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FDI AND GDP: COMPARATIVE ANALYSIS FOR CHINA, INDIA AND EUROPE

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Abstract: *This work aims to examine the connection between FDI (foreign direct investment) and the Gross Domestic Product (GDP) of Europe, China, and India. A linear regression model was chosen using China, India, and Europe as examples, using GDP as the dependent variable and FDI as the independent variable. The best results with this model were achieved for China, where the highest correlation of both factors was found at 0.9929813. For India, the correlation between FDI and GDP was slightly lower (0.9548797), while for Europe, GDP and FDI appear to be relatively uncorrelated (correlation of 0.2576872).*
Keywords: *FDI, GDP, CAI, Linear Regression*

INTRODUCTION

With the background of the Comprehensive Agreement on Investment (CAI), established between China and Europe at the end of 2020, the connection between FDI and GDP in comparison to China, India and Europe will be investigated.

Foreign Direct Investment (FDI) is regarded as a crucial provider of technology and expertise in developing nations. In contrast to portfolio investments and development aid, they are characterised by the transfer of production know-how and management skills. While portfolio investments are limited and do not provide the advanced technologies needed, FDI promotes growth through job creation, meeting investment needs and knowledge sharing. The presence of foreign companies forces local companies to invest in education, and competition motivates innovation. FDI's generate positive productivity effects for the host economy (Agrawal & Khan 2011, 72–73).

In this work, the connection between FDI and GDP of Europe, China and India will be investigated. First, we must figure out if there are fundamental differences between these countries regarding this. Later, some statistical investigations to find out if the influence of FDI on the GDP is significant will be explored.

PREVIOUS RESEARCH
Foreign Direct Investment (FDI)

Normally, when one thinks of FDI, one thinks of setting up a production facility in another country. However, FDI includes a significantly larger number of cross-border activities (Neuhaus 2006, 42). FDI is a cross-border investment made by the investor, who is resident in another country or economy, with the aim of establishing a permanent and strategic, long-term stake in a company in the other economy build relationship. This is the case if the direct investor receives at least 10%

of the voting rights in the target company of the investment (the so-called 10%-rule). Direct investments are contrasted with so-called portfolio investments, in which the goal is generally not to have any influence on the part of the investor (OECD 2009, 17). If this definition is taken as a basis, setting up a production facility in another economy is definitly a method of FDI, but so is buying into an investment that already exists in another economy (Neuhaus 2006, 42). The above mentioned 10% rule just mentioned can also be deviated from if it is possible to exert influence with less than a 10% share in the company. This also applies in the other direction, for example, in the United Kingdom prior to 1999, influence involvement was only equivalent to 20% (Jones & Wren, 2006, p. 8).

Gross Domestic Product (GDP)

The GDP is the standard measure for the value of all products and services that are produced in a country or a region within a certain time period. The term "gross" implies that no deductions have been made in the depreciation of machinery, buildings and other capital goods used in production. "Domestic" refers to production coming from the institutional units located in the country. This includes end products, services, fixed assets, and exports (less imports). The GDP can be measured in three different ways (OECD 2010, 16):

• As value added: this includes production minus intermediate consumption, plus taxes on products (such as value-added-tax, VAT), but minus subsidies on products.

• As income from production: this corresponds to the sum of compensation of employees, the gross operating surplus of companies and the state, the gross self-employment income of unincorporated companies and the net taxes on production and imports (such as VAT, payroll tax, import duties, etc., less subsidies).

• As expenditure on final goods and services: this includes consumption expenditure, gross capital formation and exports, less imports.

Although GDP is seen as the most important indicator of the economic strength or economic activities of a country or region, it is not a measure of the well-being or standard of living of a society (OECD 2010, 16). The GDP only reflects an overall value; it does not provide any information about how wealth is distributed in current society.

Comprehensive Agreement on Investment (CAI)

On December 30, 2020, the European Union (EU) and China completed the fundamental negotiations on the CAI. This agreement gives EU investors improved access to the Chinese market. Under this agreement, China has committed to ensuring fairer treatment for EU companies so that they can operate on a level playing field in China. These obligations extend to state-owned companies, including transparency of subsidies and rules against forced technology transfer (European Comission, n. d.).

Egger (2021) investigated the China-European union CAI. Before the agreement, Chinese investors in the EU had significantly more liberal market access compared to European investors in China. This led to one-sided regulation of foreign investment to varying degrees between the EU and China. Looking at the provisions of the agreement, it is clear that the new advantages granted to EU investors in China are proportionally greater than vice versa. In addition, the agreement contains a comprehensive list of sustainable development goals as well as non-investment goals (Egger 2021, 191–192). The main benefit of the agreement for China is to create a clearer legal framework for growing Chinese investment in Europe. This is particularly significant in the context of trade protectionism emanating from the United States (US). For example, a Chinese company under scrutiny for national security reasons can appeal to the arbitral tribunal to examine whether the host

government's actions and measures comply with the principle of good faith as set out in the CAI (Wang & Li 2021, 5–6).

Literature Review

Until 1991, the Indian economy was highly regulated by numerous bureaucratic rules. Domestic and foreign companies could develop their activities only after prior approval by the government. High import duties and hesitant approval of foreign investments were intended to protect domestic industry (Matter 2000).

Sengupta and Puri (2018) examined the relationship between FDI and GDP in India and its neighboring countries Pakistan, Nepal, Bangladesh and Sri Lanka. It was discoveredthat a relationship between FDI and GDP existed in all the cases. FDI is instrumental in improving the economic situation as the countries under study grow. It was determined that the target country is most likely to benefit from FDI if it has a high level of technological progress, a high savings rate and an open trading system. India has had a steady GDP growth since 2000, with only a small dip in the GDP growth curve bewteen 2008 and2009. In addition, the FDI growth in India has been increasing since the liberalisation of the country (Sengupta & Puri 2018, 476–477). FDI acts as a source of financing and increases the competitiveness of the domestic economy. However, their importance varies from country to country. In India, the results of FDI are extremely positive as the country has repeatedly been considered an attractive destination for foreign investors on a global scale (Sengupta & Puri 2018, 484). In the research of Agrawal and Khan (2011), it was discoveredthat a 1% increase in FDI in China leads to an increase in GDP by 0.07% in China and in India by 0.02%. The impact of FDI on growth was stronger in China than in India, reflecting on the preference of most foreign investors for China. This is due to China's larger market, easier access to the export market, government incentives, developed infrastructure, cost efficiency and a positive macroeconomic climate. In contrast, India scores with a talented management system, rule of law, transparent labor system, cultural affinity and a favorable regulatory environment (Agrawal & Khan 2011, 76).

Regarding Europe, in 2021, the main players in EU foreign investment flows were the United States, the United Kingdom and Singapore. FDI can be subject to significant fluctuations related to global economic events, industry-specific developments or the individual situation of companies considering investing abroad. These fluctuations can also be due to periods of uncertainty among investors. Eurostat (2023) has examined fluctuations since 2013. There was a significant volatility between 2013 and 2016. The situation changed in 2017, when the value of EU FDI fell for the second year in a row, both in outflows and inflows. 2018 saw its third annual decline as flows turned negative. In 2019, EU FDI flows returned to positive, albeit comparatively low levels. In 2020, the direction of changes in flow values diverged for the first time in the period under consideration. Inflows increased again, although less sharply than in the previous year, while outflows decreased. In 2021, both flows fell again, with inflows falling more sharply and becoming negative, while outflows fell more moderately and remained positive (Eurostat 2023).

RESEARCH METHODOLOGY
Data

The United Nations Conference on Trade and Development (UNCTAD) offers its statistics in the freely accessible UNCTADstat database. These statistical data series are regularly updated and categorised according to various topics. Through the navigation browser, users can view tabular or graphical representations, easily select and reorganise data and use personalised functions. Several simple extraction options are also available (UNCTAD, n. d.). The data is downloaded from UNCTAD as a complete database for FDI and GDP that includes all countries. For China, the data

for the special administrative regions of Hong Kong and Macao as well as the province of Taiwan are also provided. However, only the data for China as a whole is covered. The data for each country will be extracted in R. Data from 1990 to 2022 will be used. Before 1990, Europe was separated, and therefore, it is expected that the data of 1989 and before are less consistent.

First, there has to be distinguished between inward and outward flows resp. inward and outward stocks. Inward flows and stocks describe the investments that are made by foreign investors in resident enterprises of the target country, while outward flows and stocks describe the investments made by the investors and enterprises in the target country countries (OECD, n.d. a; b). Regarding this, the inward flows and stocks are relevant for this investigation. More information about the collection methodologies can be found in UNCTAD (2009, 77).

Furthermore, a distinction must be made between flows and stocks. Flows describe the investments during a certain time, e.g., a year, while stocks describe the complete investments that are made until this particular time (OECD, n.d. a; b). In this regard, flows have to be observed for the investigation.

In Fig. *1* the FDI for China, India, and Europe since 1989 is shown. While FDI in China and India rose steadily, apart from a slight dip in 2009, FDI in Europe fluctuated greatly at times which coincide with the recent investigations mentioned above. In 2002, FDI in Europe even fell below zero. This can be interpreted as foreign investors withdrawing money from a country in total.
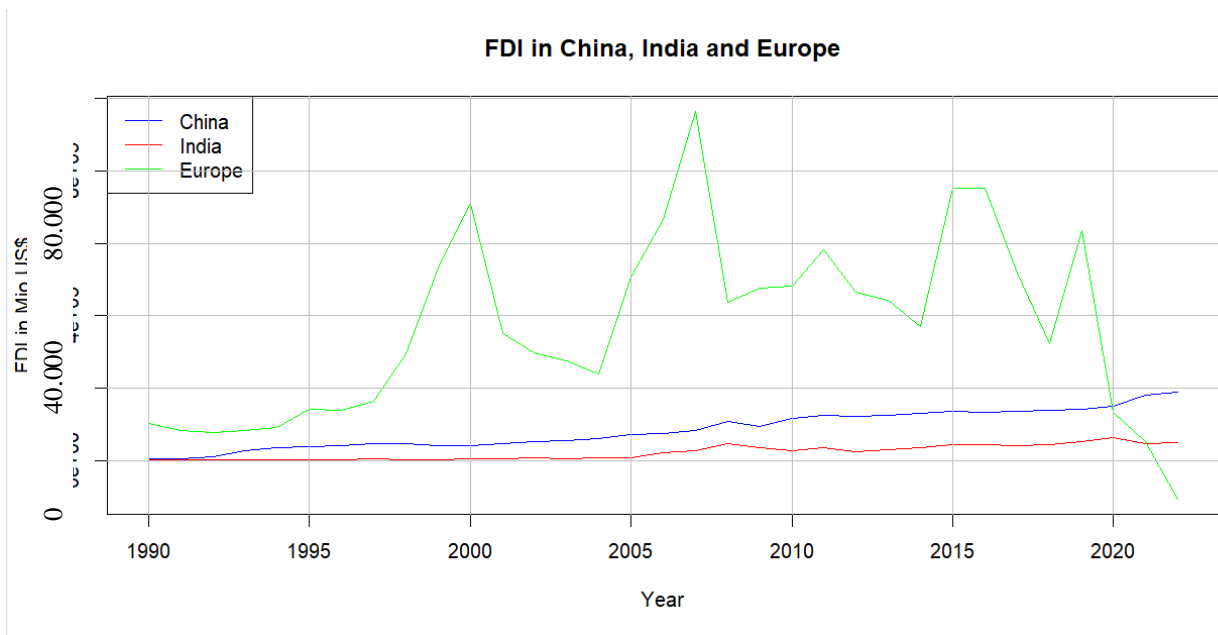

Fig. 1. FDI in China, India, and Europe. Source: own figure

Different measures are also available for GDP, first in prices and in prices per capita. The prices per capita takes the different populations of the target countries into account. But since it has to investigate the connection of the FDI that is given for the countries, the normal price should be considered, which is not normalised on the population. Furthermore, one can choose between the current price at the time of the country or constant prices, normalised to the prices of 2015. It was decided to consider the current prices, since the FDI is also given in current prices.

Fig. *2* shows the GDP in China, India, and Europe since 1990. India's GDP shows a constant increase, while China's GDP has risen faster than India's after 2010. Europe's GDP has seen greater fluctuations, rising from around 1 Mio. US$ up to 2 Mio. US$ after 2000, although it seems to have stabilised around this level.
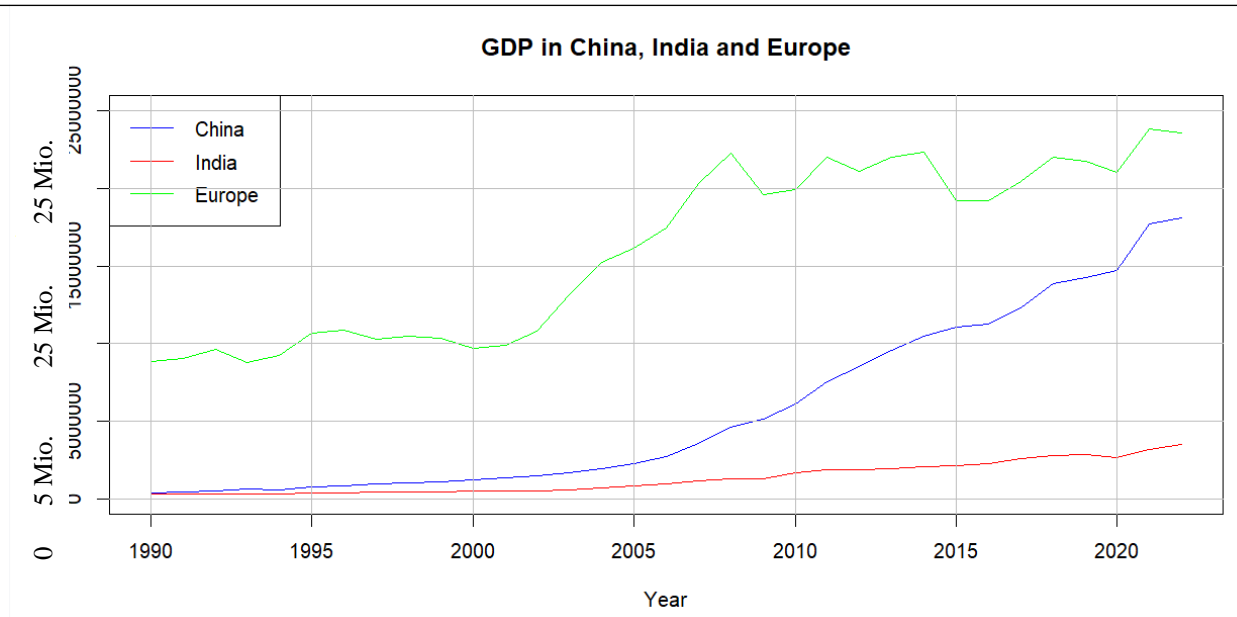
Fig. 2. GDP in China. India and Europe. Source: own figure

Correlation between FDI and GDP

In order to analyse the correlation between FDI and GDP, the Pearson correlation and the Spearman correlation were utilised. The Pearson correlation is the standard correlation and it measures the linear relationship between two continuous variables and it assumes that the data is normally distributed. The data should be checked for normal distribution using the Shapiro-Wilk test. The results are shown in Table 1. For the critical P value, 0.05 was set. It can be seen that many of the p-values determined are above this, so it cannot be concluded that the data is distributed normally. Therefore, the correlation should be determined using the Spearman correlation.

Table 2 shows the Spearman correlation coefficients for FDI and GDP for China, India, and Europe. FDI and GDP show a very high correlation for China and India, while these indicators only have a very low correlation for Europe. This appears logical, since the FDI in Europe fluctuated while the GDP increased continuously (see Fig. *1* and Fig. *2*).

Table 1. Results of Shapiro-Wilk normality test of the FDI and GDP of China, India, and Europe

| Results of Shapiro-Wilk test, p-value	FDI	GDP
China	0.07496	0.0001763
India	0.0006229	0.00101
Europe	0.4589	0.0002777

Table 2. Results of Spearman Correlation between the FDI and GDP of China, India, and Europe

	Spearman Correlation FDI-GDP
China	0.9929813
India	0.9548797
Europe	0.2576872

Linear regression between FDI and GDP

In this work, the connection between FDI and GDP for the three countries will be examined using a linear regression model, modelled in the statistics software R.

First, it should be checked whether the connection between FDI and GDP can be represented using a linear approach. For this purpose, a scatter diagram or a point cloud should be created from the data pairs from FDI and GDP of the three countries. If the point cloud resembles an inclined ellipse, the connection can be modelled using a linear function (Frost 2017, 3). Fig. *3* shows the scatterplots with the revision levels for FDI and GDP for China, India, and Europe. It can be seen that the relationship between FDI and GDP for China and India can still be easily represented with a straight-line regression, but this is not the case for Europe. This is consistent with the results of the Spearman correlation between FDI and GDP (see Table 2).
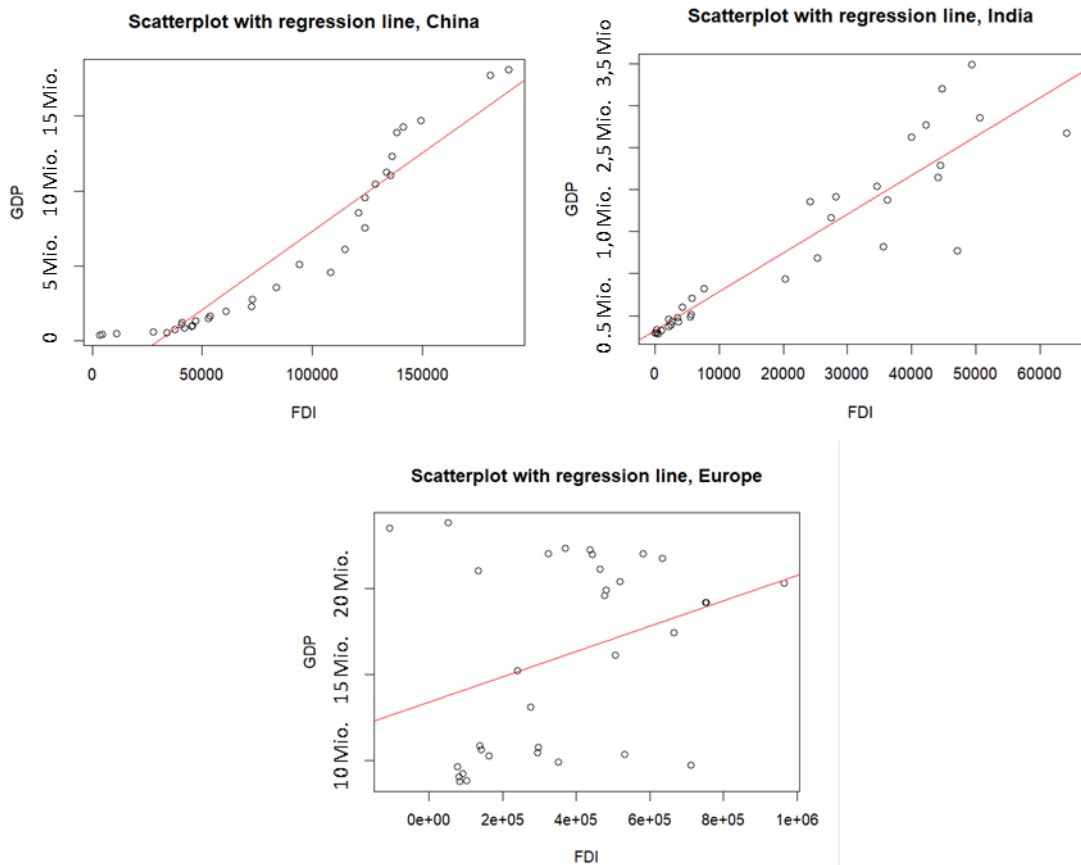
Fig. 3. Scatterplots of FDI and GDP with regression lines for China, India, and Europe. Source: own figure

The general form of a linear regression equation is shown in equation (1):

$$Y = \beta_0 + \beta_1 \cdot X + \epsilon \qquad\qquad (1)$$

with
X: The independent variable, in this case the FDI.
Y: The dependent variable, in this case the GDP.
β_0: The Y-intercept that indicates the expected value of Y when $X = 0$

ε: The error term that represents the deviation between the actual and estimated values of Y.
$\beta_0 + \beta_1 \cdot X$ represents the regression line (see Fig. *3*)

For a better understanding, the ϵ in $\epsilon_{\beta 0}$ and $\epsilon_{\beta 1}$ will be broken down to represent the errors of β_0 and β_1. See equation (2):

$$GDP = \beta_0 + \beta_0 \cdot FDI + \epsilon_{\beta 0} + \epsilon_{\beta 1} \qquad (2)$$

RESULTS

Table 3 shows the determined values for the equation (2), calculated in R for China, India, and Europe. The t-value of β_0 and β_1 is the coefficient by the standard error: $t(\beta_0) = \beta_0/\epsilon_{\beta 0}$ and $t(\beta_1) = \beta_1/\epsilon_{\beta 1}$. High values of $t(\beta_0)$ and $t(\beta_1)$ were looked for. This may suggest that the standard error ϵ is small, compared to the determined coefficient β (Thime 2021). Regarding this, it is visible that the t-value for Europe is much smaller than the t-values for China and India. This indicates that the relationship between FDI and GDP can be modelled better as a linear regression for China and India than for Europe.

Table 3. Determined values for equation (2) for China, India, and Europe, additionally the t-values

	β_0	β_1	$\epsilon_{\beta 0}$	$\epsilon_{\beta 1}$	$t(\beta_0)$	$t(\beta_1)$
China	-3.137 E+06	104.6 00	5.993E +05	6.0 67	-5.2 34	17.2 41
India	3.237 E+05	46.23 0	1.020E +05	3.5 15	3.1 73	13.1 54
Europe	1.342 E+07	7.378	1.635E +06	3.7 06	8.2 05	1.99 1

Table 4 shows the determined p-values of the t-statistics. The p-value provides clues about the significance of the coefficient for the model. Typically, a p-value of less than 0.05 is considered significant. This suggests that the coefficient has additional utility to the model by helping to explain variation in the model's dependent variable (Thime 2021). It can be seen from Table 4 that the significance is given for both coefficients in the case of China and India, whereas the coefficient β_0 as in the case of India is less significant. In the case of Europe, the coefficient of β_0 is significant, while the coefficient of β_1 is not significant. This is another hint that the linear regression does not explain the connection between FDI and GDP for Europe. The multiple and adjusted R-squared shows the same. The multiple and adjusted R-squared gives the percentage of the variation of dependent variable (the GDP) which is explained by the variation of the independent variable (the

FDI) (Thime 2021). For Europe these values are only 0.113and 0.085 and 11.3 % and 0.85%, respectively, while the values for China and India are above 84%.

Table 4. The determined p-values of the t-statistic, the multiple and adjusted R-squared

	$Pr(>|t(\beta_0)|)$	$Pr(>|t(\beta_1)|)$	Multiple R-squared	Adjusted R-squared
China	1.100E-05	2.000E-16	0.906	0.903
India	0.0034	3.180E-14	0.848	0.843
Europe	2.880E-09	0.0554	0.113	0.085

CONCLUSION

Results
A linear regression model was chosen to analyse the correlation between FDI and GDP using China, India, and Europe as examples, using GDP as the dependent variable and FDI as the independent variable. It is best to implement this model using China as an example, which showed the highest correlation of both factors with 0.9929813. For India, the correlation between FDI and GDP was slightly lower (0.9548797) while GDP and FDI seem to be relatively uncorrelated for Europe (correlation coefficient of 0.2576872).

This result is confirmed by the t-values of the linear regression equation. The t-value for Europe is much smaller than the t-values for China and India. This means that the standard errors of the coefficients are relatively high in comparison to the coefficients themselves in the case of Europe. It was also not possible to prove the significance of the coefficients in the case of Europe.

Limitations and further work
Countries produce their GDP estimates in their own currencies. In order to make these estimates internationally comparable, they must be converted into a common currency. This is often done using current exchange rates. However, this can lead to a misleading comparison as they do not reflect the actual quantities of final goods and services in GDP. A more accurate approach is to use purchasing power parities (PPPs). PPPs are currency converters that take into account the price differences between countries (OECD 2010, 16).

Furthermore, the restriction must be made that only the connection between two individual factors was calculated. Especially in the case of Europe, the GDP seems to depend heavily on several other factors, which requires further investigation. For example, Agrawal & Khan's (2011) model for GDP was examined with human capital, labour force, FDI and gross capital formation as independent variables (p. 76). By consideration of other factors, the GDP of Europe could be better described.

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ПЧИ И БВП: СРАВНИТЕЛЕН АНАЛИЗ ЗА КИТАЙ, ИНДИЯ И ЕВРОПА

Резюме: *Преките чуждестранни инвестиции (ПЧИ) се считат за основен източник на технологии и ноу-хау в развиващите се страни (Agrawal & Khan 2011, 72). Тази статия има за цел да проучи връзката между ПЧИ и брутния вътрешен продукт (БВП) на Европа, Китай и Индия. За да се анализира връзката между ПЧИ и БВП, е избран линеен регресионен модел с Китай, Индия и Европа като примери, използвайки БВП като зависима променлива и ПЧИ като независима променлива. Най-добри резултати с този модел са постигнати за Китай, където е установена най-висока корелация на двата фактора при 0,9929813. За Индия корелацията между ПЧИ и БВП е малко по-ниска (0,9548797), докато за Европа БВП и ПЧИ изглеждат относително некорелирани (корелация от 0,2576872). Този резултат се потвърждава от t-стойностите на уравнението на линейната регресия. Т-стойността за Европа е много по-малка от t-стойностите за Китай и Индия, което означава, че стандартните грешки на коефициентите са относително високи в сравнение със самите коефициенти в случая на Европа.*
Ключови думи: *ПЧИ, БВП, ЦСИ, линейна регресия*

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