EFFECTS OF ECONOMIC CONDITIONS ON FOREIGN DIRECT INVESTMENT: COUNTRY LEVEL PANEL DATA ANALYSIS

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Abstract

Foreign direct investment (FDI) has long been a major source of financing for infrastructure and commercial projects, especially for developing nations. This paper explores a panel data analysis of the economic conditions that affect levels of FDI inflow, with a sample set consisting of 18 countries from 1981 to 2014 on a quarterly basis. Variables considered include macroeconomic conditions such as GDP, stock market performance, interest rates of varying terms, crime perception, and trade openness. The final model(s) discussed establish that FDI inflow is positively correlated with strong GDP and stock market performance as well as, surprisingly, 3-month and 10-year interest rates. Trade policies and crime perception seem to act with a significant lag, and the effects of many variables seem to depend on the development status of the country as well.

Keywords: FDI, investment, GDP, interest rates, trade, crime, developing country

1 Introduction

This paper explores the effects of specific economic conditions on foreign direct investment (FDI) inflows across 18 countries from 1981 to 2014. The question being explored is which market characteristics are most significant in attracting FDI and the interplay between such conditions.

FDI is generally defined as a sizable financial investment of a long maturity (2-10 years) by a foreign investor, company, or government (Aizenman, 2006). Due to their longevity and financial value, FDI decisions are predicated upon a range of factors. The market conditions explored in this paper include GDP, GDP per capita, interest rates of varying terms, trade openness, domestic stock market returns, inflation, crime perception, economic uncertainty, and the strength of the domestic currency. Subsample regressions are also used to investigate differing conditions for developing and developed countries.

As of the writing of this paper, the relevant scholarly literature on this topic is limited. Many studies analyze the effect of FDI on the economy overall but not the other way around. However, existing studies point to the significance of factors such as GDP, domestic stock market returns, and interest rates especially. Another consistent theme is the disparity between the developed and developing world. This paper builds upon existing theory to further inspect the correlation between such conditions and FDI inflows.

The selected regression model(s) discussed in this paper attest to the importance of the factors mentioned in the previous paragraph, with these variables remaining highly significant throughout all the specifications explored. Other compelling relationships that are uncovered include the role of trade openness and crime, as well as the lagged effect of several key variables.

In addition, subsample regressions and interaction variables show that certain conditions are far more significant in developing countries than developed in terms of attracting FDI.

2 Literature Review

There has been some, albeit limited, research dedicated to exploring the factors affecting FDI levels and the interplay between foreign investment and the economy at large. The following studies have helped me develop my understanding of FDI and the economic conditions that underlie it.

Several studies have investigated the relationship between economic output and FDI. In "Effect of FDI on Real GDP Per Capita Growth: 60 Countries", published in 2017 in *Applied Econometrics and International Development,* authors Edwards and Naanwab inspect how FDI levels affect GDP growth. This is the opposite of the relationship I am exploring in my model, but it is worthwhile nonetheless to understand the relationship between these factors. Their research found that overall the correlation is not significant, but it is more visible in the developing world (Edwards and Naanwab, 2017). This is important as it helped me realize that developed and developing countries have differing relationships with FDI, and I should explore subsample regressions and interactions of the development status variable. A similar study was reported on in "Impact of FDI on GDP: A Comparative Study of China and India", published in *International Journal of Business and Management* in 2011. In it, authors Agarwal and Khan explore the same relationship in China and India, finding that a 1% increase in FDI leads to a 0.7% increase in GDP. This informs me that there may be a statistically significant relationship to uncover between these variables.

One of the variables I had to consider closely was interest rates, due to their complicated effect on economic performance and FDI inflows. The study "Interest Rates in Attracting FDI: ASEAN Analysis", published in *National Institute of Development Administration,* established a negative correlation between interest rates and FDI. This was also more visible in developing countries (Siddiqui and Aumeboonsuke, 2014). Again, this highlights the importance of subsample regressions based on development status. It also provides insight into the effect of higher interest rates. As per the neoclassical theory of investment, the decisive factor in investing capital is the comparison between the ROI (return on investment) and the cost of capital. A higher interest/discount rate would lead to lower valuations and ROIs on investments, deterring FDI. In addition, as per the monetary transmission mechanism and the Taylor Rule, higher rates "transmit" through the economy and dampen economic activity through higher borrowing costs, which would raise the cost of capital in comparison to the FDI.

The neoclassical theory of investments is also relevant to stock market returns. Strong equity performance would lead investors to expect high returns on investments, increasing the ROI in relation to the cost of capital. This relationship is further explored in "FDI and Stock Market Development: Complements or Substitutes?" in *The Journal of International Economics.* In this 2001 study, Claessens et al uncover a positive correlation between stock market returns and FDI. They cite the momentum effect, the belief among investors that strong performance today indicates a continuation of the trend tomorrow. An interesting addition to this theory comes from "Multinationals as Arbitrageurs: The Effect of Stock Market Valuations on Foreign Direct Investment" in *The Review of Financial Studies.* This study shows that although overall stock market performance can attract FDI, it can also drive up equity prices and raise the P/E ratio,

deterring further investment (Baker et al, 2009). Therefore, this is an effect worth keeping in mind while exploring this relationship.

Another question I needed resolved was the relationship between FDI and economic volatility/uncertainty. Instinctively, an uncertain economy would deter investors. However, I know from my understanding of the capital asset pricing model (CAPM) that uncertainty can lead to a higher beta (level of market responsiveness) and higher potential ROI (but also larger potential loss). This complexity was explored in "Volatility, employment and the patterns of FDI in emerging markets" in *Journal of Development Economics.* This study found that higher levels of market volatility affected investment decisions by foreign companies regardless of risk tolerance levels: even generally risk-neutral investors took market uncertainty into account, diversifying their capital across multiple markets to accommodate for it. This means each individual country receives less FDI (Aizenman, 2006). However, this study looked at regional market volatility instead of country-specific volatility.

Other studies focus on the correlation between FDI and specific economic and social conditions. "FDI and Trade: Two-Way Linkages?" from *Quarterly Review of Economics and Finance* finds that openness to manufacturing trade is the most decisive factor in attracting FDI. They also hint at a "feedback loop" in which more trade volume leads to higher FDI which further increases trade volume, and so on (Aizenman and Noy, 2006). Similarly, "The Effect of Crime on FDI: A Multi-Country Panel Data Analysis" from *The Journal of Developing Areas* analyzed 62 countries to explore this relationship. Their primary finding was that financial crimes and the security of market instruments (contracts, debt, banking systems, etc.) were most significant in attracting FDI (Hibbert and Brown, 2017). These studies encouraged me to include crime and trade

openness in my models. However, unfortunately, I was unable to find an appropriate variable measuring financial crimes and stability.

3 Data

My sample set consists of the following 18 countries, with data collected from the first quarter of 1981 to the first quarter of 2014: United States, Brazil, United Kingdom, Indonesia, South Korea, Germany, Mexico, Greece, New Zealand, China, India, Japan, South Africa, Turkey, Russia, France, Italy, Canada.

Before delving into the variables used, my three data sources are as follows:

1. Federal Reserve Economic Data (FRED) of the St. Louis Federal Reserve: This is a widely cited data collection project consisting of over 200,000 U.S. and international economic time series from 69 different sources, with a focus on economic, financial, and market data.
2. World Bank Data Bank: This is an "analysis and visualization" tool for economic, social, and political data collected from across the globe. I specifically consulted the World Development Indicators series of this database.
3. Statista: This is a German platform that collects and visualizes data on over 60,000 topics from over 25,000 sources.

The variables I included in this final model are as follows. I have underlined the variables that I included in my final model, which is discussed in depth in the following sections:

1. **Foreign Direct Investment (fdi)**: This variable measures the FDI inflow of the reporting country in USD in a given quarter. It was obtained from FRED. I do not have an expected coefficient for this variable as it is the dependent variable.

2. **Gross Domestic Product (gdp)**: This variable measures the total value of goods and services produced in the reporting country in a given quarter, measured in millions of USD at 2017 prices. It was obtained from FRED. My expected coefficient for this variable was positive, given that higher GDP indicates greater economic output and activity, raising the expected return on investments made in the country. In this model, this variable was positively correlated (0.005) and significant at the 1% level.
3. **Ten-Year Interest Rates (ten_year):** This variable indicates the prevailing ten-year market discount rate in the reporting country on a quarterly basis. It was obtained from FRED. I was unsure of this variable's coefficient. On one hand, a higher interest rate will disincentivize borrowing and slow down economic activity as per the monetary transmission mechanism and Taylor Rule, lowering the expected return on investments. An investment also yields lower cash flows when discounted at a higher rate, thereby discouraging FDI. However, on the other hand, a higher long-term rate may indicate expectations of a lower short-term rate in the near future as per the general shape of a typical yield curve. Therefore, investments of a shorter maturity (less than 8-10 years) would benefit from such conditions. I was generally inclined towards a negative coefficient for this variable, but the final model showed a positive correlation (1.801e+08) and it was significant at the 5% level.
4. **Three-Month Interest Rates (three_month)**: This variable indicates the prevailing three-month market interest rate in the reporting country on a quarterly basis. It was obtained from FRED. Similar to the ten-year rate, I was uncertain about this variable's coefficient for many of the same reasons. It is worth noting that three months is a significantly shorter time frame than what generally constitutes FDI, so I also suspected this variable may not

be significant at all. However, it turned out to be significant at a 1% level across all my major models and had a positive coefficient (1.524e+08).

5. **National Stock Market Returns (stockx_lag1)**: This variable measures the annualized return rate of the national/flagship equity exchange of the reporting country. It was obtained from Yahoo Finance and was lagged by 1 quarter. I expected a positive coefficient for this variable as stronger stock market returns would boost investor sentiment and attract further investment due to expectations of continued strong performance. In my final and across all major models, this variable had a positive coefficient (529838) and was significant at the 1% level.
6. **GDP Per Capita (gdpcap_lag1)**: This variable measures the GDP per capita, or per person, of the reporting country (once again in millions of USD at 2017 prices). It generally provides a more accurate and reliable measure of a country's economic output relative to its size. This variable was obtained from FRED and was lagged by 1 quarter. I expected a positive coefficient for the same reasons as the original GDP variable, and the model confirmed this (645305.41). It was also significant at the 1% level.
7. **World Uncertainty Index (uncertainty)**: This variable measures the level of economic and market uncertainty in the reporting country on a quarterly basis, on a scale of 0 to 1.5 (with 0 representing very little to no uncertainty). It was obtained from FRED. I expected a negative correlation between this variable and FDI inflows, as economic uncertainty and volatility would likely reduce expected returns on investment. However, it should be pointed out that per CAPM, a higher beta (level of market responsiveness) would increase both upward and downward potential in terms of security prices. Therefore, the coefficient

of uncertainty would probably depend on the level of risk aversion/tolerance for the investor.

8. **Broad Effective Exchange Rate (exchange)**: The BEER is a measure of a country's currency's overall strength compared to a basket of global currencies. It is measured on a scale beginning from 0, with 100 representing the 2020 levels of currency strength. This data was obtained from Statista. I was uncertain about the coefficient for this variable, given that a strong currency would raise the purchasing power of people in the domestic country and raise consumption. However, at the same time, a stronger currency may also deter export levels due to domestically manufactured products being more expensive for recipient countries.
9. **Development Status (dev_status)**: This is a categorical variable with 0 = developing and 1 = developed. This was obtained from the World Bank. I expected certain variables to be more significant for developing countries, given that the developing world is usually the recipient of FDI. This implies that economic conditions in developing countries are more decisive in determining FDI inflows, whereas conditions in the developed world are likely less important in this investment decision due to generally long-term economic stability.
10. **Crime Perception Index (crime)**: Also known as the Rule of Law Estimation, this measures the broadly perceived strength of a country's institutions, "in particular the quality of contract enforcement, property rights, the police, and the courts" as per the World Bank, where it was obtained from. This variable is measured on a scale of -2.5 to 2.5. I expected a positive coefficient for this variable, given that higher confidence in the security and strength of national institutions would reassure investors of the stability of their investment projects and attract FDI.

11. **Trade Openness (trade)**: This measures the level of trade openness for the reporting country, obtained by calculating exports plus imports divided by GDP is the total trade as a percentage of GDP. It was sourced from FRED. I expected a positive coefficient for this variable, given that more openness to trade activity would strengthen international commercial ties and raise FDI.
12. **CPI (cpi):** This variable measures the inflation level for all items in the reporting country on a quarterly basis (measured in a change in prices from the previous quarter). It was obtained FRED. I expected a negative coefficient for this variable, given that higher inflation reduces economic certainty and can dampen consumer confidence, reducing economic output, consumption, and growth. Higher inflation can also usher in higher interest rates by the central bank, reducing economic activity overall.

The following table displays the summary statistics for my data.

Variable		Mean	St. Dev	Min	Max	Observations
fdi	overall	8.9e+09	3.23e+10	-2.58e+10	5.65e+11	N = 2013
	between		2.07e+10	2.58e+08	8.58e+10	n = 18
	within		2.72e+10	-7.68e+10	4.88e+11	T = 111.83
gdp	overall	2.65e+11	1.43e+12	40731.8	1.52e+13	N = 1596
	between		1.15e+12	53012.36	4.87e+12	n = 18
	within		9.21e+11	-4.08e+12	1.06e+13	T = 88.667

uncertainty	overall	0.144	0.148	0	0.9778038	N = 2348
	between		0.036	0.709552	0.2013633	n = 18
	within		0.143	-0.575	0.9654876	T = 130.44
stocks	overall	9338.679	14101.35	0.235951	86046	N = 1347
	between		11331.65	0.5052719	34908.78	n = 17
	within		9501.934	-23373	60475.9	T = 79.23
exchange	overall	110.7438	23.91	46.05	192.193	N = 1408
	between		19.1585	73.986	142.711	n = 18
	within		15.02	48.96877	166.24	T = 77.22
ten_year	overall	11.54869	15.5776	0.1	200	N = 1727
	between		11.061	1.99923	42.374	n = 18
	within		10.80077	-21.32599	176.148	T = 95.944
three_year	overall	9.19305	12.32881	0.08	137.26	N = 1571
	between		10.9852	0.3642	49.338	n = 16
	within		8.59	-35.194	97.11	T = 98.187

dev_status	overall	0.53407	0.498944	0	1	N = 2348
	between		0.499143	0	1	n = 18
	within		0.1177098	-0.0079	0.9920868	T = 130.4
gdp_cap	overall	19623.97	14576.28	402.9	55675	N = 2192
	between		14160.09	672.93	44534	n = 17
	within		4923.137	3210.285	32116	T = 128.94
crime	overall	0.60745	0.9310825	-1.083	1.922	N = 1266
	between		0.9467205	-0.906881	1.84	n = 18
	within		0.104	0.22627	1.029	T = 70.3
trade	overall	39.33168	17.489	7.7669	92.05	N = 2120
	between		12.462	19.38	59.37	n = 18
	within		12.539	7.272	82.9585	T = 117.7

There are some worthwhile observations to highlight. Firstly, the between and within standard deviations for my dependent variable, FDI, is quite similar (2.02e+10 and 2.07e+10), indicating similar variation within a country's history as the variation between countries. The same is true for trade openness, with deviations of 12.4 and 12.5. Interestingly, the opposite is true for

crime, with a wide disparity between its deviations within countries (0.104) and between them (0.946).

In addition, the national stock market returns dataset is largely incomplete, including only 1347 observations compared to the full 2348 for most variables. This means it is missing over 1000 observations. Despite this, this variable was highly significant across all my models, and removing it was only detrimental to the coefficient of determination and overall significance for the model.

Below is the correlation matrix for my variables.

Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) fdi	1.000											
(2) gdp	0.156*	1.000										
(3) uncertainty	-0.059*	-0.084*	1.000									
(4) stocks	0.072*	-0.098*	0.093*	1.000								
(5) exchange	-0.072*	-0.295*	0.067*	0.564*	1.000							
(6) ten_year	-0.047	-0.103*	0.081*	0.213*	0.050	1.000						
(7) three_month	-0.163*	-0.086*	0.025	0.008	0.113*	0.819*	1.000					
(8) dev_status	-0.172*	-0.244*	-0.049*	-0.314*	-0.135*	-0.409*	-0.353*	1.000				
(9) gdp_capita	-0.164*	-0.249*	-0.010	-0.239*	-0.014	-0.392*	-0.386*	0.861*	1.000			
(10) crime	-0.126*	-0.267*	-0.122*	-0.298*	-0.065*	-0.441*	-0.351*	0.902*	0.898*	1.000		
(11) trade	0.018	0.144*	0.128*	-0.129*	-0.107*	-0.148*	-0.258*	0.218*	0.265*	0.146*	1.000	
(12) cpi	-0.010	-0.055*	-0.102*	-0.032	-0.030	-0.072*	-0.056*	0.164*	0.230*	0.280*	0.246*	1.000

**** p<0.01, ** p<0.05, * p<0.1*

FDI is significantly correlated with all my variables except trade openness and CPI. However, all the correlations here are shown to be negative, which is interesting given that my final model only consists of positive coefficients. In addition, GDP, development status, and crime are all highly and significantly correlated with all variables as well. Finally, the strongest relationship here is between crime and development status, with a significant correlation of 0.902. This indicates that developed countries (1) are perceived to be significantly tougher on crime and have more secure institutions than the developing world (0).

While exploring my variables, I reviewed graphs of certain pairs to see if there may be an interesting underlying relationship. The scatterplot correlating GDP per capita with FDI indicated the possibility of a polynomial relationship, as shown below. This is why I experimented with various polynomial forms of GDP per capita, which I will explain in further detail in the following sections.

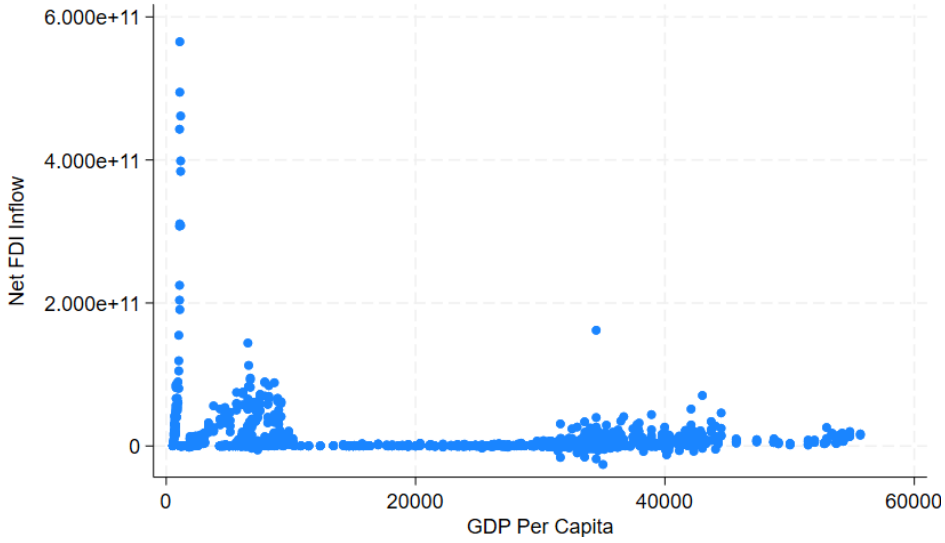

Figure 1

4 Empirical Model and Estimation

I selected the following as the strongest model, with its regression output below:

fdi *= (-1.893e+10) + (0.005)****(gdp)*** *+ (1.801e+08)****(ten_year)*** *+*

*(1.524e+08)****(three_month)*** *+ (529838)****(stockx_lag1)*** *+ (645305.41)****(gdpcap_lag1)***

Regression results

fdi	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]	Sig
gdp	.005	0	25.47	0	.005	.005	***
ten_year	1.732e+08	75219013	2.30	.022	25503853	3.208e+08	**
three_month	1.447e+08	57302247	2.52	.012	32183495	2.572e+08	**
stockx_lag1	526896.36	84835.865	6.21	0	360362.71	693430.02	***
gdpcap_lag1	633032.07	53841.352	11.76	0	527340.96	738723.18	***
Constant	-1.837e+10	1.904e+09	-9.65	0	-2.211e+10	-1.463e+10	***
Mean dependent var	6676499945.980		SD dependent var		11522820023.159		
R-squared	0.547		Number of obs.		798		
F-test	188.575		Prob > F		0.000		
Akaike crit. (AIC)	38151.476		Bayesian crit. (BIC)		38179.568		

**** p<.01, ** p<.05, * p<.1*

As shown above, the coefficient of determination for this model is 0.5473, which was one of the highest among the models I tested. Three variables - GDP, stock returns, and GDP per capita - are significant at the 1% level, while 10-year and 3-month interest rates are significant at 5%. The coefficients for my variables are all positive and generally confirm what I had hypothesized

based on the theoretical background and literature review. What was surprising, however, was the fact that 10-year and 3-month interest rates are both positively correlated with FDI inflow. This does not necessarily contradict my expectations, given that I was unsure of the coefficients for these two variables; but it is a relationship worth exploring further, which I do in the Discussion section. The model overall is significant at the 1% level, and the rho is moderate at 0.63.

I decided to use an incremental and iterative approach to estimating my model. This means I began with the basic form of the variables that I expected were most likely to be significant: GDP, GDP per capita, 10-year interest rates, and domestic stock market returns. (I made these selections based on the literature review and underlying theories.) This model was significant at 1%, with all the variables also significant with the exception of 10-year rates. The coefficient of determination was quite low, at 0.108. I then adjusted, removed, and added different versions of them, tracking the coefficients of determination, significance levels, and other metrics of all the models I experimented with. Through this process, I arrived at 3-4 models that exhibited certain strengths and interesting features of their own, and from these I selected the model discussed above. I will delve into these other specifications in the Empirical Results section.

Since I have the categorical variable of development status, I explored the interplay between this variable and the rest of the model. First, I used sample splitting to separate my final regression model into developed versus developing countries. Here are the results of my subsample regression for developing countries:

Regression results

fdi	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]	Sig
gdp	.005	.001	7.34	0	.003	.006	***
ten_year	-14823105	1.442e+08	-0.10	.918	-2.997e+08	2.700e+08	
three_month	46648431	67657285	0.69	.492	-86955478	1.803e+08	
stockx_lag1	121986.85	115025.95	1.06	.29	-105156.71	349130.41	
gdpcap_lag1	1168887.3	1592016.3	0.73	.464	-1974892.4	4312667	
Constant	-5.061e+09	7.027e+09	-0.72	.472	-1.894e+10	8.816e+09	

Mean dependent var	12711290935.673	SD dependent var	19144921877.410
R-squared	0.853	Number of obs.	171
F-test	187.675	Prob > F	0.000
Akaike crit. (AIC)	8142.879	Bayesian crit. (BIC)	8161.729

*** p<.01, ** p<.05, * p<.1

As shown, the coefficient of determination is far higher at 0.8528. Most of my variables are insignificant, however. The one variable that remains significant is GDP (at 1%). Therefore, this model overall is not usable. Here is my subsample regression for developed countries:

Regression results

fdi	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]	Sig
gdp	-.445	.396	-1.12	.262	-1.222	.332	
ten_year	2.324e+08	99919743	2.33	.02	36193094	4.286e+08	**
three_month	2.642e+08	1.217e+08	2.17	.03	25130971	5.033e+08	**
stockx_lag1	1330958.9	168881.25	7.88	0	999302.91	1662614.9	***
gdpcap_lag1	569002.56	76697.317	7.42	0	418381.19	719623.93	***
Constant	-2.062e+10	3.133e+09	-6.58	0	-2.677e+10	-1.447e+10	***

Mean dependent var	5030647857.882	SD dependent var	7539690422.410
R-squared	0.266	Number of obs.	627
F-test	44.526	Prob > F	0.000
Akaike crit. (AIC)	29977.734	Bayesian crit. (BIC)	30004.380

*** p<.01, ** p<.05, * p<.1

Surprisingly, the overall model is significant at 1%. All my variables are also significant at 5%. The only insignificant variable is GDP, an exact opposite result of the previous subsample regression. This suggests that GDP is a significant factor in determining FDI inflows for developing, but not developed, countries. This logically makes sense and is substantiated by theory, given that a developing country exhibiting strong economic performance would attract FDI due to the potential for high returns, but such performance is likely not as meaningful for a country that is already developed.

I was also interested in seeing the results of interacting development status with other variables, specifically GDP (given the relationship uncovered in the subsample regressions). Interestingly, I found that GDP has a positive coefficient when interacted with developing countries but negative for developed countries. This also corresponds to the underlying theory, as

strong economic output in a developing country would boost FDI inflow, but the relationship is likely not as strong for developed nations. In addition, it may be speculated that developed countries have far more domestic sources of investment while the developing world often relies on foreign investors, countries, and organizations, so FDI inflow will inherently be more responsive to economic conditions in the developing world. Interacting the categorical variable with 3-month interest rates shows that this variable is significant and positively correlated with FDI inflow regardless of development status. Although experimenting with the categorical variable produced compelling and thought-provoking results, I could not include it in my final fixed-effects model.

Regression results

fdi	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]	Sig
gdp	.005	0	25.54	0	.005	.005	***
Dev Status*gdp	-.528	.378	-1.40	.163	-1.271	.215	
ten_year	2.227e+08	81189702	2.74	.006	63366767	3.821e+08	***
three_month	1.342e+08	58881378	2.28	.023	18629057	2.498e+08	**
stockx_lag1	546880.66	85598.679	6.39	0	378848.93	714912.4	***
gdpcap_lag1	653798.73	54651.305	11.96	0	546517.25	761080.22	***
gdpcap_growth	1.845e+10	1.144e+10	1.61	.107	-4.001e+09	4.091e+10	
Constant	-1.813e+10	2.017e+09	-8.99	0	-2.209e+10	-1.417e+10	***

Mean dependent var	6676499945.980	SD dependent var	11522820023.159
R-squared	0.550	Number of obs.	798
F-test	135.758	Prob > F	0.000
Akaike crit. (AIC)	38150.914	Bayesian crit. (BIC)	38188.371

**** p<.01, ** p<.05, * p<.1*

I experimented with the natural log form of certain variables, most prominently FDI and GDP. However, these variations did not yield any benefit to the coefficients of determination or any other metric, so I discarded them. I also tried the lagged form of several variables, especially the ones that I expected would have a delayed effect on the dependent variable. These included GDP per capita, stock exchange returns, crime, and trade openness. The first two variables were most significant and increased the coefficient of determination when lagging them by one quarter. Crime and trade openness were most significant when lagged by two and four quarters, respectively. However, including crime in the model at all reduced the coefficient of determination, so I excluded it from the final specification. Including trade (lagged by four quarters) produced an interesting model that I will explore further in the Empirical Results section, although it was still not as strong as the final model I selected. Leading forms of these variables also did not yield any benefit to the model. Thus, due to their effect of raising the coefficient of determination, my final model included only the lagged forms of stock exchange returns and GDP per capita, each lagged by one quarter.

I also explored polynomial forms of the GDP per capita variable, given the relationship depicted in the scatterplot in the Data section. Interestingly, through the same incremental and iterative method, I found that the fourth exponent of the variable yielded a high coefficient of determination of 0.5521, shown below. The overall model is significant at 1%, as are all my variables. However, the reason I did not select this as my final model was due to the lack of a theoretical basis: I was uncertain as to the real-life practical meaning of GDP per capita raised to the fourth power. (Interestingly, one model with GDP per capita *squared* actually produced the highest coefficient of determination that I had seen, at 0.5538. However, this same variable was insignificant in this model.)

I further explored the strength of my final model through tests for multicollinearity, heteroskedasticity, and serial correlation. I will discuss the results of these tests in the Empirical Results section.

5 Empirical Results and Discussion

My final model, as discussed above, had a coefficient of determination of 0.5473, a rho of 0.63, and an overall significance of 1%. GDP, GDP per capita, stock exchange returns, and 3-month interest rates were also significant at 1%, while 10-year rates were significant at 5%.

I conducted the Hausman test to determine what kind of model would be best for my data. I received a p-value of 0, indicating a fixed-effects model should be used. Despite this, I still experimented with a random-effects model, which had a slightly higher coefficient of determination. However, 10-year rates were not significant in this model. Despite this, removing this variable reduced the coefficient of determination to 0.44.

Hausman (1978) specification test

	Coef.
Chi-square test value	35.183
P-value	0

The VIF test for my original (final) model yielded 2.57. This indicates a healthy level of multicollinearity. The lack of multicollinearity between GDP and GDP per capita was surprising to me.

Variance inflation factor

	VIF	1/VIF
ten year	4.606	.217
three month	4.378	.228
gdpcap lag1	1.485	.674
gdp	1.29	.775
stockx lag1	1.117	.895
Mean VIF	2.575	.

I also tested for heteroskedasticity and received a p-value of 0, indicating some degree of heteroskedasticity.

```
. xttest3

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (13)  =   13665.38
Prob>chi2 =      0.0000
```

In order to test for serial correlation, I obtained the robust estimation of standard errors. In this model, 10-year and 3-month rates became insignificant at 0.17. However, removing this variable made the other variables less significant and a much lower coefficient of determination overall.

Regression results

fdi	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
gdp	.005	0	73.31	0	.005	.005	***
ten_year	1.732e+08	1.189e+08	1.46	.171	-85807494	4.321e+08	
three_month	1.447e+08	1.012e+08	1.43	.178	-75772964	3.651e+08	
stockx_lag1	526896.36	256979.15	2.05	.063	-33013.102	1086805.8	*
gdpcap_lag1	633032.07	98594.156	6.42	0	418213.86	847850.28	***
Constant	-1.837e+10	4.696e+09	-3.91	.002	-2.860e+10	-8.136e+09	***

Mean dependent var	6676499945.980	SD dependent var	11522820023.159
R-squared	0.547	Number of obs	798
F-test	232895376.537	Prob > F	0.000
Akaike crit. (AIC)	38149.476	Bayesian crit. (BIC)	38172.886

*** $p<.01$, ** $p<.05$, * $p<.1$

I also spent time exploring combinations and differing forms of other variables. One interesting model I explained earlier included polynomial forms of the GDP per capita variable. The squared version yielded the highest coefficient of determination, but the variable itself was insignificant in it. The fourth exponent of this variable, however, yielded a high coefficient of determination, and all variables and the overall model were significant. However, due to a lack of a real-life explanation for this variable, I did not select it as my final model.

Regression results

fdi	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
gdp	.005	0	25.41	0	.005	.005	***
gdp_capita	341190.6	130550.51	2.61	.009	84918.133	597463.06	***
gdpcap4	0	0	2.54	.011	0	0	**
ten_year	1.713e+08	75010434	2.28	.023	24064091	3.186e+08	**
three_month	1.433e+08	57076019	2.51	.012	31227992	2.553e+08	**
stockx_lag1	547084.9	84719.601	6.46	0	380779.14	713390.65	***
Constant	-1.206e+10	3.271e+09	-3.69	0	-1.848e+10	-5.641e+09	***

Mean dependent var	6676499945.980	SD dependent var	11522820023.159
R-squared	0.552	Number of obs	798
F-test	160.035	Prob > F	0.000
Akaike crit. (AIC)	38142.920	Bayesian crit. (BIC)	38171.013

*** *p<.01*, ** *p<.05*, * *p<.1*

Another interesting model included trade openness lagged by 4 periods. This yielded a high coefficient of determination of 0.5217. However, at the same time, several variables were less significant, and GDP per capita became completely insignificant. This model does indicate, however, that trade openness does have some lagged effect on FDI inflows.

Regression results

fdi	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
gdp	.005	0	18.56	0	.005	.006	***
trade_lag4	1.434e+08	56378800	2.54	.011	32735626	2.541e+08	**
gdp_capita	-652934.77	433229.52	-1.51	.132	-1503507.2	197637.68	
gdpcapsq	13.913	4.844	2.87	.004	4.402	23.424	***
ten_year	1.936e+08	81428842	2.38	.018	33708796	3.535e+08	**
three_month	1.425e+08	59063566	2.41	.016	26493303	2.584e+08	**
stockx_lag1	570746.75	90353.064	6.32	0	393353.89	748139.61	***
Constant	-3.592e+09	5.840e+09	-0.62	.539	-1.506e+10	7.873e+09	

Mean dependent var	6285457650.433	SD dependent var	10780852727.368
R-squared	0.522	Number of obs	726
F-test	109.995	Prob > F	0.000
Akaike crit. (AIC)	34696.510	Bayesian crit. (BIC)	34733.211

*** $p<.01$, ** $p<.05$, * $p<.1$

I was especially interested in exploring the effect of crime on FDI. However, unfortunately, crime was not a significant variable in any of the models I tried. Neither was inflation. However, lagging each variable by 2 periods made them both more significant, although not enough to justify their inclusion in the final model.

In the end, my final model was the one I selected due to its relatively high coefficient of determination, overall significance level, and the significance of each variable. In addition, the variables in this model fit the underlying theory of FDI and international investments, and the coefficients generally matched my expectations. In addition, across all the strongest models I

considered, the regression yielded very similar metrics. Each model had a coefficient of determination between 0.52 and 0.55, a rho between 0.5 and 0.65, and very similar coefficients and significance levels for the main variables (the ones included in the final model). This testifies to the overall strength and consistency of my final model. There are several practical conclusions to be drawn from this:

1. GDP, GDP per capita, and stock market returns were the most significant across all the models. This implies these conditions are the most pivotal in determining levels of FDI inflow. In addition, subsample regressions of developing and developed countries reveal a more nuanced relationship. For developing countries, strong economic output attracts FDI, whereas in the developed world, such conditions matter far less. In fact, as the interaction between development status and GDP showed, the coefficient for this variable can even be negative for developed countries.
2. Several key variables act with a lag. Stock market returns and GDP per capita act with a 1-period lag in affecting FDI. Other models show that trade openness is most significant with a 4-period lag. In addition, inflation and crime perception tend to be more significant when lagged, although still not enough to be included in the final model. All these relationships underline the fact that many economic conditions take time to affect investment decisions and policymaking.
3. The coefficients of most variables corresponded to the literature review and underlying theories. However, the fact that 10-year and 3-month interest rates both had positive coefficients across multiple models has important implications. This indicates that 3-month (short-term) rates being higher may indicate to investors that mid-term rates, usually 3-7

years, may be lower. This pattern also applies to 10-year rates being high: it may indicate shorter rates in the meantime, which is generally the timeframe for most FDI projects.

4. The strongest model with all variables being significant included a polynomial form of GDP per capita. It is worthwhile to investigate what the real-life application of this variable may be.

I am still left with certain questions about the model and opportunities for further exploration. For example, why were the crime and inflation variables so insignificant? According to the theoretical review, both factors have important implications for investment decisions. This may be an issue with the data source, or the kind of data collected. I would like to have used a variable that more specifically focuses on political and market stability and the security of financial instruments. That is not the only potential issue with my data. I also have significant gaps in observations for many of my variables, especially stock market returns. Some of my variables are also recorded on an annual basis, but none of these were included in my final model. Quarterly data for these variables may have yielded stronger and more significant relationships.

Overall, I believe my model provides valuable and compelling insight into the factors affecting FDI inflow levels. For my homeland Bangladesh and other countries, especially in the developing world, it is necessary to understand what economic conditions are most conducive to international investment, which constitutes a significant contribution to the country's development. My models highlight the importance of variables such as GDP, stock market returns, interest rates, and trade openness to attracting FDI inflow.

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