# Foreign Direct Investment's Effect on Research & Development Spending in Middle-Income Countries

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## Abstract

This research delves into the intricate relationship between Foreign Direct Investment (FDI) inflows and Research and Development (R&D) spending in middle-income countries, with a particular focus on the concept of the "middle-income trap." R&D spending is a key input for innovating and the creation of indigenous technology, which is key for middle-income countries to avoid the middle-income trap and advance towards high-income status. The study aims to determine whether FDI inflows act as a catalyst or a hindrance for R&D spending within the middle-income world. Utilizing Pooled Ordinary Least Squares (OLS) regressions to analyze data across various middle-income nations, a negative correlation between FDI inflows and R&D spending emerges. This counterintuitive result challenges the prevailing notion that FDI invariably promotes domestic innovation and raises questions about its role in potentially perpetuating the middle-income trap. These findings carry profound implications for both theoretical understanding and practical policy-making. They suggest that middle-income countries need to exercise caution in embracing FDI, balancing it with initiatives that foster domestic innovation capabilities. This approach could be pivotal in enabling these countries to successfully transition to high-income status, avoiding the stagnation often associated with the middle-income trap.

Keywords: foreign direct investment, R&D, middle-income trap

## 1. Introduction

In our current era marked by globalization and the prevalence of globalized capitalism, we witness a significant transformation in the way modern global corporations, often referred to as multinational corporations (MNCs) operate. These corporations have surpassed the conventional concept of a "home country" and now function seamlessly across multiple national boundaries. Their widespread presence is exemplified by products like the iPhone, which require components sourced from as many as 43 different countries spanning six continents (Pentrova, 2018).

MNCs employ a strategic tool known as Foreign Direct Investment (FDI) to expand their operations beyond their home countries, catering to their complex supply chain needs. Typically, this involves the injection of capital from developed economies into emerging or developing ones. However, astute observers have noted that these foreign investments in developing countries often focus on parts of the production process with modest profit margins (Anastasi, 2023; Zeng and Fang, 2014). As a result, capital inflows tend to target economically less lucrative activities within relatively impoverished nations. This dynamic raises important questions about the impact of FDI on the development of these countries, particularly middle-income (MI) nations.

Historical data reveals that between 1960 and 2008, only a mere 13 MI economies managed to achieve high-income (HI) status (World Bank, 2013). In contrast, most MI countries struggle to transition into fully developed nations, a challenge encapsulated as the "Middle-Income Trap" (MIT) (World Bank, 2007). According to the prevailing MIT consensus, as wages rise in these countries, they become less competitive in low-value-added economic sectors. Simultaneously, they often lack the innovation capacity needed to compete in higher-value-added industries. Consequently, scholars advocate strategic investments such as research and development (R&D) and the enhancement of human capital as potential solutions to the MIT challenge (Doner and Schneider, 2017).

The central question in the scholarly discourse revolves around whether FDI hinders a nation's ability to innovate, upgrade its industries, and advance in its development journey. It is essential to clarify that this paper does not attempt to provide a definitive answer to this complex question. Instead, its primary aim is to shed light on how FDI influences R&D spending in MI countries. R&D spending is a critical factor in nurturing indigenous innovation capacity, enabling MI nations to modernize their industries and break free from the constraints of the MIT. While numerous scholars have proposed theoretical frameworks to explain the effects of FDI in the developing world (Anastasi, 2023; Doner and Schneider, 2017; Zeng and Fang, 2014; Blomstrom and Kokko, 2003), it is regrettable that empirical research examining the relationship between FDI inflows and R&D expenditures in MI countries is notably scarce. This gap in empirical scholarship is unfortunate, particularly given the challenges posed by the MIT and the imperatives of globalization. As a result, policymakers in MI countries lack robust empirical evidence on which to base informed decisions regarding FDI.

The existing body of scholarship on this topic is limited in both its scope and methodology. A significant portion of studies in this domain take a qualitative approach. To the best of the author's knowledge, empirical studies on this subject are limited to just two, although several others touch on related themes, such as the broader relationship between FDI and innovation. Unfortunately, these two existing empirical studies fall short of providing a comprehensive analysis of the issue. This underscores the need for further empirical research to fill this gap in our understanding of how FDI affects R&D spending in MI countries and contribute to the discourse on FDI in the developing world and the MIT. This study employs a Pooled Ordinary Least Squares (OLS) regression analysis to address this gap in scholarly investigation.

## 2. FDI's Effect on R&D Spending; Literature Review

There are debates among Economists about whether FDI hurts or aids the development of new technology. On the pro-FDI side, some argue that the spillover effects and tightened competition will increase innovation in developing countries. Erdal and Gocer (2015) argue FDI spending in developing countries should have a positive effect on R&D spending and other "innovation activities." This is because of spillover effects, as local staff internalize the knowledge and technology of these foreign enterprises after working for them. They look at 10 'developing' countries solely in Asia (China, India, Iran, Pakistan, Malaysia, Thailand, Saudi Arabia, Turkey, South Korea, and Singapore) from the years 1996-2013. However, it should be noted that both South Korea and Singapore were HI, developed countries for most of the years they looked at. The model they constructed shows that FDI inflows are expected to increase developing countries' level of R&D spending and increase the frequency of other innovation activities. They conclude that developing countries that suffer from capital deficiency and technology gaps, when compared to the developed world, should construct public policy to increase the level of FDI in their country. Erdal and Gocer (2015) fall short since they solely look at Asian countries, added two developed countries, and looked at a shorter time period when compared to the model constructed in this paper.

Ali et al (2023) seek to examine the relationship between FDI and innovation within BRICS (Brazil, Russia, India, China, and South Africa) countries during the years 2000-2020. Using some of the new tools in econometrics they find that "foreign direct investment (FDI), trade openness, economic growth, and research & development expenditure positively impact technological innovation in BRICS countries." A rather interesting finding of this paper is that while testing the causality among their variables using the Dumitrescu-Herlin causality test, they find a one-way causal relationship between R&D spending and FDI inflows, meaning that increases in R&D spending lead to higher levels of FDI, yet the relationship does not hold for the inverse.

One argument that comes from the anti-FDI side is that FDI inflows could create a situation in which foreign R&D spending acts as a substitute for domestic R&D spending. In this case, domestic firms will just try to imitate foreign products rather than trying to create indigenous technology. That is precisely what Azman-Saini et al (2018) argue. Their data set consists of 48 developing countries over the years of 1996 to 2013. Their model shows that FDI inflows depress R&D spending in these developing countries. While FDI does depress R&D spending, it is positively correlated with "imports of machinery and equipment, stronger legal protections, better human capital, and higher economic growth." Their paper does a better job than Erdal and Gocer (2015), yet Azman-Saini et al (2018) fail to take advantage of all the data that is currently available.

The empirical research looking at the relationship between FDI and R&D spending is rather scant, though a number of scholars have theorized how this relationship functions in the context of the MIT. Doner and Schneider's (2017) research looks at the political economy of the MIT. They state that the economic impediments leading to the MIT mostly come from productivity slowdowns as they 'exhaust the gains from moving into MI status, '(or at least the current economic literature says so). MI countries, on the aggregate, grow slower than low-income (LI) and HI ones, as they can no longer compete with LI countries in low-value-added industries (since their wages are too

high) and HI countries in high-value-added industries (as they are not technologically advanced enough yet). To upgrade industries and make improvements in human capital, a country needs more and better education (especially higher and technical), greater savings and better investment, better infrastructure, more innovation, more R&D spending, and industrial policy. To pursue these policies, a state needs better institutions, yet there are social cleavages that exist in MI countries that make coalition building for these institutional upgrades very difficult. These cleavages include economic inequality, informal workers vs. formal workers, and home-grown businesses vs. multinational corporations (MNCs).

Due to these cleavages, Doner and Schneider (2017) warn against excessive amounts of FDI. MNCs do not have vested interests in upgrading the host countries institutions or industries and most of their R&D spending is in their home country. MNCs could just be profiting from the developing countries 'resources, such as cheap labor, and taking benefits back to their home country, trapping the host country in their place in the global division of labor, as MNCs do not have much interest in R&D spending in host countries. Because of this, it is asummed that the larger the share of FDI in a country, the lower the R&D spending. Also, there are political problems that derive themselves from the cleavages between local businesses and MNCs. This could make the political system unable to invest in R&D.

Two studies (Zeng and Fang 2014; Anastasi 2023) have used *World-Systems Theory* to explain the MIT, which works nicely as "during the last two decades of the 20th century there appears to have been less upward mobility than occurred in the 1960s and 1970s, which suggests that 'globalization', rather than spreading wealth and facilitating development, may create barriers for nations on the lower rungs of the global economy to move upwards" (Zeng and Fang 2014). Because of the global division of labor that global capitalism brings, countries far down the supply chain cannot advance from the periphery (and semi-periphery) to the core. The industries in the periphery are much more competitive when compared to industries in the core since there is a much smaller amount of countries to compete in core industries, which the authors label as "quasi-monopolized." So when the exchange happens between core and periphery countries, competitive products are in a much weaker position, so "there is a constant flow of surplus value from the producers in the periphery to the producers in the core" (Zeng and Fang 2014). It is not just exchange, when firms from HI countries enter the developing world, they do so to lower production costs, taking advantage of cheap resources and labor. In the developing world, these MNCs from HI countries focus on the lowest profit-generating parts of the production process, saving the higher profit-generating parts, such as R&D for their home countries.

Zeng and Fang (2014) pay special attention to China, labeling its development as 'dependent.' They state that FDI has contributed to China's development thus far, yet will create hurdles to creating indigenous innovation capacity. The reason is that foreign investors use China as a production base for economic activities with thin profit margins. Due to this, China cannot produce enough profit to reinvest in its productive capacity. Thus R&D will be ignored. FDI also creates insecurity. As capital will go to wherever wages are the lowest, this might incentivize keeping wages low and sticking with current industries. Again, the industries that foreign investors use China for do not produce a large amount of profit, so this could suppress R&D spending for the short- and long-term.

Anastasi (2023) theorizes that MI countries that have large portions of the economy dominated by FDI will struggle to upgrade industries, as due to the low profit-generating nature of the industries that FDI inflows set up, it would be difficult for MI countries to devote enough money to R&D spending. To upgrade industries and avoid the MIT, MI countries should focus on building their own national champions through technology transfers.

There have been some studies that have produced some rather nuanced results in regard to FDI's influence on the host country's ability to innovate and upgrade industries. Blomstrom and Kokko (2003) theorize that whether FDI inflows aid or harm the host country's ability to innovate depends solely on the host country's firms' ability to adopt and adapt foreign technology. Meaning that FDI could play a positive role, with the correct conditions. In a similar vein, Javorcik (2004), studying Lithuania (a recent graduate to HI status), finds that when FDI is used to set up a fully foreign-owned enterprise, there is no evidence of productivity spill-overs to domestic firms. This story changes a bit when he looks at joint ventures. His findings show that positive productivity spillovers exist through contacts between the joint venture and local firms in upstream sectors. So it seems as though the nature of FDI is quite important if it is used for local industrial upgrading. Due to this, it seems as though the nature of FDI and the context it finds itself is quite an important determining factor as to whether FDI will play a positive or negative role in innovation.

There seems to be no consensus as to what FDI means for R&D spending in MI countries. Some studies just look at developing countries as a whole. This is a mistake, as R&D spending is not as important to low-income (LI) countries when compared to MI countries. The few quantitative studies do not take full advantage of the available

data. Most of the qualitative research is bearish on FDI's impact on developing countries' R&D spending and their ability to innovate more generally, yet has yet to provide empirical evidence to support these claims. Due to the gaps in the current literature, research that looks at all MI countries over a longer amount of time would be welcomed.

**3. Hypothesis and Data**

The research hypothesis posits a negative correlation between FDI relative to GDP and domestic R&D spending relative to GDP in MI countries. This proposition is underpinned by three principal rationales:

(i) Concentration of MNCs' R&D Spending: It is postulated that MNCs predominantly allocate their R&D expenditures to their home countries. Consequently, as the share of the economy dominated by MNCs, vis-à-vis domestic firms, increases, a concomitant decrease in domestic R&D spending is expected. This proposition posits that greater MNC dominance displaces domestic firms in terms of economic activity and, consequently, reduces the capacity for domestic R&D investments.

(ii) FDI Impact on Economic Sectors: The hypothesis asserts that FDI tends to establish enterprises engaged in low-profit-generating aspects of the production process in comparison to MNCs' home country operations. In cases where local firms lack the technological sophistication to operate in these segments, the presence of MNCs may deter R&D spending by local firms. In essence, the hypothesis contends that MNCs might preemptively occupy sectors that local firms would otherwise have entered, impeding the latter's ability to invest in R&D.

(iii) Imitation Versus Innovation: The hypothesis also raises the possibility that local firms, when entering industries dominated by MNCs, may be incentivized to emulate foreign technologies rather than making the requisite investments to foster indigenous innovative capabilities. This imitation-driven behavior is expected to further curtail domestic R&D spending.

The dataset utilized in this research is drawn from the World Bank's DataBank (https://databank.worldbank.org/source/world-development-indicators) and encompasses a comprehensive selection of 108 countries classified within the World Bank's middle-income category. The dataset spans the years 1990 to 2022. Due to the nature of this panel data, a Pooled OSL regression was chosen. The variables collected are delineated in Table 1. It is noteworthy that the Pearson correlation coefficient analysis has been employed to assess the relationships between these variables. Importantly, the examination of correlation coefficients has not revealed any exceptionally high values, suggesting the absence of significant multicollinearity concerns within the dataset.

Table 1. Variables-1

| Variable | Mean | SD | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|
| 1. Research and development expenditure (% of GDP) | 0.440 | 0.344 | | | | | | |
| 2. Foreign direct investment, net inflows (% of GDP) | 3.769 | 6.183 | -0.106 | | | | | |
| 3. GDP per capita (current US$) | 3224 | 2952 | 0.322 | 0.097 | | | | |
| 4. Gross domestic savings (% of GDP) | 16.385 | 19.378 | 0.313 | 0.016 | 0.252 | | | |
| 5. Current account balance (% of GDP) | -3.699 | 15.549 | 0.183 | -0.339 | -0.026 | -0.020 | | |
| 6. Imports of goods and services (% of GDP) | 44.516 | 22.932 | -0.209 | 0.294 | -0.042 | -0.400 | 0.013 | |
| 7. Exports of goods and services (% of GDP) | 34.657 | 19.444 | -0.024 | 0.256 | 0.191 | 0.357 | 0.028 | 0.583 |
| 8. Government expenditure on education, total (% of GDP) | 4.592 | 2.564 | 0.157 | -0.002 | 0.037 | -0.313 | 0.070 | 0.380 | 0.107 |
| 9. Patent applications, residents | 8709 | 85830 | 0.494 | -0.025 | 0.141 | 0.187 | 0.072 | -0.096 | -0.060 | -0.034 |

*Source*: The World Bank DataBank; World Development Indicators

The first Pooled OLS regression just has the dependent variable, R&D expenditure (relative to GDP), and the independent variable, Foreign direct investment, net inflows (relative to GDP). After removing the years with missing data, 616 observations were recorded in the first regression. Due to the large amount of observations of this project, to visualize the data, only observations in the year 2017 were chosen for Figures 1 through 3. Figure

1 shows the amount of R&D spending relative to GDP in MI countries for 2017, Figure 2 shows the amount of FDI relative to GDP in MI countries for 2017, and Figure 3 is a scatter plot chart of both variables.
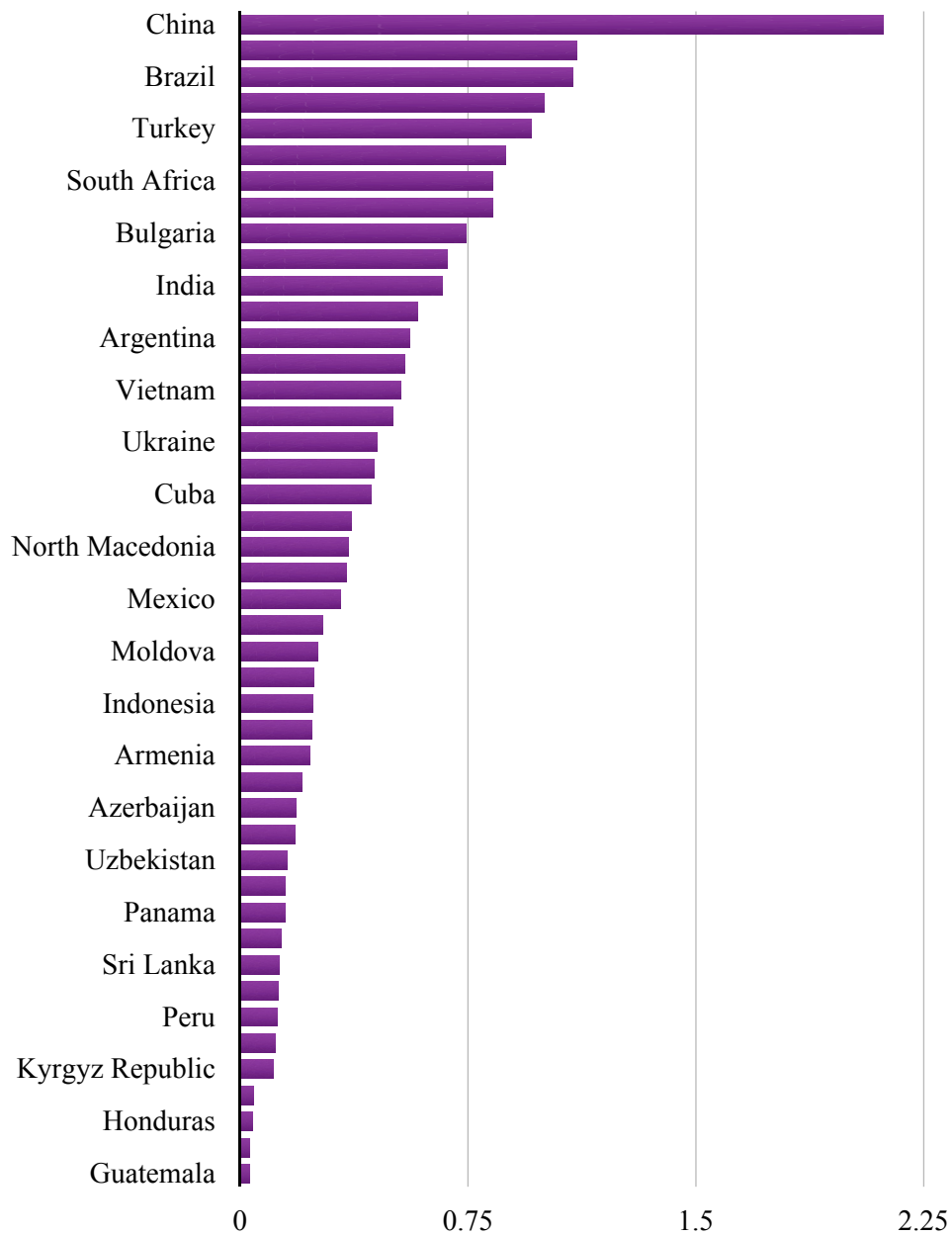


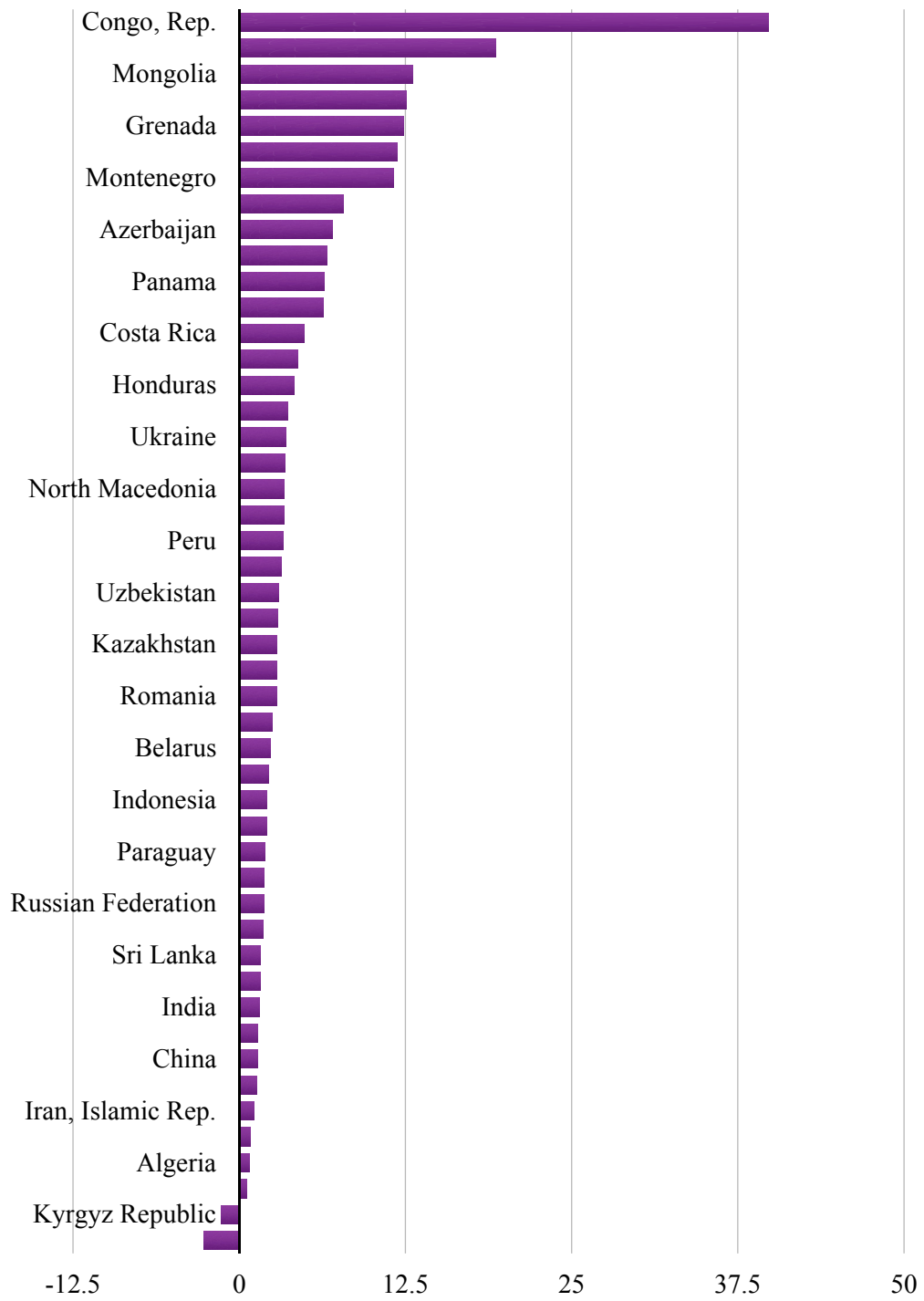Figure 1. R&D spending (% of GDP) (2017)
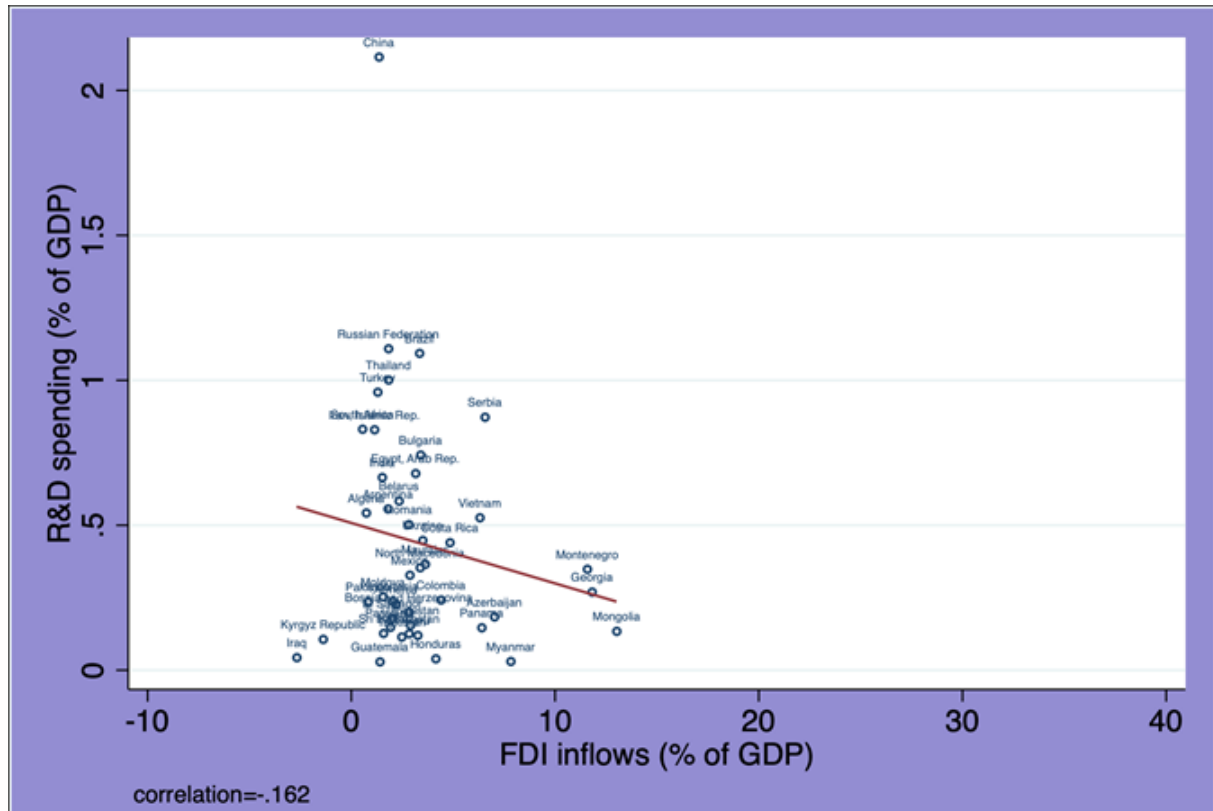
Figure 2. FDI (% of GDP) (2017)

Figure3. FDI effect on R&D spending in middle-income countries (2017)

As for the second Pooled OLS regression, five control variables were added; GDP per capita (current US$), Gross domestic savings (relative to GDP), Current account balance (relative to GDP), Imports of goods and services (relative to GDP), and Exports of goods and services (relative to GDP). The countries and the years remained the same as the first regression, but after removing the years with missing data, 586 observations were recorded. The third regression kept the controls GDP per capita (current US$) and Gross domestic savings (relative to GDP), yet also added Government expenditure on education, total (relative to GDP), and Patent applications (residents). 391 observations were recorded for the third model. The first, second, and third regression results are shown in Table 2.

Table 2. First, second, and third OLS regression (1990-2022)

| VARIABLES | R&D expenditure (% of GDP) | R&D expenditure (% of GDP) | R&D expenditure (% of GDP) |
|---|---|---|---|
| Foreign direct investment, net inflows (% of GDP) | -0.106** (-2.652) | -0.148** (-3.243) | -0.112** (-2.959) |
| GDP per capita (current US$) | | 0.239** (6.056) | 0.167** (4.104) |
| Gross domestic savings (% of GDP) | | 0.601** (7.166) | 0.225** (5.317) |
| Current account balance (% of GDP) | | -0.024 (-0.353) | |
| Imports of goods and services (% of GDP) | | 0.423** (3.002) | |
| Exports of goods and services (% of GDP) | | -0.471** (-3.512) | |
| Government expenditure on education, total (% of GDP) | | | 0.282** (7.081) |
| Patent applications, residents | | | 0.460** (11.758) |
| Observations | 616 | 586 | 391 |
| R-squared | 0.011 | 0.220 | 0.455 |
| Durbin-Waston statistic | 0.259 | 0.340 | 0.301 |

Notes: Numbers not in parentheses are standardized coefficients and numbers in parentheses are t-values.

** $p<0.01$; * $p<0.05$;

Source: The World Bank DataBank; World Development Indicators

## 4. Discussion of Results

In the initial OLS regression, a statistically significant inverse relationship between FDI and R&D expenditure in MI countries is observed. This relationship implies that a one standard deviation increase in FDI is associated with a reduction of approximately 0.106 standard deviations in R&D spending, both relative to GDP. It is important to note that the effect size, while statistically significant, is not of substantial magnitude. This is partly due to the relatively large standard deviation of FDI and the comparatively smaller standard deviation of R&D spending. Nonetheless, it is reasonable to assert that heightened FDI levels within MI countries tend to correspond with diminished R&D investment.

In the subsequent OLS regression, the negative relationship between FDI and R&D spending remains statistically significant, albeit with a slightly reduced effect size. Specifically, the coefficient decreases from -0.106 in the first model to -0.148 in the second model. As in the initial model, the effect size in the second model is relatively modest due to the inherent characteristics of the variables' standard deviations. Nevertheless, the conclusion remains that heightened FDI inflows in MI countries correlate with diminished R&D expenditures.

A similar pattern emerges in the third model, where a one standard deviation increase in FDI is linked to a reduction of approximately 0.112 standard deviations in R&D spending in MI countries. Across all three models, a consistent negative correlation between R&D expenditure and FDI inflows is evident. While the relationship is statistically significant, its strength is not exceptionally pronounced. These findings suggest that FDI inflows exercise a moderating influence on R&D expenditure within MI countries.

In light of the results from these three models, it is reasonable to reject the null hypothesis positing a positive relationship between FDI and R&D spending. Consequently, the conclusions drawn by Erdal and Gocer (2015), advocating for the pivotal role of FDI in enhancing R&D and innovation levels in developing countries, are called into question. While this study's findings do not align with Erdal and Gocer's assertions, they do align with the empirical discoveries of Azman-Saini et al. (2018). Furthermore, this research lends empirical support to the theoretical postulations made by Anastasi (2023), Doner and Schneider (2017), and Zeng and Fang (2014).

It is noteworthy that the negative relationship between FDI inflows and R&D expenditure within MI countries, as revealed by this study, suggests that the presence of MNCs in domestic economies marginally discourages R&D investment. Although the effect size is not substantial, it remains statistically significant across all three models. The precise underlying reasons for this negative relationship remain ambiguous. The study's results lend credence to the three hypotheses outlined in Section 3 without definitively excluding any of them. The true rationale behind the adverse relationship between FDI inflows and R&D expenditure may be attributable to one or a combination of these hypotheses or possibly other unexplored factors. In sum, it is reasonable to conclude that FDI inflows do not serve as an incentive for R&D spending within MI countries.

## 5. Conclusion

This study aimed to examine the relationship between FDI inflows and R&D spending in MI countries, with a focus on how FDI affects MI countries' ability to innovate and upgrade industries. The analysis of empirical data and regression models provided insights into this complex relationship. Through a comprehensive analysis of empirical data spanning the years 1990 to 2022 across 108 MI countries, this study demonstrated that FDI inflows have a significant and moderately negative relationship with R&D expenditure relative to GDP. While the effect size may not be substantial, the consistent statistical significance across multiple regression models suggests a discernible trend. This finding challenges the optimistic notion that FDI inherently promotes innovation and technology advancement in MI countries, as suggested by some scholars.

Contrary to the pro-FDI stance that spillover effects and competition foster innovation, the study's results align more closely with the concerns raised by those who caution against excessive reliance on FDI. The presence of MNCs, often focused on low-profit, labor-intensive activities, appears to exert a dampening influence on domestic R&D spending. The findings resonate with the voices of scholars who have emphasized the importance of nurturing indigenous innovation capacity, investing in human capital, and addressing institutional cleavages to escape the MIT. This could be due to various factors, including the concentration of MNCs' R&D activities in their home countries, the potential displacement of local firms from higher-value activities, and the incentive for imitation over indigenous innovation. While this study does not definitively pinpoint the precise mechanisms driving the negative relationship between FDI and R&D expenditure, it adds empirical weight to the need for nuanced policy approaches in MI countries.

It's important to acknowledge the limitations of this study, such as the inability to pinpoint a single causal mechanism behind the negative relationship. Additionally, the effect size, while statistically significant, is relatively modest. Further research should delve into the nuances of FDI types, industry contexts, and policy environments to gain a deeper understanding of the underlying dynamics.

In conclusion, this study contributes to the limited empirical research on the relationship between FDI and R&D spending in MI countries. The results suggest that policymakers in MI economies should approach FDI with caution and consider policies that foster indigenous innovation and technological upgrading. As the global economic landscape continues to evolve, understanding the implications of FDI on domestic innovation remains crucial for the sustainable development of middle-income countries.

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**Data sharing statement**

No additional data are available.

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