



# Do economic freedom, innovation, and technology enhance Chinese FDI? A cross-country panel data analysis

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## ABSTRACT

This study evaluates the determinants of Economic freedom, innovation and technology concerning Chinese foreign direct investment. The aim of the study is to explore, that how these determinants influence Outward Foreign Direct Investment (OFDI) from China toward different regional economies. The study will enrich the existing literature by providing useful policies to the concerned economies to influence more Chinese FDI to host economies. The panel data set includes 27 (African, European, and Asian) Countries data over the period of 2003 to 2018. Moreover, the study employed panel data analysis and the result reveals that property rights, patents residents (pantentAR), Research & Development (R&D), Inflation, official exchange rate (OER), and Tax Burden (TaxB) have a strong positive and significant impact on Chinese OFDI in the selected sample countries, While Government Expenditures (GovE) has positive, but insignificant impact on Chinese OFDI. On the other hand, Chinese OFDI is negatively and statistically significant association with Business Freedom (BusF). This study will put forth considerable policies to the concerned to induce further inflows of Chinese FDI into the host countries. The policymakers should build policies that provide a comfortable environment for business activities and mostly focus on value-added production i.e., expenditures on R&D to enhance high-technology exports because they efficiently attract FDI into host countries. Another key factor is Tax Burden (TaxB), which significantly influences Chinese FDI along with other factors.

## 1. Introduction

It is agreed that each country in the world is trying to attract foreign direct investment to achieve economic development as well as economic growth [1]. Foreign direct investment provides human capital [2], information about technology, modern technology,

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money, modern ways of production, and so on. Everybody knows well that now a day's China is leading on the platform of outward FDI to developed and developing countries. The outward FDI from China in 2018 amounted to \$143.04 billion approximately. FDI is seen as an engine of growth as it provides much-needed capital for investment, increases competition in the host country's industries, and aids local firms to become more productive by adopting more efficient technology or by investing in human and/or physical capital. It is expected that by providing access to, transferring technology and foreign markets, and generally building capacity in the host country firms, FDI improves the integration of the host country into the global markets and fosters growth. FDI is seen as "a key driver of economic development & growth [3–7]. Lall and Narula [8] propound that the different mechanisms and forms of FDI bring changes in development. They explained the role of Multinational Enterprises (MNEs) in host countries' industrial development. By considering the learning perspective, the determinants of FDI in Nigeria are infrastructure development, market size, and stable macroeconomic policy. FDI in Nigeria contributes positively to economic growth [9]. Better financial markets allow agents in the economy to get the benefits of knowledge spillover from FDI. The empirical analysis shows that FDI plays a key role in economic development. On the other hand, foreign firms may play an important role in providing modern technology and information about technology to the host country. However, when foreign firms came into competition with local firms that cause imperfect competition, local firms cannot be able to compete with foreign firms [4]. There is no strong evidence of bi-directional and long-run connection between FDI and economic growth in Malaysia. It is suggested, that FDI indirectly affects economic growth in Malaysia [10]. There are many determinants of FDI by which host countries try to attract FDI, and the investor countries want to invest in foreign developed and developing countries for many purposes. The first determinant of the study is economic freedom, as comprised of up to three proxies of economic freedom to pursue the observation of a link between IFDI and economic freedom. The impact of market size and gross capital formation on inward FDI is positive and significant [11]. Economic freedom along with political freedom positively associated with IFDI. Further, the relationship of voice and accountability is positive with inward Foreign Direct Investment (IFDI) [14]. According to Quazi [15], Economic freedom used as a proxy for domestic investment climate and found as a significant determinant of inward FDI. Additionally, Political instability found to be significantly negative toward IFDI. Higher levels of EF can be viewed as indications of unrestricted news of the economic environment. Economic Freedom (EF), through its sub-components, has been identified as a key determinant in attracting FDI [16]. EF could exercise a direct promoting effect on economic growth [17]. Higher levels of EF would motivate individuals and firms by stimulating their economic incentives and would lead to the efficient allocation of resources. The 2nd determinant of the study is Innovation and technology which is now a day's well-known methodology of production and distribution. This paper considered approximately 3 proxies of innovation and technology to explore the relationship between IFDI and innovation and technology. Acuna-Opazo and Castillo-Vergara [18] showed that market and organizational innovations have a positive and significant effect on business performance in a group of companies at the initial stages. The government should adopt such policies that supports high-tech sector, larger investments in innovations and promote high-tech trade. As well as preferential tax, innovation financing, better management of S & T, R & D, and innovation funds [19]. Tax preferences can affect innovation quality by influencing R&D, which means there is a "partial intermediary effect" that exists between tax preferences, R&D, and innovation quality. Further, R&D and innovation quality enhance the performance of enterprises [20]. With technological developments, the capacity to sustain the benefits of FDI becomes easy. As a result, technology may be the important driving force of inward FDI in emerging economies since they benefit from technology transfers through FDI inflow [21]. A favorable investment environment for technology transfers positively influences FDI [22]. This argument supports the leapfrogging technological growth pattern in some countries particularly emerging economies. In pursuance of advancement, emerging economies recognize the need to reduce the technology gap and stimulate innovative capacity [23]. The ability to adopt technology and innovative capacity increases the capability to survive new challenges in the business environment. Some contrasting literature exists, which reflects negative relationship of IFDI with economic freedom, innovation, and technology. Economou [11] found that there is a negative relationship exists between labor costs and IFDI. Domestic institutions have a positive impact on innovation. But the FDI showed a negligible effect. Given the institutional setting of China, FDI may channel for technology transfer but does not lead necessarily to innovation [24].

The nexus of Economic freedom and innovations with FDI has garnered immense attention in the present time. However, there are scanty empirical studies that scrutinize the nexus between economic freedom, innovations & Technology, and China's OFDI. Prior studies relevant to Chinese outward FDI, most focus has been devoted to hosting countries' macroeconomic variables (GDP, Trade openness, exchange rate, and inflation), and natural resource variables (Fuel and minerals) [25,26]. The role of economic freedom, innovations, and technology in determining the flow of FDI from China has been unexplored so far. This gap in the literature motivated this study to explore the environmental impacts of economic freedom and innovation by considering its different dimensions, which will yield robust results. Further, this study will consider heterogeneity effects i.e., by investigating the nexus between innovations, economic freedom, and China's OFDI across the different regions and income levels of the countries. The study results will have useful policy implications for the authorities concerned to induce further inflows of Chinese FDI into the host countries.

## 2. Literature review

Economou [11] examines the impact of several traditional foreign direct investments alongside the impact of economic freedom from 1996 to 2017 by using the 2SLS method & Robust standard error test for four south European economies (Greece, Italy, Portugal, and Spain) and found a positive impact of market size and gross capital formation on inward FDI. Additionally, property rights, government integrity, monetary freedom, and financial freedom also have positive relation with inward FDI. Sambharya and Rasheed [27] studied the various dimensions of economic freedom and political freedom with IFDI by using a generalized least square (GLS) method over the series of 1995 to 2000 for 95 countries and resulted, that economic freedom (Market-driven prices and wages) positively related to IFDI. Their study also found a positive link of political freedom (voice and accountability, better allocation of

resources in society) with IFDI. Quazi [15] investigated the nexus between economic freedom and FDI for seven East Asian countries over the years 1995–2000 by using GLS, the random effect model and the Ramsey RESET model. The result depicts that domestic investment climate is a significant determinant of inward FDI. On the other hand, Political instability found significantly negative toward IFDI. Economou et al. [12] Examine the determinants of inward FDI for 24 OECD and 22 non-OECD developing countries over the period of 1980 to 2012 by employing dynamic panel approach, standard fixed effect and Arellano–Bover/Blundell–Bond panel data estimation method. They found that one-legged FDI, market size, trade openness, and schooling have positive impact on FDI inflows. However, inflation and high corporate tax have negative relation with IFDI. While institutions (Political stability and absence of violence) have positive effect on inward FDI. Kang and Jiang [13] studied the factor determining outward FDI of China's location choices of multinational firms toward the eight east and southeast Asian economies from the period of 1995 to 2007 by using the LaGrange multiplier test, the random-effects model and the variance inflation factor test are applied. Their study reveals positive impact of the market-oriented economy on Chinese MNEs' location choices. Political influence (legal regulation regimes and legal dimensions) is found negatively associated with Chinese MNEs' location choices. Furthermore, a strong positive relation found regarding bilateral trade and Chinese MNE's location choices. Zhang [7] investigated the spatial pattern of Chinese outward foreign direct investment (OFDI) to Latin America, by considering the determinants of socioeconomic factors that affect the attractiveness of Latin America for Chinese capital. The study includes 33 Latin American countries throughout 2013–2015, regression analysis and variable inflation factor (VIP) are applied on the panel and the analysis demonstrates that China's OFDI is positive relationship with bilateral trade and the local size of the population. Azman-Saini, Baharumshah and Law [16] observed the link between Economic freedom, economic growth, and foreign direct investment for 85 countries from 1975 to 2004 through the GMM estimator method. The study resulted that economic freedom (market size, legal structure and property rights security, access to sound money, market regulations, and trade with foreigners, especially absorptive capacity) has positive and statistically significant influence on economic growth, Economic freedom provides opportunities to MNEs. Zghidi et al. [28] explored the association among FDI, economic growth, and economic freedom for four north African economies from the period 1980 to 2013 by using the GMM method. Their results confirmed that FDI is the main channel for technology transformation and economic freedom is an important term for economic growth. Especially, authors explored that EF is an important factor for FDI attraction. Moreover, a strong positive relation exists among FDI and economic growth, EF works as the complement of FDI and that FDI is more effective for economic growth. Kang et al. [29] explored foreign direct investment determinants by giving attention to economic and institutional factors among the South Asian Association for Regional Cooperation (SAARC), Central Asian Countries and Association of Southeast Asian Nations (ASEAN) over the time of 2002–2014 by utilizing the generalizing method of movements (GMM) technique. Their results reveal, large differences in the economic and institutional factors have serious implications for FDI Central Asian countries, SAARC, and ASEAN regions. Furthermore, the analysis indicates that real GDP, Economic freedom, and domestic investments have a positive impact on inward FDI in SAARC. Whilst the labor force and governance negatively impact IFDI. Moreover, Central Asian countries domestic investments, real GDP, and governance index have positive effect on inward FDI. Furthermore, they argue that without GDP other factors such as governance, labor force, economic freedom, and domestic investment affects positively the term IFDI in the ASEAN region and that the domestic investment positively affects inward FDI to all regions (ASEAN, SAARC, and Central Asia). Ghazalian and Amponsem [30] examined the economic freedom and sub-components of economic freedom reflecting the quality of institutions on IFDI. Their results suggests that economic freedom positively influences IFDI, But the different factors of economic freedom have different effects on IFDI.

### 3. Relationship of innovation and technology with FDI

Acuna-Opazo and Castillo-Vergara [18] observed the effect of barriers to innovation in the performance of business in the different stages of business in the companies by using multiple linear regression analysis for the services and manufacturing industries in Chile. Their result shows that market and organizational innovations have a positive and significant effect on business performance in a group of companies at the initial stages. Liu et al. [19] examine that China transformed itself from a planning to a market-oriented economy and sustained long-period economic growth in which the contribution of innovation in science and technology (S&T) is increasingly important. They analyzed 287 policies issued by China govt, to suggest those policies which are conducive to better innovations over the period of 1980 to 2005. The study analysis suggests those policies that support the high-tech sector, larger investments in innovations and promote high-tech trade along with preferential tax, innovation financing and better management of S&T, R&D and innovation funds. Ting, Sheng and Hang [20] studied the relationship between tax preferences, R&D and innovation quality from 2008 to 2017, using the mediating effect test for the selected area enterprises in Shanghai Shenzhen. The study resulted that tax preferences can affect innovation quality by influencing R&D, that means that there is a “partial intermediary effect” that exists between tax preferences, R&D and innovation quality. The study also found that R&D and innovation quality enhance the performance of enterprises. Piperopoulos, Wu and Wang [31] conceptualized how knowledge-seeking motivates the internationalization of emerging market enterprises, Whether OFDI leads to promoting innovation performance and geographical location choices affect links in different countries of Chinese EMES? The study estimates the data set of Chinese EMES (total 96, 76(79%) in developed countries, and 20(21%) in developing countries) over the time period of 2001 to 2012 by using 2 types of count model (1). Poisson regression and 2). negative binomial regression. They concluded that OFDI has positive impact on Chinese EMES subsidiaries and that the effect is more impressive when OFDI directs toward developed countries rather than developing economies. Vahter [32] investigated that does FDI affects productivity growth, innovation and knowledge-sourcing activities of domestic firms. The panel data of the study consists of the Estonia manufacturing sector during 1995–2004 by using 2 stages least squares regression approach. And found a positive spillover on the innovation process by the entry of FDI through knowledge flows to domestic firms. Lew and Liu [33] examined whether the absorptive capacity (ABC) of the host country contributes to the utilization of knowledge spillover, innovation and inward FDI. their

study covers 31 provinces of China from the year 2008 to 2011 by using OLS and goodness of fit models. They resulted, the lower ABC of a firm negatively affects IFDI and if a firm ABC is at a higher level then it permits more IFDI. Additionally, innovation is likely to expel more due to IFDI, while radical innovation is more dependent on human capital ABC demonstrated that ABC is a moderator of IFDI knowledge spillover [2]. Khachoo and Sharma [34] examined the spillover existence and its impact on the innovative performance on the domestic firms in the Indian manufacturing sector. The study developed the measurement of intra and inter-industry to capture the effect of FDI on the innovation performance of the incumbent firms active in the same sector as MNC in upstream and downstream sectors. The econometric result shows after accounting for endogeneity, FDI has a moderate impact on the innovative performance of firms in the selected industries. And the impact is statistically strong as well in the supplying sector over the innovation performance. Ascani, Balland and Morrison [35] studied the FDI relation to full fill the gap of FDI effects on neighboring regions and the type of FDI generating strong learning effects. As previous studies show, all the countries compete to attract FDI to access knowledge and technology and boost economic development. Quazi [15] the existent literature reflects the positive impacts of IFDI. Their study covers 103 Italian provinces for the period of 1999–2006 by using fixed effect estimation and spatial autocorrelation. They observed that the local economy benefited from only specific categories of FDI. Whilst negative outcomes may face by other types of FDI. Furthermore, spatial implications of FDI evidence are limited. Howell [36] employed structural innovation model to investigate the indigenous innovation process in China as well as the role of industry-relatedness and tested that to what extent the relaxation of foreign ownership control influences the relationship between firms' innovation process and relatedness. The study analysis data from 2001 to 2007 by employing CDM and ACF models over nearly 170000 Chinese firms and found that R&D boost innovation output and the relatedness economies are also linked positively with each phase of the innovation process, although the effects depend on the firm innovation stages. Moreover, FDI liberalization encourages firms to rely on related economies in the following ways: (1) To help in solving organizational problems faced by related industries. (2) To complement R&D expenditures that are required to adopt advanced technologies from foreign. (3) To recombine related industries' knowledge to bring forth new proprietary ideas. Liu and Buck [37] empirically observed the impact of different channels for the spillover of international technology on the Chinese high technology industries innovation process. The study is based on 21 sub-sectors of Chinese high technology industries, the OLS estimator and GMM method are used to analyze data from 1997 to 2002. The reported estimations show that learning by trade (exports, imports) promotes Chinese indigenous firms' innovation, as well as foreign R&D activities of MNEs significantly affecting the host country's domestic innovation performance only when absorptive capacity is taken into account. Castellani and Zanfei [38] scrutinized 3932 firms of manufacturing industries in France, Spain, and Italy (in which 1950 located in France, 980 located in Italy, and 1002 located in Spain) for the period of 1992–1997 by using the chi-squared test alongside OLS to find the impact of foreign presence on the domestic production. The research work found positive and significant externalities in Italian firms, generalized result for individual country results indicate the productivity gap between foreign and domestic firms and the absorptive capacity of domestic firms. The result also shows a high gap tends to favor positive effects of FDI. This confirms the “catching up hypothesis” and contradicts the “technology accumulation hypothesis”. Kayalvizhi and Thenmozhi [39] explored how technology, corporate governance and culture affect IFDI? The sample covers 22 emerging economies data from 1996 to 2014. They concluded that technology plays a crucial role in attracting FDI, as innovation capacity and technology absorption increase IFDI, while cultural dimensions weakly influence IFDI and power distance has a stronger effect on FDI inflows. Further, they argued that the better quality of a country's governance attracts greater IFDI.

## 4. Data and methodology

### 4.1. Data

The core vision of the study is to investigate the determinants of Economic freedom and innovation and technology concerning Chinese FDI. This study conducted the data set of 27 (African, European, and Asian) Countries based on the period 2003 to 2018. This section contexts the model specification and econometrics methods used for empirical analysis. Then, we proceed with model selection, description of data sources, and variables used.

### 4.2. Methodology

Panel data technique and approach is largely used for longitudinal data analysis in the area of social sciences research [40]. In the panel data method, individuals (e.g., countries, firms, or groups of peoples) are scrutinized cross-section wise as well as occasionally over specific time intervals [41]. Furthermore, with repeated observations of abundant cross-sections, researchers are skilled to study and analyze the dramatic changes with short time series data by using panel data techniques [42]. One core advantage associated with the employment of the panel data is that it provides chances to deal with such a problem of heterogeneity i.e., to control unobserved heterogeneity of individuals or time specific [43]. There are particular leads and benefits of using panel data, as estimated parameters provide more details, correctness, and precision with less likelihood of collinearity between the variables [44,45]. When the time series and cross-sections aspects gather with each other, they improve the quality and quantity of the data in such ways that would not be possible using only one of these two aspects [46,47].

In the aim to estimate the determinants and motivations of Chinese OFDI, to Africa, Asia and Europe. In this study, the panel data approach/analysis have been utilized. This analysis considers the variables heterogeneity, allows a huge amount of data points, and upgrades the efficiency of the findings. There are basically three kinds of panel data models with different methods: (a) Common constant (b) Fixed effects (FE) (c) Random effects (RE). In such a common constant model, the coefficients are constant (i.e., the

intercepts and slopes). In this model for a specific event, not even country particular effect nor the temporal effects are taken into account, thus all country’s data is pooled to run the Ordinary Least Squares (OLS) regression technique [48]. Even if there are either entity or time-specific effects, however, at some time and moments, these are statistically insignificant. This model is also known as the pooled ordinary least squared model (POLS) or commonly pooled regression model.

One disadvantage of the pooled regression analysis is that it assumes homogeneity for all variables and entities which does not lead to control of the particular country effects. This may lead to bias estimation due to a correlation between the independent variables and unobservable effects [49]. However, under the thesis that the data is homogeneous is confined and complicated, this study of more interest involves the inclusion of Fixed and Random Effects in the method of findings [50].

As for the Random effects model, it is a regression with a random constant term, that is built on the Generalized Least Squares (GLS) estimator that takes into account time series and the cross-sectional aspects of the data [51]. Intercepts are seen as random variables across the pooled countries. As a result, it can provide better estimations especially when there are little time-series differences. However, if the specific effect is correlated to some of the explanatory variables then biased and inconsistent estimates are likely to occur. Torres-Reyna [52], the differences across entities are supposed to be random and uncorrelated with the independent variables contained by the model.

As for the fixed-effect model, it is a regression with a fixed constant term. Bai, Choi, and Liao [53], FE assumes that something within the individual may affect or bias the independent or outcome variables. The rationale behind the assumption of the correlation between the entity’s error term and independent variables. FE removes the effect of those time-invariant characteristics so we can assess the clear effect of the predictors on the outcome variable. One more important assumption of the FE method is that those time-invariant characteristics are unique to the entity/individual and that should not be correlated with other entity/individual characteristics.

The Hausman [54] specification test is applied to identify the presence of fixed and random effects in the model. Where the null hypothesis is that preferred random-effects model and the alternative hypothesis is that preferred fixed effects model, (see Green [55], chapter 9). When the value of Hausman test is greater than 0.05 then will select random effect and if it’s become smaller than 0.05 then will priori fixed effect model.

### 4.3. Model specification

The given model should be used for the estimations of results:

$$OFDI_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 Z_{it} + \alpha_i + \gamma_t + \mu_{it}$$

Where  $OFDI_{it}$  is Chinese FDI toward country “i” overtime “t” and  $X_{it}$  demonstrates running’s three main variables for motivation of Chinese OFDI. Where  $Z_{it}$  represents the set of control variables (Official exchange rate, Secondary school enrolment, GDP per capita, and inflation). While  $\alpha_i$  shows the countries’ unobserved effect that is constant over time. While  $\gamma_t$  represents the unobserved effects of periods that are common across groups of countries. In last the term  $\mu_{it}$  is different across groups of countries and time periods.

Based on the above-discussed theoretical framework and the structure of Asian, European, and African economies along with the sharp characteristics of the flow of Chinese FDI to Asia, Africa, and Europe, we have presented and used the given model for result estimating of the determinants of FDI in regions (see Table 1).

$$\ln OFDI = \beta_0 + \beta_1 \ln(\text{Patent}, AR) + \beta_2 \ln(\text{Property}, R) + \beta_3 \ln(\text{TaxB}) + \beta_4 \ln(\text{BusF}) + \beta_5 \ln(\text{GovE}) + \beta_6 \ln(\text{OFER}) + \beta_7 \ln(\text{Inflation}) + \beta_8 \ln(\text{R\&D}) + \mu_{it}$$

Where:

- OFDI denotes China’s Annual OFDI stock in Asian economies.
- Tax,B is Tax Burden(annual Tax in %)

**Table 1**

Variables description.

Variables	Description	Data source
FDI	Stock outflow Foreign direct investment from China (in million dollars)	2018 Statistical Bulletin of China’s outward FDI.
Economic freedom (EF)	Liberalism to economic activities (Range from 0 to 100)	Heritage Foundation
- Government		
- Expenditures		
- Fiscal freedom		
- Business Freedom		
- Tax burden etc		
Exchange rate (ER)	Official exchange rates	World development indicator (WDI)
Innovations & technology(I&T)	Research & Development expenditures	World development index (WDI).
- Research &		
- Development		
- Patents		
- Property Rights etc		

- Property R is Property rights backed by transparency in dealings.
- BusF represents business freedom (% of GDP)
- GovE is government spending/expenditures (annually in %)
- Inflation is annual consumer prices (%).
- OFER is the Official exchange rate (LCU per US\$, period average)
- PatentR is Patent applications, residents.
- R&D is research and development expenditures (% of GDP)

## 5. Results and discussion

### 5.1. Descriptive statistics and diagnostic tests

The observations, means and standard deviations of the data justified for analysis are reported in Table 2, so far as the descriptive statistics enable a regressor to know about the distribution and nature of the data, such variables like PatentsAR, propertyR, TaxB, BusF, and GovE are main independent variables, whilst OFER, Inflation, and R&D are our control variables and the term FDI is the dependent variable of the model. Where the standard deviations reflect the worth of a variable included in the regression, as well as the pairwise correlation among the variables of the selected data can be seen in Table 2 Where the term propertyR is the second variable highly correlated with the FDI, and PatentAR (0.675 & 0.673) from all other variables of the table, while TaxB and GovE are highly correlated with each other as shown in Table 3. However, the well-known and widely useable test variance inflation test (VIF) is employed to test whether the serial correlation among the variables causes multi-collinearity.

Where Table 4 reports the results of the variance inflation factor (VIF) test. The VIF values are pretty much lower than that of 10 as shown in Table 3. This demonstrates that the existing correlation between variables is not causing the problem of multicollinearity [56]. In addition, the regression is run along with clustered standard errors corrected at the country level, according to Mottaleb and Kalirajan [57] regression with cluster-id leads to overthrowing the possible serial correlation in our static model. Further, to check the potential effect of heteroscedasticity we have conducted the Breusch-Pagan/Cook-Weisberg test. The probability value of 0.69 indicates that our regression results do not suffer from the problem of heteroscedasticity.

As shown in Table 5 the coefficient explains that if 1% change occurs in an explanatory variable, then the dependent variable will be changed by the coefficient value of the variable according significantly by its sign. Table 5 depicts, when PatentAR increased by 1% then FDI will be decreased by 0.035%, but it is not significant statistically, so FDI from China has negative relation with PatentsAR of the host countries. So far as, when 1% increase occurs in property rights then FDI flow to the host country would increase by 1.097% significantly. Similarly, when TaxB increased by 1% in the host countries will lead to 1.328% rise in FDI from China significantly. Same is the case with BusF when it is increased by 1% s, then FDI enhance by 5.739% which is statistically significant as well. Moreover, the increase in GovE by 1% will increase FDI will by 0.629% in host countries significantly. Furthermore, if OFER increases by 1% then the FDI from China will enhance by 0.193% to the host countries, and it is statistically significant as well. Additionally, when inflation in the host countries increases by 1% then it will lead to increase in FDI by 0.307% significantly. The relationship between R&D and FDI from China is negative, if R&D expenditures increased by 1% then the FDI flow will reduce by 0.781% and is statistically significant.

Based on the Hausman test, The fixed effect technique is applied to regression of the justified data advised by the Hausman test where the p-value is 0.025 as shown in Table 6, which indicates that the fixed-effect method is a better one than the random effect method, which control the unobserved individual’s heterogeneity, which is constant over some time. In addition, the regression is run along with clustered standard errors corrected at the country level. According to (Mottaleb and Kalirajan [57] regression with cluster-id leads to overthrowing the possible serial correlation in our static model.

Table 7 represents the estimations of data with fixed-effect analysis. The regression of fixed effect reveals different coefficient values for the variety of variables included in the data from 2003 to 2018. The results for variables in Table 7 depict that, when the PatentAR increase by 1%, it influences the FDI flow with an increase of 0.530% to the host countries significantly. If property rights increase by 1% then FDI flow will enhance by 1.491% which is statistically significant. While, if TaxB increases by 1% then FDI will rise by 6.949%, TaxB is the most influential variable and statistically significant as well. BusF, when it is increased by 1% then the FDI inflow decreased by 1.762% significantly, it reveals a negative relation in contrast to TaxB. where GovE increase by a percent will bring a 0.296% increase in FDI, but it is statistically insignificant. While a 1% increase in OFER will influence FDI with an enhancement of

**Table 2**  
Descriptive statistics.

Variable	Obs	Mean	Std.Dev.	Min	Max
lnFDI	419	4.969	3.109	-2.813	13.395
lnPatentAR	431	7.025	1.825	4.043	12.817
property	417	20.322	2.048	10.736	23.863
lnTaxB	432	4.281	.238	3.395	4.543
lnBUSF	432	4.269	.207	3.57	4.605
lnGovy	429	3.89	.655	-.693	4.557
lnOFER	423	1.918	1.612	-1.584	5.64
lnInflation	392	1.167	1.084	-2.922	4.081
lnRDE	382	-.041	.76	-1.799	1.521

**Table 3**  
Correlations matrix.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) lnFDI	1.000								
(2) lnPatentAR	0.332*	1.000							
(3) LnpropertyR	0.675*	0.673*	1.000						
(4) lnTaxB	0.052	-0.257*	-0.207*	1.000					
(5) lnBUSF	0.336*	-0.045	0.313*	-0.269*	1.000				
(6) lnGovy	0.194*	-0.124*	-0.075	0.753*	-0.196*	1.000			
(7) lnOFER	0.247*	0.243*	0.259*	-0.037	-0.121*	-0.003	1.000		
(8) lnInflation	-0.112*	-0.068	-0.317*	0.268*	-0.446*	0.235*	-0.036	1.000	
(9) lnRDE	0.240*	0.506*	0.588*	-0.587*	0.411*	-0.485*	0.150*	-0.462*	1.000

**Table 4**  
Variance inflation factor.

VIF	1/VIF
2.770	0.361
2.690	0.372
2.630	0.380
2.470	0.405
2.250	0.445
1.770	0.565
1.460	0.683
1.150	0.866
2.150	

**Table 5**  
Linear regression (pooled OLS).

lnFDI	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]
lnPatentAR	-0.035	0.101	-0.34	0.732	-0.233	0.164
PropertyR	1.097 ***	0.093	11.86	0.000	0.915	1.279
lnTaxB	1.328 *	0.780	1.70	0.090	-0.208	2.864
lnBUSF	5.739 ***	0.712	8.06	0.000	4.337	7.140
lnGovy	0.629 **	0.253	2.49	0.013	0.132	1.126
lnOFER	0.193 **	0.077	2.51	0.012	0.042	0.344
lnInflation	0.307 **	0.124	2.47	0.014	0.062	0.552
lnRDE	-0.781 ***	0.248	-3.14	0.002	-1.270	-0.292
Constant	-50.579 ***	4.416	-11.45	0.000	-59.270	-41.888
R-squared	0.622		Number of obs		308.000	
F-test	61.575		Prob > F		0.000	

\*\*\*p < 0.01, \*\*p < 0.05, \*p < 0.1.

**Table 6**  
Hausman (1978) specification test.

Hausman test	Coef.
Chi-square test value	16.20
P-value	0.025

2.721%. Further, if a 1% increase occurs in inflation affects FDI positively by 0.222% significantly. In last when the host country increases R&D by 1% so FDI inflow from China will increase by 1.713% which is statistically significant.

## 6. Conclusion and policy implications

### 6.1. Conclusion

In recent year's China, OFDI has gradually increased over time specifically in developing economies. This study will provide useful insights into the existing literature by exploring the determinants which motivate Chinese FDI by taking a large sample of 27 countries (African, Asian and European) from 2003 to 2018, by employing a fixed-effect method with cluster standard errors. Further, diagnostic tests like VIF and Breusch-Pagan tests have been conducted to check for multicollinearity and heteroscedasticity issues. Regression results with cluster standard error controlled for possible serial correlation. The findings of the study provide evidence of variables i.e.,

**Table 7**  
Main Regression results (fixed Effect).

lnFDI	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]
lnPatentAR	0.530 **	0.246	2.16	0.032	0.047	1.014
propertyR	1.491 ***	0.131	11.39	0.000	1.234	1.749
lnTaxB	6.949 ***	1.405	4.95	0.000	4.183	9.715
lnBUSF	1.762 **	0.840	-2.10	0.037	-3.415	-0.108
lnGovE	0.296	0.220	1.35	0.180	-0.137	0.729
lnOFER	2.721 ***	0.289	9.40	0.000	2.151	3.291
lnInflation	0.222 **	0.097	2.30	0.022	0.032	0.412
lnRDE	1.713 ***	0.477	3.59	0.000	0.774	2.653
Constant	-57.724 ***	5.972	-9.67	0.000	-69.480	-45.967
R-squared	0.612		Number of obs		308.000	
F-test	53.806		Prob > F		0.000	

\*\*\*p < 0.01, \*\*p < 0.05, \*p < 0.1.

PatentAR, PropertyR, TaxB, and R&D expenditures positively and significantly influence Chinese FDI toward the set of selected countries except for Ghat Effects positively but insignificant. While BusF has a significantly negative effect on Chinese FDI toward the host economies. Amongst all the variables TaxB, OFER, BusF, and RDE are found the crucial determinants of Chinese Outward FDI and statistically significant as well, which are counted for (6.949%, 2.721%, 1.762% and 1.713%).

## 7. Policy implications

The study finding has some policy implications for Asian, European, and African countries.

- ✓ The innovation and technology proxies by patentAR, and the use of intellectual property, have a strong positive impact on FDI. Therefore, the host countries should opt for those policies that enhance the quality of production through innovations and new technology, backed by expenditures on research and development to attract more and sufficient amount of Chinese FDI.
- ✓ Higher levels of economic freedom can be viewed as indications of the unrestricted economic environment. Economic Freedom (EF), through its sub-components, (TaxB, GovE, and BusFetc) has been identified as a key determinant in attracting FDI relevant to the study of [15]. Higher levels of EF would motivate individuals and firms by stimulating their economic incentives and would lead to the efficient allocation of resources. Therefore, policymakers should adopt policies that promote economic freedom to boost their economies.

## 8. Limitations and future recommendations

- Firstly, our study Analyses the panel data for 27 African, European and Asian economies. The researchers may conduct a study of other economies.
- Secondly, this study considers the time period of 2003 to 2018. In future, another study may update the study time period from 2003 to the present year.
- Thirdly, this paper employed Fixed Effect model for the analysis. New study on such topic may opt for other analysis techniques.
- Fourthly, this study picked three subcomponents i.e., proxies of EF and two subcomponents of Innovation and Technology. A future study may pick other subcomponents of EF and I & T.

## Author contribution statement

José Moleiro Martins, Azeem Gul, Mário Nuno Mata: Conceived and designed the experiments; Performed the experiments; Wrote the paper.

Syed Arslan Haider, Sareer Ahmad: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

## Data availability statement

Data included in article/supplementary material/referenced in article.

## Additional information

No additional information is available for this paper.



## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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