International Journal of Business and Economic Affairs (IJBEA)
**10**(4), 32-47 (2025)
DOI: 10.24088/IJBEA-2025-104003
ISSN: 2519-9986

# Evaluating the Effects of China-Pakistan Economic Corridor (CPEC) on Income Inequality, Household and Economy-wide Welfare in Pakistan: A Computable General Equilibrium (CGE) Analysis

Fiaz Hussain[1*], Hasnain Abbas Naqvi[2], Denise Tsang[3], Nauman Waheed[4]

[1,4]Fatima Jinnah Women University, Rawalpindi, Pakistan.

[2] University of Hafr Al Batin, Saudi Arabia.

[3]Henley Business School, University of Reading, United Kingdom.

**Abstract:** Income inequality threatens long-term socioeconomic development and poverty reduction programs worldwide. The UN Sustainable Development Goals of the 2023 Agenda emphasizes that governments address poverty and income disparities to achieve SDG 10. Foreign direct investment is an important tool in combating poverty and income inequality. Currently, Pakistan is dealing with socioeconomic difficulties. China's direct investment in Pakistan, which accounts for 41 per cent of total foreign direct investment (FDI), could help boost the country's socioeconomic development. It can provide several advantages, such as creating jobs, generating tax revenues, and transferring managerial and technological know-how. This study uses Computable General Equilibrium (CGE) modelling to examine the effects of China's investment in Pakistan under CPEC on income inequality, household welfare, and economic welfare. Contrary to previous studies on the topic, this analysis considers several transmission pathways that were previously ignored in analyses of how FDI affects household incomes in urban and rural areas. The simulation analysis indicates that Chinese FDI benefits the nation's GDP, welfare, and income and may help narrow income gaps between all household types. China's emergence as a significant economic player has enabled Pakistan to attract more foreign investment, which will help secure further investment from other nations.

**Keywords**: Foreign Direct Investment, Income Inequality, CPEC, Economic welfare, Computable General Equilibrium, Pakistan.

Received: 10 August 2025 / Accepted: 15 September 2025 / Published: 22 October 2025

## INTRODUCTION

Scholars have reached a general agreement in the empirical literature that foreign direct investment (FDI) positively impacts economic growth in developing countries (Joshua et al., 2020; Saidi et al., 2020; Dinh et al., 2019; Acquah & Ibrahim, 2020), by generating a wide range of benefits for the recipient economy (Sahoo, 2006). Nonetheless, there are concerns that FDI may exacerbate income inequality (Nguyen, 2021), potentially preventing wealth distribution and poverty reduction in the host nations (Magombeyi & Odhiambo, 2017; Ucal et al., 2016). This study is motivated by the United Nations Sustainable Development Goals (SDGs), which aim to have a substantial global impact by 2030. The UN has designated 17 SDGs, with SDG-10 notably focusing on reducing inequality and tackling important local and global concerns. The UN Sustainable Development Goals in the 2023 Agenda put pressure on governments to address poverty and income disparities, which have historically impeded the growth and development of both developed and developing nations (Seven & Coskun, 2016).

Atkinson (1997) defined income inequality as the unequal distribution of income, which can limit the effectiveness of poverty-reduction efforts. Although growth is essential for eradicating poverty, its distribution is equally important. Despite over a decade of growth, research has shown that inequality has continued to rise (Smolensky et al., 1994). In some studies, FDI has positively impacted the host countries' economic growth, productivity, and welfare. (Azam & Feng, 2022; Moreno Plascencia & Espinosa Ramrez, 2018), while others have raised concerns that FDI could also exacerbate income inequality (Huynh, 2021; Kaulihowa & Adjasi, 2018; Herzer & Nunnenkamp, 2011), despite its positive impact on economic development.

*Corresponding author:Fiaz Hussain
†Email: fiazhussain@fjwu.edu.pk

Various explanations exist for how foreign direct investment (FDI) could worsen income inequality. One possibility is that FDI may create wage disparities in the host economies, even though multinational enterprises can have positive external effects (Jaumotte et al., 2013). Additionally, many FDI companies repatriate profits to their home countries, which can further exacerbate income inequality. Despite the argument that FDI can worsen income inequality, empirical studies on FDI's effect on income inequality have produced mixed results (Kaulihowa & Adjasi, 2018; Ravinthirakumaran & Ravinthirakumaran, 2018).

In light of the above discussion, this paper examines the effects of CPEC investments on income inequality in Pakistan. China's One Belt One Road (OBOR) is one of the major infrastructure projects worldwide (Mathews, 2019). Its main aim is to develop infrastructure that links China to the rest of the world. The project comprises various initiatives, with the "21st Century Maritime Silk Road" (MSR) and the "Silk Road Economic Belt" (SREB) as its main components. The MSR endeavours to connect China to the Indian Ocean, the Persian Gulf, the Mediterranean, and Europe via three principal routes, while the SREB focuses on constructing waterways between member countries. With approximately 900 projects spread across 65 countries, the OBOR initiative has an investment volume of $850 billion (Kazi, 2017). About two-thirds of the world's population and three-quarters of its energy resources are expected to benefit from the program.

The CPEC is a major part of the larger Silk Road Economic Belt (SREB) project. The CPEC aims to improve connectivity and economic growth between Pakistan and Central Asia by connecting China's Xinjiang region with Pakistan's Gwadar Port. This initiative is considered one of Pakistan's most significant infrastructure development projects, with an anticipated investment of $50 billion in various infrastructure projects (Bashir et al., 2021). The CPEC project includes investments in electricity generation, which will help increase Pakistan's energy supply. The CPEC project is projected to contribute to socioeconomic development, new industrial projects, poverty reduction, and a higher standard of living in Pakistan by 2030, with a 7.5% annual GDP growth rate and the creation of 2 million new jobs. Pakistan's urbanisation is expected to increase by 50-60 per cent, and the GDP is predicted to grow by 8 per cent by 2025, as outlined in Pakistan's Vision 2025 (Planning Commission, 2015). Ultimately, the CPEC project seeks to foster sustainable economic growth in Pakistan (Ali & Asgher, 2016).

CPEC was launched in Pakistan in 2015. So far, 23 projects have been completed, 40 are under construction, and 43 are in the pipeline. Table 1 presents the status of the development projects.

Table 1: Status of the Projects under CPEC

| Sector | Completed | Under Construction | In-pipeline |
|---|---|---|---|
| Energy | 10 | 6 | 5 |
| Transport Infrastructure | 5 | 11 | 19 |
| Gwadar | 3 | 7 | 4 |
| SEZs | - | 4 | 5 |
| Social Development | 5 | 12 | 10 |

Source: Authors' compilation based on the data obtained from the CPEC Authority Pakistan

In addition, China's growing direct investment in Pakistan could help boost Pakistan's socioeconomic development. By 2021, more than 41 percent of the country's total FDI inflows had come from China (Figure 1). Pakistan can attract international investors due to China's increased investment.

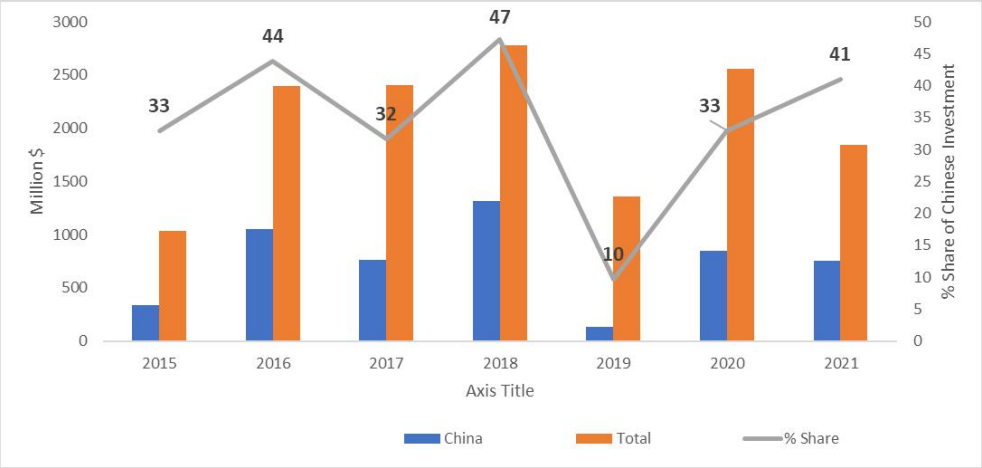


Figure 1: Chinese direct investment in Pakistan 2015-2021

Pakistan provides a relevant case study, with its socioeconomic indicators presenting a bleak picture of the country. Despite slow GDP growth, the economy is grappling with persistent high budget deficits, colossal public debt, and a stagnant revenue base, as highlighted by Younus (2020).

According to estimates from the World Bank and the Pakistani Government's MDPI, 39.2 percent and 22 percent of Pakistan's population live below the poverty line. Furthermore, the country's human development index (HDI) and Gini coefficients, which are commonly used to measure income inequality, further illustrate the extent of the problem. Pakistan's HDI in 2019 was 0.557, placing it in the medium human development category and ranking it 154th out of 189 countries. Meanwhile, according to the World Bank, the country's Gini index in 2018 was 31.6. Given this, the study aims to explore the impact of Chinese direct investment on Pakistan's economy, household welfare, and income inequality.

The motivation for this study arises from the UN Sustainable Development Goals of the 2023 Agenda to control poverty and income disparities that have impeded the growth and development of countries across the globe. Achieving sustainable growth that benefits the entire population is a significant challenge in a developing country. In that scenario, FDI is an important element of economic development (Azam & Feng, 2022; Joshua et al.,2020). However, in the literature, the impact of FDI on income inequality is not clear-cut, indicating the need for more in-depth empirical investigations. In the context of Pakistan, which is currently facing socioeconomic challenges, China's investment, which accounts for more than 41 per cent of the country's total FDI, could help boost the country's development. However, much of the literature on the possible impact of CPEC on Pakistan mainly focuses on the environmental and climate change effects of CPEC (Khalid et al., 2021; Waheed et al., 2021), politics and international relations (Rahman et al., 2021; Shaikh & Chen, 2021), or on the strategic and economic significance for Pakistan (Malik, 2018; Qazi, 2019). Thus, this study delves into how investment under CPEC influences income inequality in Pakistan.

The study makes significant contributions to the literature by analyzing the relationship between CPEC investment and income inequality. First, this study has employed CGE to comprehensively understand how China's investment in Pakistan through the CPEC affects income inequality, household welfare, and overall economic well-being. Second, this study provides a microeconomics analysis of household incomes in urban and rural areas through transmission pathways. Third, this research enhances understanding of the nuanced relationship between FDI and economic welfare within the Pakistani context.

The following is the organization of the paper: In Section 2, the theoretical and empirical literature is presented. Section 3 outlines the research methodology that was used. Section 4 contains the analysis and results, and Section 5 concludes and discusses the policy implications.

## THEORETICAL UNDERPINNING AND EMPIRICAL LITERATURE REVIEW

### Theoretical Literature

This study examines the effect of FDI on income inequality through the lenses of modernisation theory, dependency theory, and world system theory. Examining different perspectives is essential to understanding FDI, income inequality, and their underlying dynamics.

Modernization theory, formulated in the 1950s and based on neoclassical economics, suggests that FDI serves as a viable conduit for newly independent economies to acquire capital, markets, and knowledge, thereby promoting economic growth (Kuznet, 1955; Rostow, 1960; King & Varadi, 2002). This approach treats domestic and foreign capital interchangeably, thereby promoting overall economic growth. According to the theory, the development of nations occurs in stages that have varying impacts on income inequality. FDI can lead to spillover gains, but the initial stages of development tend to worsen income inequality. The theory suggests that the inflow of foreign capital worsens income inequality in early development stages but improves it once optimal development is achieved. The Kuznets effect postulates that income inequality increases and decreases as per capita income rises to a certain level. While FDI can initially increase development in certain sectors and regions, benefiting some skilled elites, the development of top industries and regions can eventually promote a more equitable income distribution across a country (Tsai, 1995).

Modernization theory supports Kuznets's (1995) idea that economic growth and income inequality exhibit an inverse U-shaped relationship. Scholars such as Joshua et al. (2020), Asongu & Odhiambo (2020), Shahbaz et al. (2019), and Shi et al. (2021) have conducted research based on modernization theory. A country's higher technology and capital have led to an overall improvement in labor productivity and efficiency.

Dependency and world-systems theory present a different perspective on the relationship between FDI and income inequality than modernization theory. While modernization theory argues that FDI helps reduce income inequality, world-systems theory claims that FDI worsens inequality between core and peripheral economies. The core economies, comprising industrialized nations with skilled labor, are opposed to the periphery economies, comprising developing nations with unskilled labor. The theory suggests that while technological advances in the periphery can spur development, the periphery remains dependent on the core, thereby aggravating income inequality. Dependency and world-systems theory argue that FDI often promotes capital-intensive production, limiting employment opportunities and raising income inequality, contrary to modernization theory's claim that FDI raises wages in the periphery. According to Feenstra and Hanson (1996, 1997), unskilled labour in developed countries may be considered skilled in developing countries, exacerbating inequality when FDI flows from developed to developing countries. Additionally, FDI activities often increase income inequality, as these activities are typically skill-biased. (Findlay, 1978; Lee & Vivarelli, 2006; Wang & Blomstrom, 1992).

FDI inflows have been linked to inequality in countries by both modernization and dependency theories, but the impact varies by a country's level of development. Modernization theory suggests that FDI inflows can initially be harmful during early development stages but can ultimately reduce income inequality by spurring FDI in other sectors. In contrast, the dependency theory proposes that income inequality varies due to differences in government capacity, internal market control, and foreign market dependence, thereby causing uneven development across countries.

### Empirical Literature

Many empirical studies, especially in emerging economies, have found that FDI inflows are associated with higher income inequality. The literature on the influence of FDI on income inequality is inconsistent and can be grouped into three categories. The first category suggests that rising FDI inflows have increased income inequality (Mihaylova, 2015; Song et al., 2021). Income inequality may slow poverty reduction. Finally, income-conscious people want an egalitarian society (Figini & Görg, 2011; Sylwester, 2005). If increasing FDI can lead to higher income inequality, it can reduce economic growth and have negative socioeconomic consequences. This is a great worry for developing economies, where FDI is an essential source of growth. Rising income inequality has

been linked to political instability, social discontent, and economic inefficiency, compounding the problems of developing countries (Alesina & Perotti, 1996; Nel, 2003). Thus, FDI's influence on income inequality must be carefully assessed to ensure that it promotes economic growth while reducing socioeconomic impact.

The second group of studies suggests that foreign investments have a negative effect on income inequality (Lee et al., 2022; Mugeni, 2015; Ofori et al., 2022; Xu et al., 2021). For example, Xu et al. (2021) have shown that FDI inflows affect income distribution positively in sub-Saharan African countries. Similarly, Ofori et al. (2022) found that FDI inflows reduce income inequality in Africa. Mugeni (2015) found that FDI inflows positively affect poverty reduction, which mitigates income inequality. In addition, Rezk et al. (2022) findings show a negative impact of FDI on income inequality in Egypt. Shi et al. (2021) examine the impact of FDI on income inequality in thirty Chinese provinces. The study found an inverse U-shaped relationship between FDI and income inequality. Moreover, Wang et al. (2023) show that FDI in emerging market countries reduces income inequality. However, in developed countries, it exacerbates income inequality. These findings are further supported by Nguyen (2023). The study's findings indicate that FDI positively impacts income inequality in 30 developed countries and reduces it in 35 developing countries.

The third group proposes that FDI does not affect the host country's income distribution (Sylwester, 2005; Franco & Gerussi, 2013; Im & McLaren, 2015). For instance, Sylwester (2005) found that FDI's effect on income inequality is uncertain and depends on specific country factors. As Huynh (2021) shows, FDI increases income inequality, but improvements in institutional equality reduce this impact. Once institutional quality reaches a certain threshold, FDI negatively affects income inequality and further intensifies its beneficial impact. Additionally, Yulsadhev et al. (2023) show that FDI reduces income inequality to a significant extent, thereby increasing human capital development and economic growth.

In contrast, Lee et al. (2022) found a negative impact on income inequality when a country has low financial development. By increasing financial development, FDI exacerbates income inequality. In addition, Wang and Lee (2023) examined the moderating effect of country risk on the relationship between FDI and income inequality. The findings show that in a low-risk country, FDI reduces income inequality, whereas in a high-risk country, it worsens it. The current body of theoretical and empirical research does not present a clear consensus on how FDI affects income inequality, indicating the need for more in-depth empirical investigations.

The empirical literature on the link between FDI and poverty and income inequality has produced mixed results, likely due to differences in time periods, data methods, and proxies for poverty and income inequality (Kaulihowa & Adjasi, 2018; Magombeyi & Odhiambo, 2017; Ucal et al., 2016). Additionally, some studies have employed modeling techniques, such as CGE modeling, to investigate FDI's impact on household welfare (Zélity, 2022), workers' welfare (Latorre, 2016), and poverty and income distribution (Nunnenkamp et al., 2007).

Despite extensive research on the determinants of FDI and its effects on economic growth, there remains a gap in understanding how investments under CPEC influence income inequality and poverty reduction in Pakistan. Most studies have instead analyzed the environmental and climate change effects of CPEC (Khalid et al., 2022; Maqsoom et al., 2021; Waheed et al., 2021), viewed it from the perspective of politics and international relations (Hussain, 2019; Rahman et al., 2021; Shaikh & Chen, 2021), or emphasized its strategic and economic significance for Pakistan (Khan et al., 2018; Malik, 2018; Qazi, 2019). This study makes a significant contribution to the existing literature by employing a Computable General Equilibrium (CGE) approach to comprehensively analyze the impact of China's investment in Pakistan through the CPEC on income inequality, household welfare, and overall economic well-being. What sets this analysis apart from previous studies is its incorporation of previously overlooked transmission pathways, shedding light on the intricate connections between FDI and household incomes in both urban and rural areas. Moreover, by delving into the unique dynamics of CPEC's influence on income inequality, household and economy-wide welfare, this research enhances our understanding of the nuanced relationship between FDI and economic welfare within the Pakistani context.

Table 2: Review Summary of Selected Latest Empirical Studies

| Study | Country | Methodology | Findings |
|---|---|---|---|
| Kyophilavong et al., (2017) | Laos | CGE model | Poverty reduction and income gap |
| Le et al. (2021) | Vietnam | Generalized Method of Moment (GMM) | Increase in income inequality |
| Ravinthirakumaran & Ravinthirakumaran (2018) | Asia-Pacific Economic Cooperation (APEC) economies | Panel ARDL | Decrease in income inequality in the long run |
| Xu et al. (2021) | 38 sub-Saharan African countries | GMM | An increase in FDI reduces the level of inequality |
| Khan & Nawaz (2019) | 11 Commonwealth of Independent States (CIS) | System-generalized method of moments (SYS-GMM) estimator | Positive impact on income distribution |
| Lee et al. (2022) | 37 countries | panel smooth transition regression (PSTR) model | FDI reduces income inequality, but this effect is limited to a specific level of financial development. |
| Rezk et al. 2022) | Egypt | OLS Regression | negative impact on income inequality |
| Fazaalloh (2019) | Indonesia | panel data regression model with panel corrected standard errors (PCSE) | FDI has an insignificant impact on income inequality |
| Huynh (2021) | 36 Asian countries | Feasible Generalized Least Squares (FGLS) | FDI reduces income inequality, provided there is an enhancement in institutional quality |
| Braha-Vokshi et al. (2021) | 6 Western Balkan (WB) countries | Two-stage least squared (2SLS), fixed, and random effect estimators and GMM. | FDI affects income inequality negatively |
| Anetor, Esho & Verhoef (2020) | 29 Sub-Saharan Africa | Feasible Generalized Least Square (FGLS) technique | FDI has a negative impact on poverty reduction |
| Zélity (2021) | Visegrád 4 (V4) countries (Czech Republic, Hungary, Poland, Slovakia) | CGE model | Benefits of FDI outweigh the costs |
| Song et al. (2021) | 20 developing countries | Panel cointegration model | Increase in income inequality |
| Munir & Bukhari (2020) | 11 Asian Countries | Instrumental variable least square (IVLS) | Trade globalization reduces income inequality |
| Wang et al. (2023) | 126 developed and developing countries | Two-way Fixed Effect Method | Decrease in income inequality in developing countries, whereas an increase in income inequality in developed countries. |

| Study | Country | Methodology | Findings |
|---|---|---|---|
| Nguyen (2023) | 24 developed & 37 developing countries | System Generalized Method of Moments (S-GMM) | FDI positively affects income inequality in developed countries, but negatively in developing countries. In contrast, the interaction of FDI and digitalisation reduces income inequality in developed countries and increases it in developing countries. |
| Yuldashev et al. (2023) | Selected Asian Countries | | With increased human and economic development, FDI reduces income inequity to a larger extent. |

Source: Authors' Compilation

## DATA AND MODEL

### Computable General Equilibrium Model of Pakistan

It is essential to comprehend how a policy or external shock can affect an economy while assessing a country's economic position. There are various ways in which these factors can affect an economy. The Computable General Equilibrium (CGE) model provides a suitable framework for thoroughly investigating the impact of external shocks, such as FDI inflows, on the economy. This model helps analyze how an external shock affects particular variables or industries, such as poverty, welfare, and inequality. The static CGE model employed in the study closely resembles the theoretical framework of the Lofgren et al. (2001) model, adding specifications frequently seen in developing nations.

Model equations explain how various sectors of the economy interact and behave while ensuring that conditions such as production factors, savings/investment ratios, and the current account balance are met. The model, which is static rather than dynamic, cannot consider the consequences of variations in investment expenditures over time. This means the model cannot determine whether changes from the base to the new equilibrium occur gradually over time or in a particular year.

Moreover, the model equations illustrate how the different parts of the economy interact. The System of National Accounts (SAM) determines the coefficients for these equations via a calibration procedure. The primary objective is to solve the model for equilibrium to replicate the data from the base year. Subsequently, it becomes feasible to introduce a disturbance to the model by altering one of the exogenous variables. The repercussions of the exogenous shock are determined by comparing the outcomes of this process to the base-year equilibrium.

A model is developed for each production activity using a multi layer nested Constant Elasticity of Substitution (CES) function. At the highest level, the gross output of each activity is a combination of the added value and the composite of the intermediate inputs. The added value section of the model consists of three-factor inputs: capital, labor, and land. The model's demand structure comprises several components, including private and public consumption expenditures, investments, and exports. It is created by combining the Cobb-Douglas function with the nested CES function of composite products. Fixed-coefficient specifications are used to model the distribution of investments among sectors. Besides, locally produced and imported goods are modeled using a Leontief specification.

In a small, open developing economy like Pakistan, the constraints governing the model's closures are mostly straightforward. The current account balance is constrained by fixed foreign savings, making a flexible foreign exchange rate optimal. Investments in savings-driven accounts are constrained by fixed savings, while the investment adjustment factor remains flexible to accommodate adjustments. In terms of the capital market, capital is activity-

specific and fully employed, which makes its price fixed. This implies that factor price distortions adjust accordingly to clear the market.

**Model Calibration**

The calibration process utilised for this study follows the established technique introduced by Mansur and Whalley (1984). Most parameters, such as input-output coefficients and Cobb-Douglas function parameters, are directly determined from the benchmark data. The CES and CET functions, on the other hand, are derived from relevant literature sources. Additionally, certain coefficients are implied in the benchmark data by the model's functional forms and other parameters. All model computations are performed using the Generalised Algebraic Modelling System (GAMS) software, as described by Brooke et al. (1997).

**Data**

To analyse the impact of China's FDI under CPEC on Pakistan's Income Inequality, Household Welfare and Economic Growth. This study employed the Social Accounting Matrix (SAM) 2010-11 for the economy of Pakistan, which was designed by Dorosh et al. (2006) . It provides information on 16 household types, categorised as rural or urban. Furthermore, it consists of 64 activities, 63 commodities, 12 factors, and 17 other important accounts, further classified into 9 activities, 9 commodities, 3 factors, and 10 other accounts.

*Welfare Measures:* In simple terms, welfare refers to the overall well-being of a community and is frequently associated with economic shifts. Equivalent Variations (EV) are used to measure the impact of CPEC on well-being. EV is a way of calculating how much additional money a person would spend before a price increase to avoid its negative effects. In other words, it computes the amount of money that would need to be given or taken away from a person to maintain the same standard of living before the price change. Mathematically, it can be written as:

$$EV_h = \left(\frac{CPIH_h^0}{CPIH_h^1}\right) EH_h^1 - EH_h^0 \tag{1}$$

Where $EV_h$ is Equivalent Variations of household h, and are the consumer price index of household h, $h$, $CPIH_h^0$ and $CPIH_h^1$ at the base year and after simulation, respectively, and consumption expenditure of household h at the base year and after simulation, respectively.

*Inequality measures:* Inequality can be measured by various methods, as detailed in the literature. To analyse the impact of FDI on household inequality, the most commonly used measures are the Theil-L, Theil-T, Theil-S, and Hoover indices. Due to data constraints, this study solely examines inequality among distinct groups of households. To compute inequality, an adaptation of the Hoover / Theil-L / Theil-T / Theil-S indices is used. The Hoover index ranges from 0 to 1, representing 0% and 100%, respectively. It is the most basic indicator of inequality. Its purpose is straightforward: multiplying the Hoover index by the sum of all resources (income) allows us to calculate the proportion of resources that need to be reallocated to achieve perfect equality indexes (Naqvi et al., 2011).

The Theil-T index values range from 0, which denotes the least inequality, to ln(N), which denotes the most inequality. On the other hand, Theil-L has a value between 0 and infinity; therefore, a higher value of Theil-L indicates greater inequality. Simply put, if the overall income of the population is Y, then the income of a particular subgroup is represented by Y, the population as a whole is N, and the total number of members of the subgroup is n. Theil-T can be represented as follows if we represent it as TT:

$$TT = \ln\left(\frac{\sum_h N_h}{\sum_h YH_h}\right) - \frac{\sum_h YH_h \ln\left(\frac{N_h}{YH_h}\right)}{\sum_h YH_h} \tag{2}$$

and Theil-L can be written as:

$$TL = \ln\left(\frac{\sum_h YH_h}{\sum_h N_h}\right) - \frac{\sum_h N_h \ln\left(\frac{YH_h}{N_h}\right)}{\sum_h N_h}, \tag{3}$$

"symmetrised" Theil index can be calculated as:

$$TS = \frac{1}{2}[TT - TL]. \tag{4}$$

Substituting the values of $TT$ and $TL$ in the above equation

$$TS = \frac{1}{2}\sum_h \ln\left(\frac{YH_h}{N_h}\right)\left(\frac{YH_h}{\sum_h YH_h} - \frac{N_h}{\sum_h N_h}\right), \tag{5}$$

Hoover's index can be written as

$$HI = \frac{1}{2}\sum_h \left|\frac{YH_h}{\sum_h YH_h} - \frac{N_h}{\sum_h N_h}\right| \tag{6}$$

Where, $YH_h$ is the income of household $h$ and $N_h$ is the number of household $h$.

## RESULT AND DISCUSSION

### Inequality Measures

This study examines the inequality among household groups using three indices: Theil-L, Theil-T, and Theil-S. The Theil-T index scale ranges from 0 (representing the lowest inequality) to "ln (N)" (representing the highest inequality), whereas the Theil-L index ranges from 0 to infinity, with higher values indicating greater inequality. The simulation results (depicted in Figure 2) reveal that all three indices reduce income inequality, suggesting an improvement in income distribution. The findings align with existing studies that have observed a negative impact of FDI on income inequality (Rezk et al., 2022; Yulsadhev et al., 2023; Braha-Vokshi et al., 2021; Wang et al., 2023) The simulations demonstrate a positive impact on income inequality, with changes of 0.327% (Theil-T), 0.328% (Theil-L), and 0.327% (Theil-S).

Table 3: Indices of Income Inequality (Simulation Results)

| Inequality Indices | Base | Simulations |
|---|---|---|
| Theil-T | 0.333 % | 0.327% |
| Theil-L | 0.332% | 0.328% |
| Theil-S | 0.331% | 0.327% |

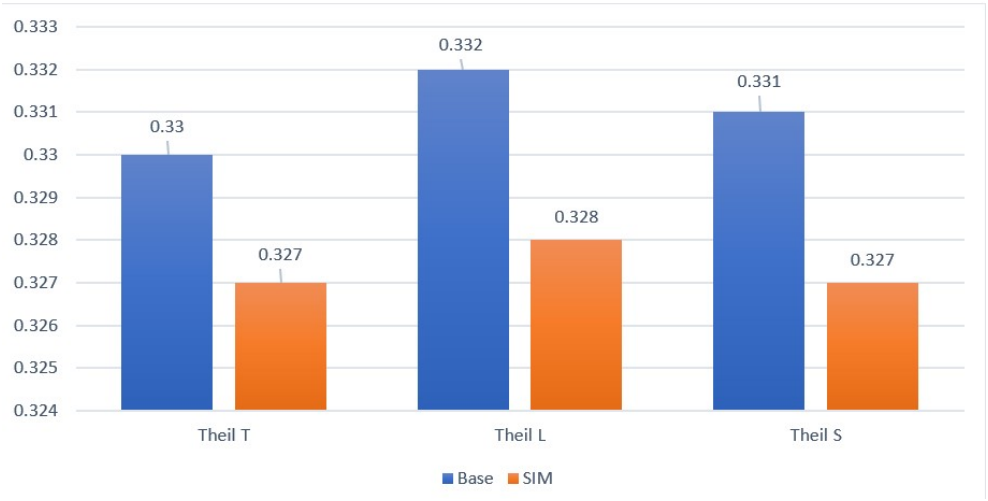


Figure 2: Indices of Income Inequality. *(Source: Simulation Results )*

### Theil Indices of Welfare

Figure (3) presents the results of simulations, where it can be seen that the Theil L and Hoover Index values have changed. In measuring the effect on welfare, the Theil-L and Hoover indices indicate noticeable impacts of

88.635% and 82.467%, respectively. Foreign investment increases wages, productivity, development of local skills, technology, and knowledge spillover, enhancing household welfare (Bue et al., 2019; Zelity, 2022; Ganiyu, 2016).

Table 4: Indices of Welfare (Simulation Results)

| Theil Indices of Welfare | Base | Simulations |
|---|---|---|
| Theil L | 87.094% | 88.635% |
| Hoover Index | 81.151% | 82.467% |

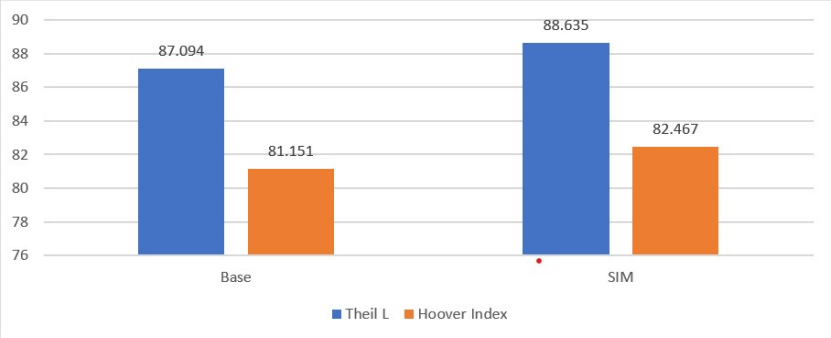


Figure 3: Indices of Welfare *(Source: Simulation Results)*

**Macroeconomic Effects**

The effects of FDI in Pakistan on various macroeconomic variables under the CPEC are shown in Figure 4. An increase in FDI improves the industry's export performance. In addition, it increases production and capital stock, improving the country's export performance. The results show that FDI inflows increase GDP by 5.81% and exports by 13.99%. These findings are consistent with the literature (Joshua et al.,2020; Saidi et al., 2020; Acquah & Ibrahim, 2020; Azam & Feng, 2022; Zhang & Song, 2001; Shamim et al., 2016). The most important result of this scenario is the appreciation of the exchange rate of 5.05 %. This is because FDI inflows positively affect the exchange rate. This positive effect will decrease the competitiveness of domestic goods and increase imports. Therefore, imports increased by 11.69%. Theoretically, an appreciation of the exchange rate negatively affects exports. The high share of industrial products (mainly textile-related commodities) in total exports is a major factor contributing to the improvement in export performance. Despite the appreciation of the exchange rate, exports showed a positive trend. According to Botta (2015), the appreciation of the exchange rate due to FDI highlights a Dutch disease effect. In addition, the results show that government consumption and net indirect taxes increased by 8.76% and 5.81%, respectively. The positive impact of FDI on taxes is consistent with Okey's (2013) and Camara's (2022) findings.

Table 5: Macroeconomic Effect (Simulation Results)

| Macroeconomic Variables | Simulations |
|---|---|
| GDP | 2.42% |
| Government Consumption | 5.81% |
| Exports | 13.99% |
| Imports | 11.69% |
| Net Indirect Taxes | 8.76% |
| Exchange Rate | 5.05% |

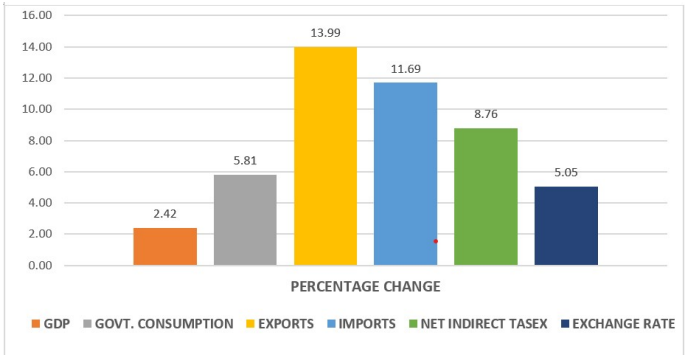


Figure 4: Macroeconomic Effects (*Source: Simulation Results)*

**Households' Equivalent Variations**

The households' equivalent variations are also analyzed, showing improvements across all 16 categories of the model's households. The highest value of the EV in the simulation's results is noted by 22.69 on the Rural Small Farmers (Quartile 1) (H-RS1), the second highest impact is 21.954 on Rural Farm Workers (Quartile 234) (H-RW234), after this category, the positive impact is registered by 21.352 and 21.086 on Urban (Quartile 3) (H-U 3) and Rural Small Farmer (Quartile 234) (H-RS234), respectively. Further, in descending order, the effects are noted by 19.397 on Rural Non-Farm (Quartile 2) (H-RN2), 18.799 on Rural Non-Farm (Quartile 3) (H-RN3), 17.667 on Urban (Quartile 4) (H-U4), 17.313 on Rural Non-Farm (Quartile 1) (H-RN1), 14.596 on Urban (Quartile 2) (H-U2), 8.979 on Rural Farm Worker (Quartile 1) (H-RW1), 6.979 on Urban (Quartile 1) (H-U1), 6.214 on Rural Non-Farm (Quartile 4) (H-RN4), 5.71 on Rural Landless Farmer (Quartile 234) (H-RW234), 4.756 on Rural Medium Farmer (Quartile 234) (H-RM234), 1.395 on Rural Landless Farmer (Quartile1) (H-RL1), and finally 0.032 on Rural Medium Farmer (Quartile 1) (H-RM1).

The positive EV indicates increased welfare, suggesting that foreign investment under CPEC positively impacts households. It is observed that foreign investment increases wages in a host country (Nguyen et al., 2019; Gopinath & Chen, 2003). Djokoto & Agyei Henaku (2022) highlight that FDI leads to job creation, advanced skill development, and technological advancement, which, in aggregate, enhances welfare. Furthermore, FDI also contributes to human development (Hossain et al., 2019; Kaukab & Surwandono, 2021), enhancing welfare.

Table 6: Households' Equivalent Variations (Simulation Results)

| Household Categories | Simulations |
|---|---|
| H-RS1 | 22.69% |
| H-RS234 | 21.086% |
| H-RM1 | 0.032% |
| H-RM234 | 4.756% |
| H-RL1 | 1.395% |
| H-RL234 | 5.71% |
| H-RW1 | 8.979% |
| H-RW234 | 21.954% |
| H-RN1 | 17.313% |
| H-RN2 | 19.397% |
| H-RN3 | 18.799% |
| H-RN4 | 6.214% |
| H-U1 | 6.979% |
| H-U2 | 14.596% |
| H-U3 | 21.352% |
| H-U4 | 17.667% |

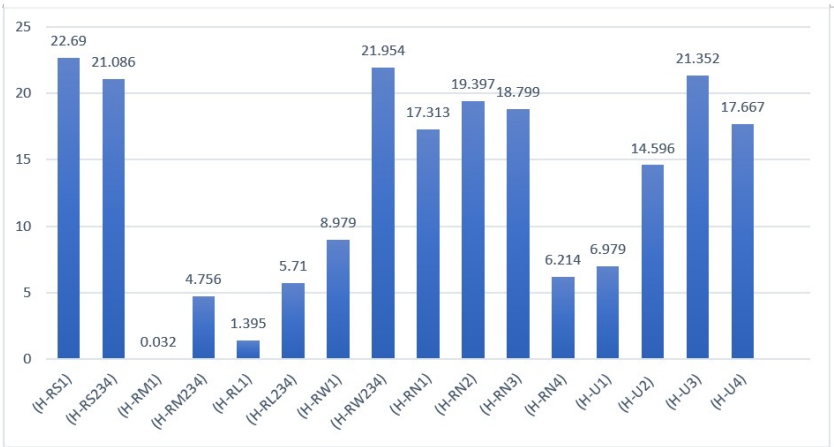


Figure 5: Households' Equivalent Variations *(Source: Simulation Results)*

## CONCLUSION AND POLICY IMPLICATIONS

### Conclusion

FDI is widely considered the primary source of foreign capital for developing economies. Numerous studies have explored the relationship between economic growth and FDI; recent research has also examined the impact of FDI on income inequality. However, the findings of these studies are inconclusive. Some studies proposed a positive link between FDI and income inequality, while others claimed a negative link. Furthermore, if host nations have low absorptive capacity, FDI may adversely affect their income distribution.

In contrast, if countries have a greater absorptive capacity, the impact of increased FDI is reduced. Several studies have failed to establish a notable connection between income inequality and FDI. According to Table 2, most studies investigating the impact of FDI on income inequality demonstrated a significant association.

Chinese FDI has recently generated controversy due to its global scale and scope. One of the largest foreign investors in Pakistan, China, has invested heavily in various sectors. Few studies have examined the impacts of Chinese FDI on the economy and inequality in Pakistan, despite an increase in FDI driven by CPEC. This paper has examined the impact of China's FDI under CPEC on the national economy and inequality using a CGE model. The model considers various transmission mechanisms that affect the real income of certain households. It also studies the macroeconomic and sectoral factors that affect income distribution. The results show that Chinese FDI positively affects the country's GDP, welfare, and income. It also suggests that investments can reduce the income gaps between all household types in the country. From the Chinese perspective, the findings point to the under-researched internalization of its proprietary knowledge in a win-win investment scenario. Therefore, future studies can explore Chinese FDI in light of the benefits discussed in the internalization theory.

### Policy Implications

The study's findings have significant policy implications for the relationship between foreign direct investment (FDI) and income inequality. Various policies can influence the effectiveness of FDI in reducing income inequality in the host country. First, Pakistan should priorities improving its administrative and economic governance. Second, it is crucial to address human resources by improving the quality of education and training, establishing a robust educational system, developing a technical education system, and promoting training programs in local and multinational firms. Third, Pakistan's policies should focus on implementing social security measures to reduce income inequality and maintain social equity, while attracting and utilizing foreign direct investment. Fourth, manufacturing-export motivated FDI policies should be encouraged by providing incentives such as tax exemptions, basic infrastructure, and minimizing red tape. Foreign investment in the export-oriented sector will increase integration into global supply chains and bring modern technology and managerial capabilities, thereby improving the economy's overall productivity and growth. Finally, the government should invest in crucial infrastructure, irrigation systems, training and education, and ease of doing business in the agriculture sector to attract foreign

investment and improve rural development and welfare.

**REFERENCES**

Acquah, A. M., & Ibrahim, M. (2020). Foreign direct investment, economic growth and financial sector development in Africa. *Journal of Sustainable Finance & Investment, 10*(4), 315-334.

Alesina, A., & Perotti, R. (1996). Income distribution, political instability, and investment. *European Economic Review, 40*(6), 1203-1228.

Ali, H., & Asgher, M. T. (2016). The role of the sectoral composition of foreign direct investment on economic growth: a policy proposal for CPEC and regional partners. *The Pakistan Development Review*, 89-103.

Asongu, S. A., & Odhiambo, N. M. (2020). Foreign direct investment, information technology and economic growth dynamics in Sub-Saharan Africa. *Telecommunications Policy, 44*(1), 101838.

Atkinson, A. B. (1997). Bringing income distribution in from the cold. *The Economic Journal, 107*(441), 297-321.

Azam, M., & Feng, Y. (2022). Does foreign aid stimulate economic growth in developing countries? Further evidence in both aggregate and disaggregated samples. *Quality & Quantity, 56*(2), 533–556.

Bashir, M. F., Ma, B., Qin, Y., & Bashir, M. A. (2021). Evaluation of One Belt One Road publications: a bibliometric and literature review analysis. *Environmental Science and Pollution Research, 28*(28), 37016-37030.

Botta, A. (2015). The macroeconomics of a financial Dutch disease. *Levy Economics Institute of Bard College Working Paper*, (850).

Braha-Vokshi, L., Rexhepi, G., Ramadani, V., Abazi-Alili, H., & Sharif, A. (2022). The impact of multinational companies on inequality in Western Balkan countries. *Review of International Business and Strategy, 32*(2), 305-323.

Brooke, A., Kendrick, D., & Meeraus, A. (1997). *Generalized Algebraic Modelling System (GAMS)*.

Bui, A. T., Nguyen, C. V., & Pham, T. P. (2019). Impact of foreign investment on household welfare: Evidence from Vietnam. *Journal of Asian Economics, 64*, 101130.

Camara, A. (2023). The effect of foreign direct investment on tax revenue. *Comparative Economic Studies, 65*(1), 168-190.

Dinh, T. T. H., Vo, D. H., The Vo, A., & Nguyen, T. C. (2019). Foreign direct investment and economic growth in the short run and long run: Empirical evidence from developing countries. *Journal of Risk and Financial Management, 12*(4), 176.

Djokoto, J. G., Agyei Henaku, K. A. A., & Badu-Prah, C. (2022). Welfare effects of agricultural foreign direct investment in developing countries. *Frontiers in Sustainable Food Systems, 6*, 748796.

Dorosh, P., & Niazi, M. K. (2006). *Social Accounting Matrix for Pakistan, 2001-02: Methodology and Results*.

Feenstra, R., & Hanson, G. (1996). Foreign investment, outsourcing and relative wages. In *Political Economy of Trade Policy: Essays in Honor of Jagdish Bhagwati* (ed. R. Feenstra, G. Grossm Irwin), Cambridge MA: MIT Press.

Feenstra, R., & Hanson, G. (1997). Productivity measurement and the impact of trade and technology on wages: estimates for the US, 1972-90. *Working Paper 97-17, University of California at Davis*.

Figini, P., & Görg, H. (2011). Does foreign direct investment affect wage inequality? An empirical investigation. *The World Economy, 34*(9), 1455-1475.

Findlay, R. (1978). Relative backwardness, direct foreign investment, and the transfer of technology: a simple dynamic model. *The Quarterly Journal of Economics, 92*(1), 1-16.

Franco, C., & Gerussi, E. (2013). Trade, foreign direct investments (FDI) and income inequality: Empirical evidence from transition countries. *The Journal of International Trade & Economic Development, 22*(8), 1131-1160.

Ganiyu, I. A. (2016). *Foreign Direct Investment and Welfare: Evidence from Sub-Saharan Africa* (Doctoral dissertation, University of Ghana).

Gopinath, M., & Chen, W. (2003). Foreign direct investment and wages: a cross-country analysis. *Journal of International Trade & Economic Development, 12*(3), 285-309.

Herzer, D., & Nunnenkamp, P. (2011). *FDI and income inequality: Evidence from Europe* (No. 1675). Kiel working paper.

Hossain, M. S., Kamal, M. S., Halim, M. R., & Zayed, N. M. (2019). Inward foreign direct investment and welfare nexus: The impact of foreign direct investment on welfare in developing countries. *International Journal of Economics and Financial Issues, 9*(4), 228-240.

Hussain, E. (2019). CPEC: Governance and security challenges—Implications for the Belt and Road Initiative. *Chinese Political Science Review, 4*(1), 135-147.

Huynh, C. M. (2021). Foreign direct investment and income inequality: Does institutional quality matter?. *The Journal of International Trade & Economic Development, 30*(8), 1231-1243.

Im, H., & McLaren, J. (2015). *Does foreign direct investment raise income inequality in developing countries? A new instrumental variables approach*. School of Economics and Finance, Yeungnam University.

Jaumotte, F., Lall, S., & Papageorgiou, C. (2013). Rising income inequality: technology, or trade and financial globalization?. *IMF Economic Review, 61*(2), 271-309.

Joshua, U., Rotimi, M. E., & Sarkodie, S. A. (2020). Global FDI inflow and its implication across economic income groups. *Journal of Risk and Financial Management, 13*(11), 291.

Kaukab, M. E., & Surwandono, S. (2021). Convergence of Human Development Index: case study of foreign direct investment in ASEAN. *Business: Theory and Practice, 22*(1), 12-17.

Kaulihowa, T., & Adjasi, C. (2018). FDI and income inequality in Africa. *Oxford Development Studies, 46*(2), 250-265.

Kazi, A. (2017). *CPEC: Impact on Central and South Asia* [Paper presentation]. CPEC Conference, Strategic Vision Institute, Islamabad, Pakistan.

Khalid, I., Ahmad, T., & Ullah, S. (2022). Environmental impact assessment of CPEC: a way forward for sustainable development. *International Journal of Development Issues, 21*(1), 159-171.

Khan, Z., Changgang, G., Ahmad, R., & Wenhao, F. (2018). CPEC: A game changer in the balance of power in South Asia. *China Quarterly of International Strategic Studies, 4*(04), 595-611.

King, L. P., & Váradi, B. (2002). Beyond Manichean economics: foreign direct investment and growth in the transition from socialism. *Communist and Post-Communist Studies, 35*(1), 1-21.

Kuznets, S. (1955). International differences in capital formation and financing. In *Capital formation and economic growth* (pp. 19-111). Princeton University Press.

Latorre, M. C. (2016). A CGE analysis of the impact of foreign direct investment and tariff reform on female and male workers in Tanzania. *World Development, 77*, 346-366.

Lee, C. C., Lee, C. C., & Cheng, C. Y. (2022). The impact of FDI on income inequality: Evidence from the perspective of financial development. *International Journal of Finance & Economics, 27*(1), 137-157.

Lee, E., & Vivarelli, M. (2006). The social impact of globalization in the developing countries. *Int'l Lab. Rev., 145*, 167.

Lofgren, H., Harris, R. L., Robinson, S., Thomas, M., & El-Said, M. (2001). *A standard computable general equilibrium (CGE) model in GAMS* (TMD, Discussion Paper No. 75). International Food Policy Research Institute (IFPRI), Washington, DC.

Magombeyi, M. T., & Odhiambo, N. M. (2017). Foreign direct investment and poverty reduction. *Comparative Economic Research. Central and Eastern Europe, 20*(2), 73-89.

Malik, A. R. (2018). The China–Pakistan Economic Corridor (CPEC): a game changer for Pakistan's economy. In *China's global rebalancing and the New Silk Road* (pp. 69-83). Singapore: Springer Singapore.

Mansur, A. H. (1984). Numerical Specification of Applied General Equilibrium Models: Estimation, Calibration, and Data. *Applied General Equilibrium Analysis*, 69-137.

Maqsoom, A., Aslam, B., Khalil, U., Kazmi, Z. A., Azam, S., Mehmood, T., & Nawaz, A. (2022). Landslide susceptibility mapping along the China Pakistan Economic Corridor (CPEC) route using multi-criteria decision-making method. *Modeling Earth Systems and Environment, 8*(2), 1519-1533.

Mathews, J. A. (2019). China's Long Term Trade and Currency Goals: The Belt & Road Initiative. *Asia-Pacific Journal, 17*(1), e5.

Mihaylova, S. (2015). Foreign direct investment and income inequality in Central and Eastern Europe. *Theoretical & Applied Economics, 22*(2).

Moreno Plascencia, Á. P., & Espinosa Ramírez, R. S. (2018). Effects of the foreign direct investment on the Productivity of Latin American countries (1990-2012). *Economía: teoría y práctica*, (49), 7-35.

Mugeni, S. (2015). *Foreign investment, democracy and income inequality: Empirical evidence*.

Naqvi, H. A., Masood, M. T., & Naeem, R. A. (2011). Impact of structural adjustment programme on household welfare and inequality-Pakistan a case-in-point for the developing countries. *Management Research, 4*(1).

Nel, P. (2003). Income inequality, economic growth, and political instability in sub-Saharan Africa. *The Journal of Modern African Studies, 41*(4), 611-639.

Nguyen, D. T. H., Sun, S., & Beg, A. R. A. (2019). How does FDI affect domestic firms' wages? Theory and evidence from Vietnam. *Applied Economics, 51*(49), 5311-5327.

Nguyen, V. B. (2021). The difference in the FDI inflows–Income inequality relationship between developed and developing countries. *The Journal of International Trade & Economic Development, 30*(8), 1123-1137.

Nguyen, V. B. (2023). The role of digitalization in the FDI–income inequality relationship in developed and developing countries. *Journal of Economics, Finance and Administrative Science, 28*(55), 6-26.

Nunnenkamp, P., Schweickert, R., & Wiebelt, M. (2007). Distributional effects of FDI: how the interaction of FDI and economic policy affects poor households in Bolivia. *Development Policy Review, 25*(4), 429-450.

Okey, M. K. N. (2013). Tax revenue effect of foreign direct investment in West Africa. *African Journal of Economic and Sustainable Development, 2*(1), 1-22.

Ofori, I. K., Dossou, M. A., Asongu, S. A., & Armah, M. K. (2023). Bridging Africa's income inequality gap: How relevant is China's outward FDI to Africa?. *Economic Systems, 47*(1), 101055.

Pan-Long, T. (1995). Foreign direct investment and income inequality: Further evidence. *World Development, 23*(3), 469-483.

Qazi, M. N. A. (2019). China Pakistan economic corridor: A game changer project. *Review of Economics and Development Studies, 5*(3), 541.

Rahman, Z. U., Khan, A., Lifang, W., & Hussain, I. (2021). The geopolitics of the CPEC and Indian Ocean: security implication for India. *Australian Journal of Maritime & Ocean Affairs, 13*(2), 122-145.

Ravinthirakumaran, K., & Ravinthirakumaran, N. (2018). The impact of foreign direct investment on income inequality: a panel Autoregressive Distributed Lag approach for the Asia-Pacific Economic Cooperation developing economies.

Rezk, H., Amer, G., Fathi, N., & Sun, S. (2022). The impact of FDI on income inequality in Egypt. *Economic Change and Restructuring, 55*(3), 2011-2030.

Rostow, W. W. (2013). The stages of economic growth. In *Sociological Worlds* (pp. 130-134). Routledge.

Sahoo, P. (2006). *Foreign direct investment in South Asia: Policy, trends, impact and determinants* (No. 56). ADBI Discussion Paper.

Saidi, S., Mani, V., Mefteh, H., Shahbaz, M., & Akhtar, P. (2020). Dynamic linkages between transport, logistics, foreign direct Investment, and economic growth: Empirical evidence from developing countries. *Transportation Research Part A: Policy and Practice, 141*, 277-293.

Seven, U., & Coskun, Y. (2016). Does financial development reduce income inequality and poverty? Evidence from emerging countries. *Emerging Markets Review, 26*, 34-63.

Shahbaz, M., Balsalobre-Lorente, D., & Sinha, A. (2019). Foreign direct Investment–CO2 emissions nexus in Middle East and North African countries: Importance of biomass energy consumption. *Journal of Cleaner Production, 217*, 603-614.

Shaikh, R., & Chen, C. K. (2021). China's debt trap in Pakistan? A case study of the CPEC project. *South Asia Research, 41*(3), 399-414.

Shamim, M. A., Khan, R. A., Ghais, K. A., & Shaikh, E. A. (2016). FDI-export nexus in Pakistan: a time series analysis. *Global Management Journal for Academic & Corporate Studies, 6*(1), 115.

Shi, L., Zhu, C., Tang, D., & Boamah, V. (2022). The Impact of FDI on China's Urban–Rural Income Gap. *Sustainability, 14*(20), 13047.

Smolensky, E., Plotnick, R., Evenhouse, E., & Reilly, S. (1994). Growth, inequality, and poverty: A cautionary note. *Review of Income and Wealth, 40*(2), 217-222.

Song, Y., Paramati, S. R., Ummalla, M., Zakari, A., & Kummitha, H. R. (2021). The effect of remittances and FDI inflows on income distribution in developing economies. *Economic Analysis and Policy, 72*, 255-267.

Sylwester, K. (2005). Foreign direct investment, growth and income inequality in less developed countries. *International Review of Applied Economics, 19*(3), 289-300.

Ucal, M., Haug, A. A., & Bilgin, M. H. (2016). Income inequality and FDI: evidence with Turkish data. *Applied Economics, 48*(11), 1030-1045.

Waheed, A., Bernward Fischer, T., & Khan, M. I. (2021). Climate change policy coherence across policies, plans, and strategies in Pakistan—implications for the China–Pakistan economic corridor plan. *Environmental Management, 67*(5), 793-810.

Wang, E. Z., & Lee, C. C. (2023). Foreign direct investment, income inequality and country risk. *International Journal of Finance & Economics, 28*(3), 2415-2435.

Wang, J. Y., & Blomström, M. (1992). Foreign investment and technology transfer: A simple model. *European Economic Review, 36*(1), 137-155.

Wang, W., Xu, T., Liu, X., & Sun, Y. (2023). FDI inflows and income inequality: A Schumpeterian economic growth. *International Review of Economics & Finance, 83*, 805-820.

Xu, C., Han, M., Dossou, T. A. M., & Bekun, F. V. (2021). Trade openness, FDI, and income inequality: Evidence from sub-Saharan Africa. *African Development Review, 33*(1), 193-203.

Younus, U. (2020, November 22). Pakistan's stagnant tax base. *Dawn*.

Yuldashev, M., Khalikov, U., Nasriddinov, F., Ismailova, N., Kuldasheva, Z., & Ahmad, M. (2023). Impact of foreign direct investment on income inequality: Evidence from selected Asian economies. *PLOS ONE, 18*(2), e0281870.

Zelity, B. (2022). The welfare effects of FDI: A quantitative analysis. *Journal of Comparative Economics, 50*(1), 293-320.