has caused a decrease in total production factors. Even though the accumulation of capital inflows is high, if the labor factor decreases, the factor of production will still decrease (OECD, 2013).

Thus, the results of this study have relevance to the theory of financial integration (Giannetti & Ongena, 2009), which explains that financial integration facilitates access to investment opportunities, and leads to increased efficiency of financial institutions because financial resources are expended to fund productive activities. But these findings no longer prove relevant to theory in crisis.

Effect of Labor Productivity Growth on the relationship between Technology Transfer and Economic Growth

The educational infrastructure for developing human capital is the basis for successful technology transfer. Although education is considered an important and necessary factor in a technology transfer facility, it's not the only success factor in transferring technology. Planning is needed that includes concrete ways in which recipient and donor countries collaborate during the technology transfer process. Without a strong will for technology transfer on both sides, it is impossible to assimilate, adapt and produce new technologies. As shown in Model II Table 4. We find that labor productivity growth significantly moderates the relationship between technology transfer and economic growth in pre-and-during crises. This study accepts H6 and supports (Furman & Hayes, 2004) and (UNCTAD, 2014) who said that strong domestic innovation and technology are key factors to overcoming many problems related to technology transfer and productivity growth. It is undeniable that the COVID-19 pandemic has also had a positive impact with higher digital acceleration, a lot of funds being diverted to research and innovation to cope with change. The fact is that the transfer of non-physical technology did not experience significant obstacles during the pandemic, and the transfer of knowledge continued even though it changed to digital media. Thus, technology is an important in promoting efficiency and encouraging labor productivity growth to produce higher output.

Table 5. Estimation results (Advanced Economic and Emerging Market Countries)

Variables	Advanced Economic		Emerging Market	
	Pre-Crisis	During-Crisis	Pre-Crisis	During-Crisis
C	2028.5*** (0.0099)	1279.6*** (0.0005)	-4912.9 (0.4046)	6958.3 (0.1099)
Foreign Portfolio Investment	-0.0979 (0.4655)	0.4631** (0.0160)	0.7395 (0.5172)	-1.4518 (0.3293)
Foreign Direct Investment	-0.2172 (0.6549)	2.5351** (0.0313)	-0.4315 (0.7889)	3.7082 (0.754)
Technology Transfer	-1.819.4 (0.1619)	-4.9587*** (0.0025)	-8.570.3*** (0.0000)	4.3498** (0.0192)
Labor Productivity Growth	-2.7270 (0.7821)	-1.6115*** (0.0049)	-7.8467 (0.1795)	-1.0832 (0.9826)
Foreign Portfolio Investment* Labor Productivity Growth	-0.0934 (0.5819)	0.2204*** (0.0061)	0.6129** (0.0217)	0.3576 (0.3885)
Foreign Direct Investment* Labor Productivity Growth	-0.4930 (0.5438)	-0.6739*** (0.0066)	0.6338** (0.0244)	3.5593*** (0.0003)
Technology Transfer* Labor Productivity Growth	0.4671 (0.5306)	-0.0220 (0.9481)	1.7591 (0.1355)	-3.9525*** (0.0000)
Export	1.3986 (0.3430)	5.9047*** (0.0000)	5.3497*** (0.0001)	-0.4700 (0.7958)
Employment	-6.2971 (0.5372)	5.1646 (0.5441)	7.6512** (0.0273)	-3.3343 (0.2062)
Trade Openness	-28228. (0.6343)	-35816.*** (0.0004)	24053. (0.5565)	40399. (0.6122)
Country Effect	Yes	Yes	Yes	Yes
Quarter Effect	Yes	Yes	Yes	Yes
R-squared	0.9998	0.9987	0.9994	0.9971
Adjusted R-squared	0.9997	0.9980	0.9990	0.9952
F-statistic	8647.5	1293.3	2683.7	546.67
Prob(F-statistic)	0.0000	0.0000	0.0000	0.0000
N	50	50	50	50

Notes: *, **, *** represent significance at the 10%, 5%, and 1% levels (2-tailed), respectively. Figures in parentheses () underneath the coefficient estimates are p-value. Seluruh model regresi dilakukan dengan menggunakan persamaan (2). Pengelompokan negara, **(1) Advanced Economic:** Australia, Canada, France, Germany, Japan, Italy, South Korea, United Kingdom, United States, and European Union **(2) Emerging Market:** Argentina, Brazil, China, India, Indonesia, Mexico, Russia, Saudi Arabia, South Africa, and Turkey.

Additional results: Comparison of Advanced Economic and Emerging Market countries

Many researchers have proven that financial integration depends on the quality of institutions, most of them say that advanced economic countries get higher growth benefits brought by foreign investment than emerging markets (Al-Abri & Baghestani, 2015; Choong et al., 2010; Comes et al., 2018; Samargandi et al., 2015). In a balanced way,

the G20 forum consists of these two groups, therefore we will discuss further the importance of labor productivity growth in mediating financial integration and technology transfer on economic growth in advanced economies and emerging market countries.

The study findings in Table 4. are discussed below: First, foreign portfolio investment is insignificant on economic growth pre-crisis both in advanced economies and emerging market countries. The lack of capital transactions, including during the crisis, is the reason. The same result also found that foreign portfolio investment is insignificant to economic growth in emerging market countries. However, during the crisis, foreign portfolio investment was significant for the economic growth of advanced economic countries, because during the crisis the flow of capital account was greater open, including foreign portfolio investment capital. In fact, foreign portfolio investment has even doubled compared to pre-crisis. These results are similar to the findings of Choong et al. (2010), who found a positive and significant effect of private capital inflows on the growth process. In particular, portfolio investment and foreign debt only hurt developing market countries.

Second, we have found that foreign direct investment has a significant effect only during the crisis period in advanced economic countries. This finding contradicts the study of Choong et al., (2010), who said that foreign direct investment has a significant positive effect on advanced economies and emerging market countries. This again depends on the capabilities of each host country. The ability of advanced economic countries to manage incoming capital during the crisis is a strength, such as institutional quality, economic conditions and Borenstein et al. (1998) added that the effectiveness of foreign direct investment on economic growth depends on the human capital of the recipient country. Third, the overall technology transfer has a significant effect on economic growth in advanced economies and emerging market countries pre-and-during the crisis. This finding again validates the study of Ferreira et al. (2020), where sustainable technology transfer has a positive effect on economic growth. The entry of new technology, is a rapid efficiency tool to drive productivity growth.

Fourth, this study also examines the role of labor productivity growth on the relationship between financial integration and economic growth. As a result, labor productivity growth moderated foreign portfolio investment in economic growth in advanced economic countries pre and during the crisis. Meanwhile, in contrast to emerging market countries, labor productivity growth moderated foreign portfolio investment towards economic growth only in the pre-crisis period. Once again, this happens because the role of the quality of human resources is the key to managing labor productivity growth. Stock market shocks are always responsive to any changes in economic conditions, and advanced economic countries with their policies have the power to overcome the situation. Furthermore, other financial integration proxies show similar results. We have found that overall labor productivity growth significantly moderated foreign direct investment on economic growth in advanced economic and emerging market countries pre and during the crisis. With exceptions, in emerging market countries, the moderating role of labor productivity growth is insignificant in mediating foreign direct investment on economic growth during the crisis. Finally, the findings show that labor productivity growth only moderates technology transfer in economic growth during the crisis in emerging market countries, as well as indicates an

increase in efforts to adopt technology rapidly by emerging market countries as a response to the COVID-19 crisis.

Robustness Checks

We conduct some robustness checks in this section. First, this study uses control variables to manage the role of independent variables on the dependent variable because the control variables were proposed to affect the independent variable (Retno & Priantinah, 2012). Our study used a control variable as in the previous study by Bende-Nabende et al. (2010) and Benzaim et al. (2021), they used control variables; exports, and employment in their model, then referring to (Choe, 2003) study has used trade openness as a control. As a result, the control variables were significantly successful in controlling alternately or together in the four main research models. Second, we further utilize two alternative measures; advanced economies and emerging markets countries following Eqs. (2) respectively. Table 4. presents the estimation results of the advanced economies and emerging market countries sub-sample in the pre-and-during the crisis. These estimates imply that the significance and magnitude of the coefficients are approximately or substantially the same from all four specifications. It confirms the robustness of estimates and shows the conditionality of labor productivity growth which has moderated the effect of financial integration and technology transfer on economic growth. Finally, Our robustness tests confirm our core results. In Table 6. we change the main dependent variable to GDP per Capita, using the same steps and equations as the main models. Results, from the four models I to IV, the only model I has different results from the main model, while the rest (models II to IV) are all consistent with the results of the main model. Taken altogether, the results discussed in this subsection show that our main findings are robust to alternative GDP per Capita.

Table 6. Alternative Estimation results (G20 Countries)

Variables	Pre-Crisis		During-Crisis	
	I	II	I	II
C	30429*** (0.0001)	30429*** (0.0001)	22915*** (0.0031)	22612*** (0.0046)
Foreign Portfolio Investment	3.7014 (0.3124)	1.2613** (0.0198)	-0.0137 (0.7736)	0.0239 (0.6861)
Foreign Direct Investment	9.2814 (0.2294)	1.8313* (0.0996)	0.3284* (0.0942)	0.2375** (0.0163)
Technology Transfer	9.5612*** (0.0001)	9.2312*** (0.0007)	0.3843 (0.8729)	-0.4462 (0.8798)
Labor Productivity Growth		-6.9710 (0.6075)		-2.3183 (0.9824)
Foreign Portfolio Investment* Labor Productivity Growth		-1.4413*** (0.0020)		0.0139 (0.4092)
Foreign Direct Investment* Labor Productivity Growth		-4.3514 (0.4967)		-0.0253 (0.5989)
Technology Transfer* Labor Productivity Growth		2.9013** (0.0368)		-0.0609 (0.4422)
Export	7.8013*** (0.0080)	1.1212*** (0.0021)	0.0030 (0.9878)	0.2124 (0.4498)
Employment	3.7912*** (0.0001)	5.1412 (0.0001)	0.0302 (0.9657)	-0.1176 (0.8832)

Trade Openness	1.2312*** (0.0001)	1.5412*** (0.0001)	0.4661 (0.1800)	0.3853 (0.2909)
Country Effect	Yes	Yes	Yes	Yes
Quarter Effect	Yes	Yes	Yes	Yes
R-squared	0.9994	0.9971	0.9855	0.9857
Adjusted R-squared	0.9990	0.9952	0.9806	0.9798
F-statistic	1.0127	6.2726	201.19	167.10
Prob(F-statistic)	0.0000	0.0000	0.0000	0.0000
N	100	100	100	100

Notes: *, **, *** represent significance at the 10%, 5%, and 1% levels (2-tailed), respectively. Figures in parentheses () underneath the coefficient estimates are p-value.

6. CONCLUSION AND LIMITATIONS

The findings show that foreign direct investment has a significant effect on economic growth during the COVID-19 crisis. While foreign portfolio investment and technology transfer have no significant effect on economic growth during the COVID-19 crisis. Overall, this study contributes to explaining the role of capability host country resources in the form of labor productivity growth in managing foreign capital flows. These results validate the theory of financial integration (Giannetti & Ongena, 2009), in which labor productivity growth has been proven to moderate by strengthening the relationship between foreign direct investment, foreign portfolio investment, and technology transfer in pre-crisis economic growth. On the contrary, during the crisis period, it is no longer proven to be moderating, because the COVID-19 pandemic crisis has brought the 'hot money syndrome' to portfolio investment and imposed restrictions on large-scale activities, which led to a decline in aggregate labor productivity. Thus, financial integration facilitates access to investment opportunities, and leads to increased efficiency of financial institutions as financial resources are expended to fund productive activities. But these findings no longer prove relevant to theory in crisis.

The purpose of this study is to investigate the role of financial integration, technology transfer on economic growth pre-and-during the COVID-19 pandemic crisis, and the importance of labor productivity growth in mediating financial integration and technology transfer on economic growth in G20 countries. There are some limitations to this research. First, the number of time series is limited, the formation of the research period is based on the International Monetary Fund report where the COVID-19 pandemic crisis period is defined to occur in 5 quarters starting from 2020Q1. Thus, this study only focuses on examining a total of 10 periods pre-and-during the COVID-19 pandemic crisis. Second, the availability of research data in quarterly form limits the search for other factors as proxies in financial integration.

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