The Relationship between Education and Foreign Direct Investment: Testing the Inverse U Shape

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Abstract:

The Zhang-Markusen (ZM) theory hypothesizes an inverse U-shaped relationship between human capital and foreign direct investment (FDI). Therefore, low wage countries with low human capital cannot attract FDI. To test this hypothesis, we regress FDI on educational levels across countries while grouping them in different income cohorts. Our findings partly support ZM. Rich countries with high human capital and poor countries with low human capital demonstrate an inverse correlation between FDI and human capital proxies. However, for middle-income and upper middle-income countries, human capital (especially tertiary education) has a positive relationship with FDI.

Key Words: *Human Capital, U shape, FDI, Least Developed Countries*

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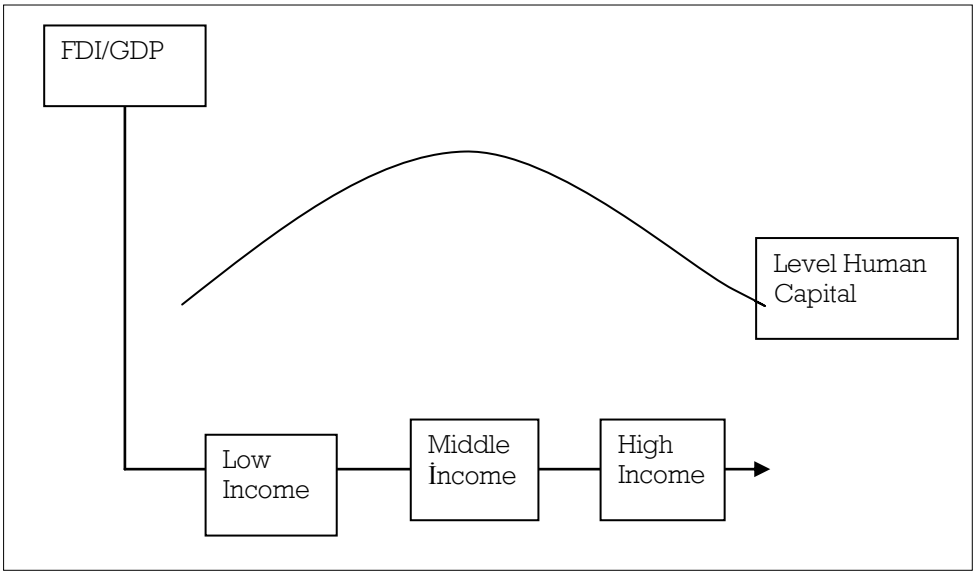
Multinational firms (MNEs) exploit factor-price differences in the world economy by locating skill-intensive processes in skilled-labor abundant regions and unskilled-labor-intensive processes in low wage countries. Zhang-Markusen (1999) (ZM) hypothesis is that MNEs will not invest, even if the wages of unskilled-labor in the host-country are very low due to insufficient human capital (graph1). *MNEs' activity will occur when the country has some skilled labor*. MNEs need direct requirements such as engineers, technicians, and accountants, and indirect requirements such as electric and water supplies, telecommunications, transport links, and legal institutions. The least developed countries account for more than 4% of world production and 11% of population, but they received less than a 1% share of FDI among all developing countries in 1994 (World Bank, 2000; Zhang-Markusen, 1999).

A highly skewed distribution of FDI across countries continues: 15 countries account for over 80 per cent of FDI to developing countries, and the 49 least developed countries attracted only 0.3 per cent of world FDI inflows in 2000 (UNCTAD 2001). We test this hypothesis across country and time using the FDI data of 165 countries between 1980 and 1999; this data were compiled by the World Bank. Based on their theory, an inverse U-shape should be acquired. Human capital disproportionally affects FDI.

Graph 1. The Inverse U-Shape of FDI/GDP and Human Capital



FDI creates new business opportunities for local firms that become suppliers to foreign affiliates. These local firms should be compatible for foreign direct investment.

Grossman and Helpman (1991) also point out that less-developed countries may specialize in low technological goods or natural resources in which spillovers and learning-by-doing opportunities are limited. So, the amount and the impact of FDI may not be effective. FDI to least developed countries has been concentrated in natural resource intensive sectors, particularly mining. FDI in mining has limited multiplier effects on output and employment. Investment in information infrastructure and skills leads to diversify economies from dependence on their natural-resource endowments and offsets some disadvantages of landlocked and geographically countries (Addison and Heshmati, 2003).

Romer (1993) argues that there are important "idea gaps" between rich and poor countries. He notes that foreign investment can ease the transfer of

technological and business know-how to poorer countries. These transfers may have substantial spillover effects for the entire economy. Thus, foreign investment may boost the productivity of all firms -- not just those receiving foreign capital.

However, the success of adoption of foreign technology depends on the existing educational infrastructure. Assume now that the developing country imports the new technology. This can happen in two ways. If the country has the relevant human capital, it can import the hardware and software and apply its existing stock of skilled labor to their use. Over time, it can both expand the supply of that skilled labour, and change its training, so that it is able not only to use the imported information technology but also to modify and develop it.(Addison and Heshmati, 2003).

Recent trends in FDI show that MNEs invest in skilled-labor countries to outsource white-collar workers. Non-tradable sectors such as bank, insurance, credit-card, accounting, investment banking, high-tech, engineering, and design companies extend their activity in skilled-labor-abundant developing countries (Business Week, 2002).

In micro-based research out of Germany, Walkirch (2010) indicates that FDI flows into skilled-labor abundant countries. The Foreign Direct Investment Survey

shows many Japanese MNEs considered availability of superior plant workers and managerial personnel to be an important factor for future investment choice of production bases among the critical factors of location choice (Miyamoto, 2003).

There are four characteristics that distinguish MNEs from national firms: high level of R&D, professional and technical workers, new and complex products, and advertising (Markusen, 1995). These characteristics are main indicators for intangible

and firm-specific assets, which are the foundation of knowledge capital (Markusen, 1995). From this perspective, we argue that human capital and physical infrastructure are important when attracting FDI to a country.

Some models suggest that FDI will only promote growth under certain policy conditions.The benefits of FDI depend on spillovers, profitability, the value-added content of FDI-related production, capital formation, employment, exports, and technology in a domestic economy (De Mello, 1997). Therefore, the level or growth of FDI will not be sufficient for a country's development. FDI promotes economic growth with sufficiently developed financial markets (Alfaro et. al., 2003). Trade openness is crucial for obtaining the growth effect (Balasumbramanyom et. al., 1996).

The role of human capital in FDI is not clear in the literature. Borensztein et al. (1998) state that FDI is an important determinant for transfers of technology and contribute more to growth than domestic investment. FDI is positively associated with economic growth. However, this association depends on human capital; countries with a low level of human capital do not benefit from FDI investments (Borensztein et al, 1998). Their calculations show that a country in which there is male population above 25 year olds with more than 0.45 years of secondary education gets an advantage in FDI. However, this research focuses on growth rate, and its explanatory variables consist of secondary education. A research on migrant network and FDI shows that a one percent increase in the number of migrants with tertiary education increases FDI by 0.41 – 0.52 percent. Furthermore, a 10 percent rise in the share of tertiary educated migrants (keeping total number of migrants constant) increases the FDI stock in their country of origin by an additional 0.3 percent (Javorcik et. al.,). The presence of migrants with a college education appears to be positively correlated with the US FDI in their country of origin. College educated migrants may be better positioned both financially and socially to assist US companies and entrepreneurs in investing abroad.

By estimating the effects of the determinants of FDI in 29 Chinese regions from 1985 to 1995, Cheng and Kwan (2000) find that large regional market, good infrastructure, and preferential policy had a positive effect but wage cost had a negative effect on FDI. The effect of education was positive but not statistically significant.

Blomstrom, Lipsey and Zeyan (1994) have not found a positive impact of education. They claim that the existing wealth is critical. Schneider and Frey (1985) show the share of an age group with secondary education to be a less important determinant. Hanson (1996) finds that the adult literacy rate was not a significant determinant of FDI. Narula (1996) demonstrates that the number of tertiary education

was not a statistically significant explanatory variable for FDI inflows. Thus, all four cross-country studies show that human capital is not necessarily an important input for inward FDI.

This conclusion is consistent for the period of the 1960s to 1970s was when FDI was concentrated on market and resource seeking (Miyamoto, 2003). Thus, demand for higher-educated labour appears to be less crucial during this period. None of this reaserch divides the education level in diffent income cathgories and searches the inverse U-shape argument of ZM.

Noorbakhsh et al. (2001) find that both the stock and flow measures of the human capital variable show statistically significant and positive effects on FDI inflows,and that the effects became more significant over time. Indeed most MNEs operating in developing countries during the late 1980s and 1990s tend to be efficiency-seeking types and high skilled labour force is expected to be crucial (Miyamoto, 2003). Nunnenkamp and Spatz (2003) uses Barro and Lee's (2000) average years of education of total population show that education becomes an increasingly important determinant from the mid-1980s to the late 1990s.

Thus, cross-country evidence indicates that human capital is an important determinant for inward FDI especially among efficiency-seeking MNEs, while not being an important determinant among market or resource-seeking MNEs. This is consistent with evidence that none of the Southeast Asian countries had institutions for industrial upgrading with skills development before the influx of FDI, at least in the low-end manufacturing sector (Miyamoto, 2003). This is also consistent with the experience in the African region, where much of the growth in FDI was in natural resources and market-seeking MNEs that were accompanied by stagnant growth in human capital (Miyamoto, 2003, Asiedu, 2002). The Heckman model predicts that it would raise the likelihood of becoming a host to FDI fows as a country improves the education level (Raziny et. al., 2004).

In this research, we concentrate on FDI and education. Although the concept of human capital is a broad subject, in this paper, we only focus on schooling due to data constraints. We will use a fixed effect GLS model for 165 countries, categorizing in terms of income level (high, upper middle, lower middle, and low) between 1980 and 1999. Our source data come from the World Bank. We believe that the effects of education and other economic variables differ for developed and developing countries. In this paper, we would like to answer the following question: what are the impacts of education by level (primary/secondary/tertiary), and by lags (five and ten years) on FDI?

The rest of this paper is organized as follows. Section 2 presents the methodology and data analysis, section 3 presents results, and section 4 offers a concluding discussion.

Methodology, Variables, and Data Analysis:

Gastanaga et al. (1999) point out that cross section studies miss time factors. Therefore, outcomes of the cross-country analysis cannot be applicable to policy reforms over time. They also point out that a time series analysis is not practical due to time length constraints. Additionally, variations over time for a single unit can be misleading in formulating a general conclusion.

We use time-series data from 1980-1999, and we apply GLS pooled cross-sectional time series fixed-effect for income group countries. In the fixed effects model, the individual-specific effect is a random variable that is allowed to be correlated with the explanatory variables. In the random effects model, the individual-specific effect is a random variable that is uncorrelated with the explanatory variables. So we would prefer the fixed effect estimator since we are not sure that the individual-specific effect really is an unrelated effect. FDI (net inflows, % in GDP) is [the] dependent variable (z_{it}). The definition of variables is in the appendix. Intercept terms are country specific.

$$z_{it} = \alpha_i + \beta x_{kit} + u_{it} \qquad (1)$$

i= country units

t= time

The presence of multinational firms in a country can encourage workers to acquire skills appropriate for the global economy. To alleviate the potential concerns of reverse causality, we regress FDI in 2000s on lagged values of education, the lagged values going as far back as 10 years (Kwork and Tadesse, 2006).

Dependent Variable: FDI: Billington (1999) considers total FDI, Culem uses the share of FDI in GNP, Chakrabarti (2001) prefers FDI per capita, and Asiedu uses the share of FDI in GDP. In this research, we consider FDI (% GDP) as a standard in the literature (Asiedu, 2002).

Independent Variables:

Infrastructure: Infrastructure increases the productivity of investments. The proxy for infrastructure varies. Billington (1999) uses government expenditure on transportation and communications, and Asiedu (2002) chooses telephone mainlines (per 1000) as a proxy for infrastructure. In this research, we will use telephone mainlines (per 1000) as is standard in the literature (Asiedu, 2002).

Openness: A high level of imports into the host area may indicate a high level of penetration by foreign companies that begin exporting to the host countries and switch later to FDI (Culem, 1988). Trade openness is crucial for obtaining the growth effect. Chakrabarti (2001) finds that market size and openness are positively associated with FDI, but other variables such as tax, wage, exchange rate, tariff, growth, and trade balance are highly sensitive to small changes.

Edwards (1990) concludes that the success of FDI depends on the openness of the economy, the reduction of the size of government and political stability, competitiveness, and the rate of domestic investment. Asiedu (2002) indicates that the main reasons for a high amount of FDI depend on openness of trade, infrastructure, and return of capital. On the other hand, economic variables (growth rate, government consumption, inflation rate, and money growth) and political variables (political risk) are not significant. We employ share of total export and imports and exports as a percentage of GDP as a proxy of openness.

Wage: The least developed countries have a comparative advantage in labor cost. No wage data is available, but the inverse of GDP per capita is used as a wage proxy in the literature (Asiedu, 2002)

Education:

The impact of human capital is measured by the level of primary, secondary, and

Variables	Average (World)	Average (High Income)	Average (Upper Middle Income)	Average (Lower Middle Income)	Average (Low Income)
FDI/GDP	1.8	1.73	2.86	1.75	1.36
Phones per 1000	117.97	402.54	139	56.82	14.46
International Trade/GDP	63.35	71.98	79.48	64.03	53.89
1/GDP per capita	.000209	.000067	.000192	0.000327	0.000906
Primary Education	48.46	57.15	46.48	54.68	36.85
Secondary Education	29.36	55.39	32.64	29.42	15.25
Tertiary Education	9.24	22.36	10.14	7.91	3.17

tertiary school enrollment.

Table 1 shows that FDI/GDP and international trade in GDP (openness) are highest in the upper middle-income countries. Primary education enrollment in low-income countries is 25% less than that in middle-income countries. However, the difference is 50% in secondary education and above 50% in tertiary education.

Table 1: Summary Statistics for 165 countries between 1980-1999

Source: World Bank (2003)

Empirical Results

Table 2 reports that telephone main lines as a proxy of infrastructure, trade, and openness are positive and statistically significant. In model 1, we are testing for whole world. These findings support Asiedu (2002). On the other hand, the inverse of GDP per capita as a proxy of wage levels is negative and insignificant. This is a refutation of Asiedu (2002). This might be that the inverse of GDP is not an appropriate proxy to measure wages.

Among education variables, only tertiary education is significant. Tertiary education keeps its significance, These results indicate that superior education is more relevant than primary/secondary education, and human capital is an important determinant in FDI.

We are testing the ZM model by grouping countries in income categories in models 2, 3, 4, 5. The ZM relationship indicates an inverse U-shape (a concave relationship) between FDI and skill levels. Tertiary education, which is the research variable, is negative (-0.035) and significant in high income countries. When we look at the upper middle income category, the tertiary education is positive (0.11) and significant. In the lower-middle income category, tertiary education is also positive (0.035) and significant, but when we look at the last category in the low-income category, none of the education variables are significant. Moreover, tertiary education is negative (-0.022). Given our findings, we support the ZM theory, since rich countries with high human capital and poor countries with low human capital demonstrate an inverse correlation between FDI and human capital proxies. Our results indicate that a 10 percent increase in education level is associated with a 0.2 percent increase in FDI. Plus, a 10 percent increase in education level is associated with a 1.0 percent increase in upper middle income countries.

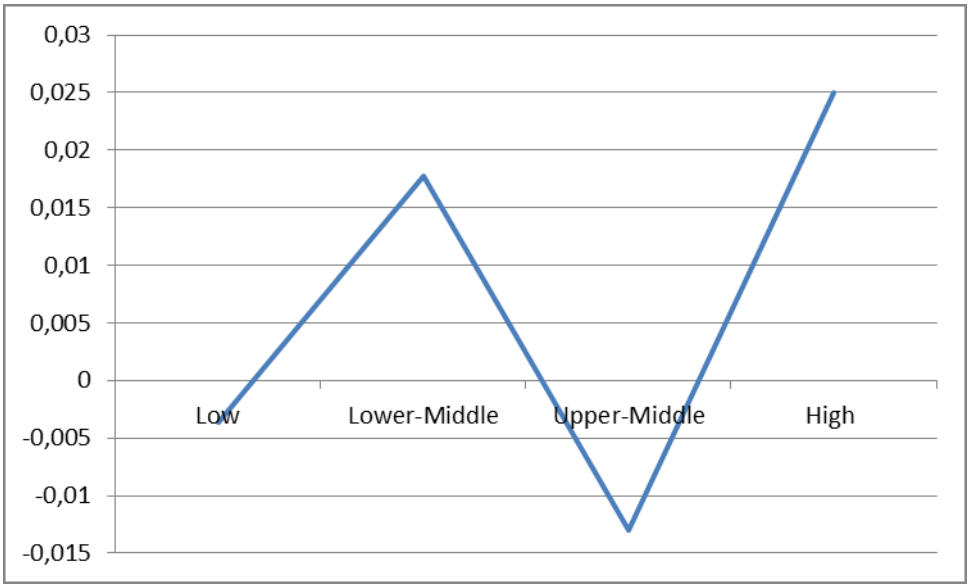
Table 2: All, High Income and Upper Middle

	Model 1	2	3	4	5
Variables	All	High Income	Upper Middle Income	Lower Middle	Low Income
Log(Phones per 1000)	.55 (7.050***	-1.68 (-4.17)***	-.11 (-.202)	1.023 (5.74)***	.75 (5.18)***
Log(1/GDP per capita)	-.104 -(1.21)	-2.25 (-5.23)***	-.59 (-.787)	1.05 (6)***	-.071 (-.4)
International Trade/GDP	.02 (9.81)***	.048 (6.98)***	.019 (3.3)***	0.019 (3.47)***	.014 (4.48)***
Primary Education	.000194 (1.44)	.025 (2.46)***	-.013 (-.89)	0.0177 (1.78)*	-.0036 (-.76)
Secondary Education	.0025 (.72)	0.0098 (1.66)*	.014 (1)	-0.0083 (-0.92)	.011 (1.38)
Tertiary Education	.0226 (5.33)***	-.0035 (-1.06)	.11 (6.32)***	0.035 (4.3)***	-.022 (-1.75)*
N	1338	302		348	470

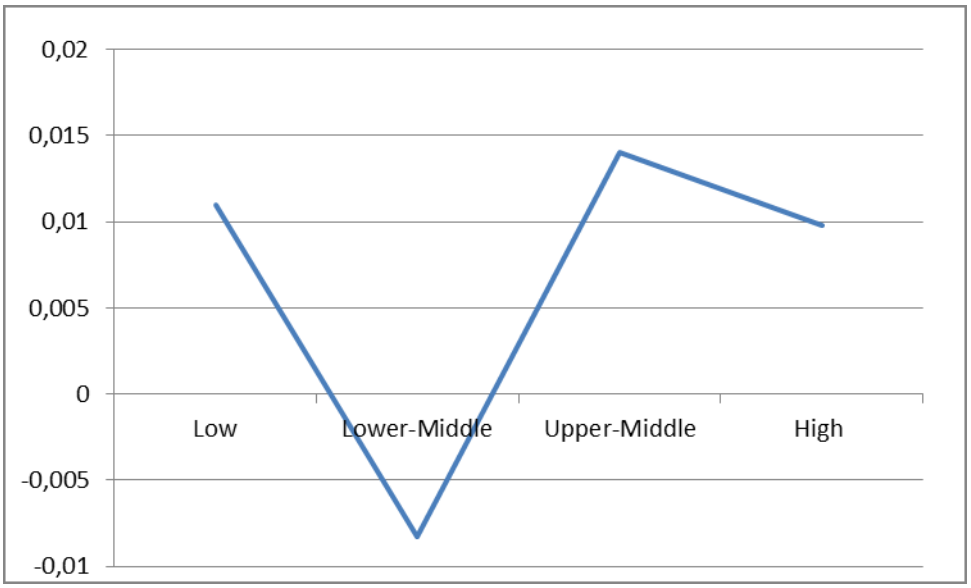
Heteroskedastic-consistent standard errors are in parentheses. ***, **, * denotes significance at the 1%, 5%, and 10% levels.

The graphs 2, 3, and 4 show the coefficients of education levels for each income categories. The inverse U-shape exists in tertiary education. The higher the level of education, the higher the potential for an investment decision and achievement of expected outcome. However, skill-biased technological change indicates that a part of the production from industrialized countries is increasingly moved or outsourced to less developed countries (Addison and Heshmati, 2003).

Graph 2. Primary Education (Coefficient)



Graph 3. Secondary Education (Coefficients)



Graph 4. Tertiary Education (Coefficients)

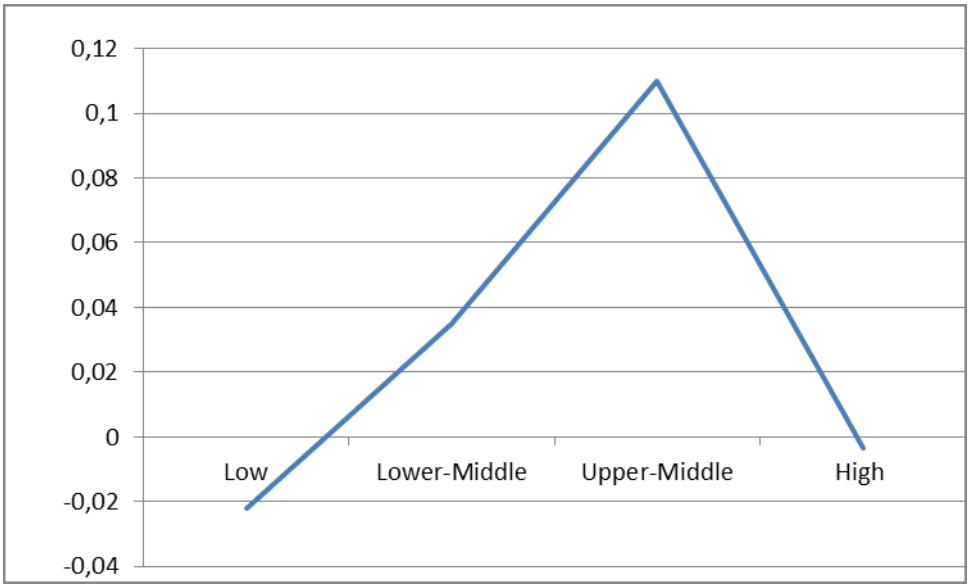


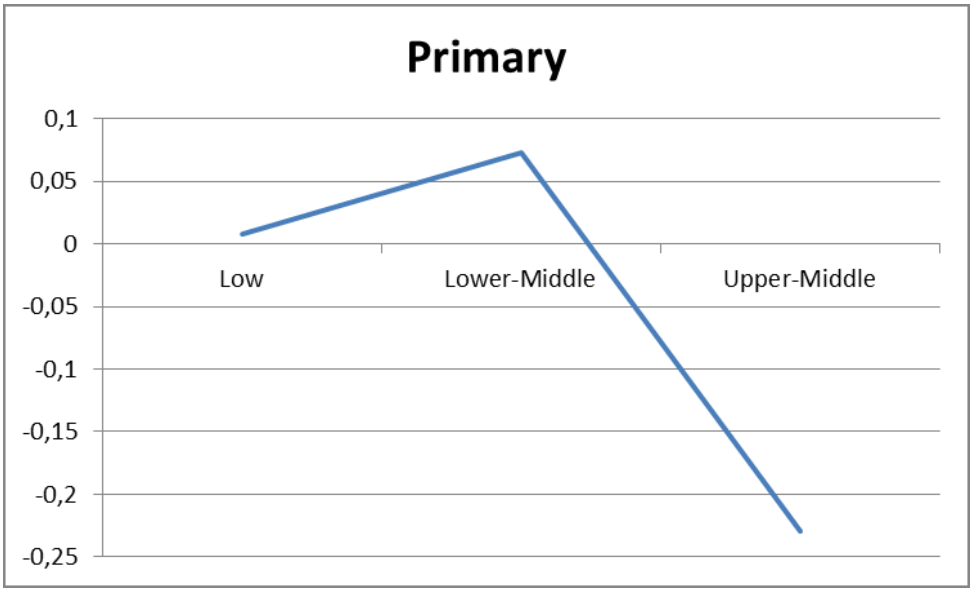
Table 3 gives coefficient estimates with dependent variables lagged 10 years. Infrastructure and openness proxies are still positive and significant. Wage proxy has a negative sign. When we look at our research variables, tertiary education is positive with the line to table 2. In high-income categories, all education variables are negative and significant. Tertiary education is negative but insignificant in upper-middle income countries, whereas it is positive and significant in lower-middle income countries. Tertiary education is negatively correlated with FDI in low-income countries. This finding mostly supports the ZM theory since in the middle income group tertiary education became positive, whereas other income categories are negative (graphs 5, 6, 7).

Table 3: Ten years lagged

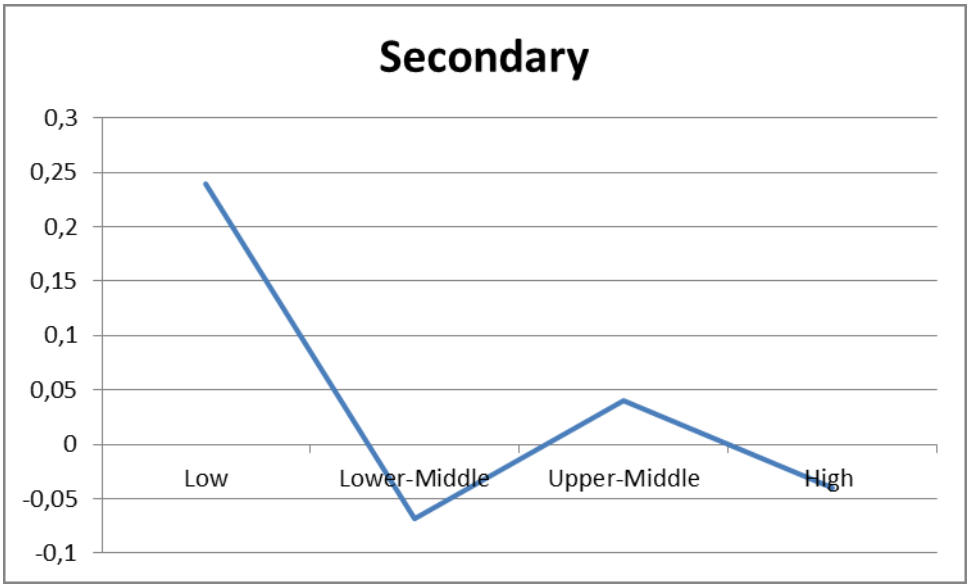
Variables	All	High Income	Upper Middle Income	Lower Middle	Low Income
Log(Phones per 1000)	0.91 (2.83)***	-5.27 (-6.77)***	1.72 (1.14)	1.21 (1.25)	3 (.8
Log(1/GDP per capita)	-.173 -(.86)	-8.24 (-23.5)***	5.82 (-2.57)**	2.64 (1.5)	-.55 (-.77)
International Trade/GDP	.021 (6.22)***	.022 (1.27)	.02 (2.06)*	-0.036 (-3.14)***	.069 (1.57
Primary Education	-.00000233 -(0.46)	-.055 (-2.52)**	-.23 (-17)***	0.073 (3.73)***	.008 (-.09)
Secondary Education	.014 (1.28	-0.04 (-2.61)***	.04 (1.65)	-0.068 (-4.08)***	.24 (1.04)
Tertiary Education	.0343 (4.52)***	-.0016 (-1.05)	-.047 (-.83)	.163 (5.4)***	-2.23 (-1.48
N	188	51	29	50	63

Heteroskedastic-consistent standard errors are in parentheses. ***, **, * denotes significance at the 1%, 5%, and 10% levels.

Graph 5. Primary Education- Ten Years Lagged (Coefficient)



Graph 6. Secondary Education- Ten Years Lagged (Coefficients)



Graph 7. Tertiary Education-ten years Lagged (Coefficients)

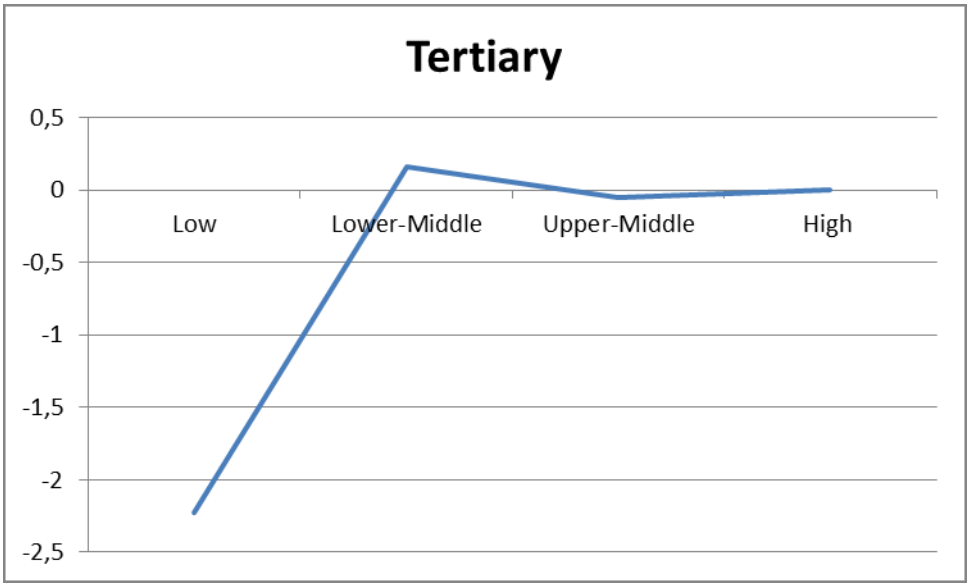


Table 4 gives coefficient estimates with 5 years lagged-behind values. The 5 year lagged behind values in table 4 support previous findings since openness, secondary, and tertiary education are positive and significant. The infrastructure has lost its significance.

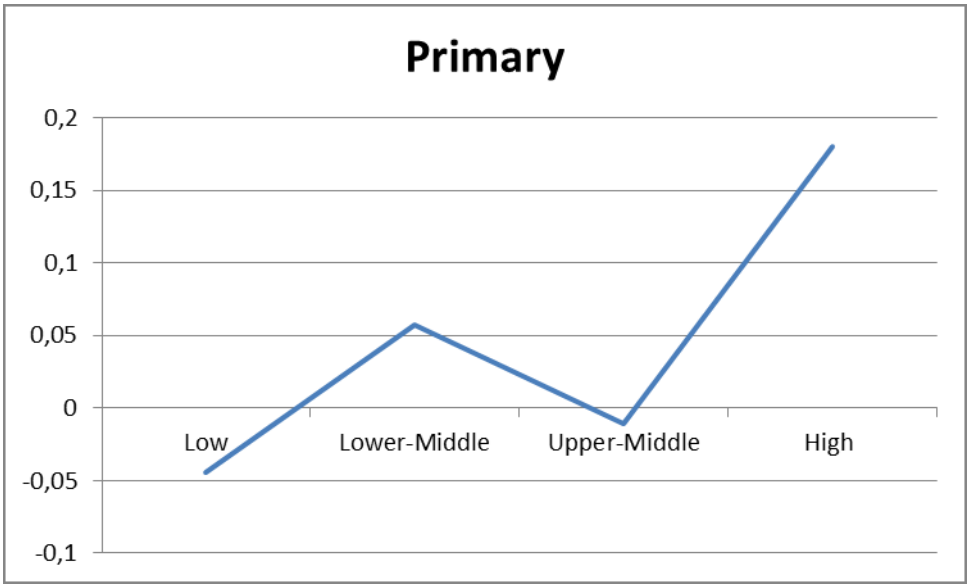
In the high income category, tertiary education keeps its negative sign. Tertiary education is still positive and significant in upper middle-income countries but loses its significance in lower middle-income countries. On the other hand, secondary and primary education is positively and significantly correlated with FDI in lower middle-income categories. In low-income countries, tertiary education is positive and significant. Overall, our result is supportive of the importance of human capital in the long-run and in the ZM theory (graphs 8,9, 10).. In the case of investment in human capital, middle-income countries benefit more than high-income countries in attracting more FDI.

Table 4: Five years lagged.

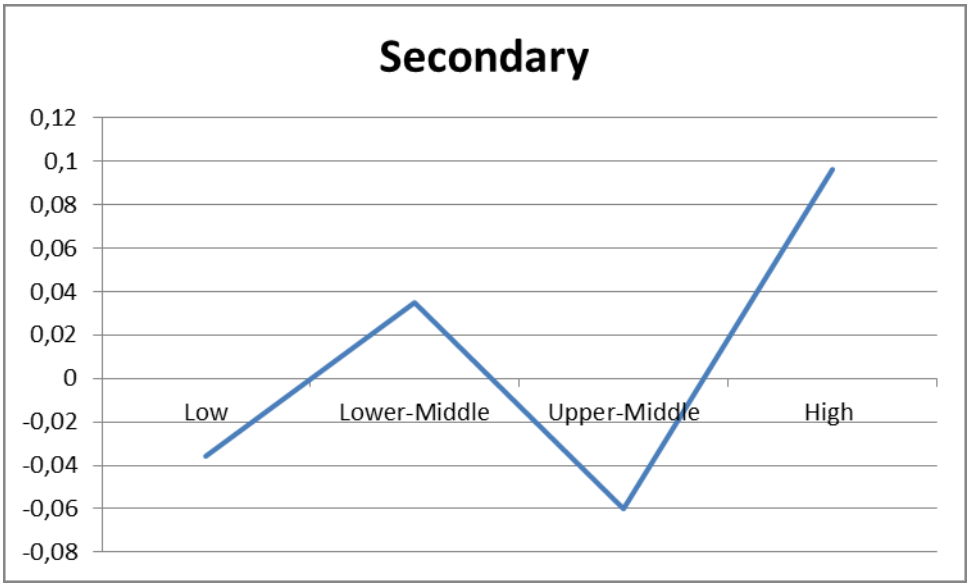
Variables	All	High Income	Upper Middle Income	Lower Middle	Low Income
Log(Phones per 1000)	-.65 (-4.61)***	12 (3.34)***	.42 (.5)	-.22 (-.42)	-2.52 (-7.48)***
Log(1/GDP per capita)	-.026 -(.25)	-3.23 (-1.5)	-1.93 (-1.69)*	-.25 (-.2)	-.097 (-.85)
International Trade/GDP	.009 (3.06)***	.059 (2.15)**	.011 (1.18)	0.01 (2.23)**	.021 (3.83)***
Primary Education	0.00087 (1.15)	.18 (3.38)***	-.011 (-.17)	0.057 (2.24)**	-.044 (-4.19)***
Secondary Education	.049 (4.9)***	0.096 (3.65)***	-.06 (1.85)*	.035 (1.97)*	-.036 (-1.15)
Tertiary Education	.054 (3.56)***	-.073 (-2.51)***	.16 (2.57)***	0.026 (1.13)	.098 (2.72)***
N	188	136	115	176	250

Heteroskedastic-consistent standard errors are in parentheses. ***, **, * denotes significance at the 1%, 5%, and 10% levels.

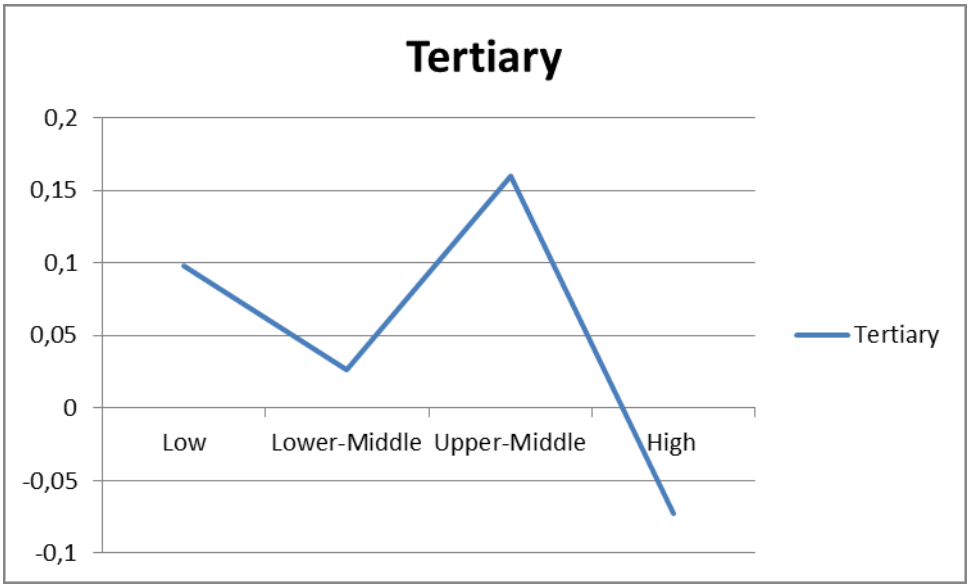
Graph 8. Primary Education- 5 years lagged (Coefficient)



Graph 9. Secondary Education- Five Years Lagged (Coefficients)



Graph 10. Tertiary Education-Five Years Lagged (Coefficients)



Conclusion

We empirically examine the ZM proposition based on an extensive data on FDI and education around the world, for a large sample of countries from 1980 to 1999. First, consistent with our thesis, we find that FDI level is significantly higher in countries with high education. The results from our panel data analysis show that secondary and tertiary education in current years and in the long-run have a positive and significant impact on FDI. This relationship is stronger in the case of middle-income countries and weaker for high- and low- income categories as ZM is predicted. This indicates that low-income countries have a lower level of competitiveness on the FDI market due to lower wages for unskilled workers. This is consistent with ZM's finding, which states that the least (most) developed countries receive the lowest FDI due to unskilled (skilled) labor abundant. However, MNEs need some skilled workers for their production process.

Our results indicate that a 10 percent increase in education level is associated with a 0.2 percent increase in FDI in general whereas a 10 percent increase in education level is associated with a 1.0 percent increase in upper-middle income countries.

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Appendix

Table 5: Definition of Variables

Foreign direct investment, net inflows (% of GDP)	Foreign direct investment is net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. This series shows net inflows in the reporting economy.
School enrollment, primary, secondary and tertiary (% gross)	Gross enrollment ratio is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown.
GDP per capita, PPP	GDP per capita based on purchasing power parity (PPP). PPP GDP is gross domestic product converted to international dollars using purchasing power parity rates.
Trade in goods (% of GDP)	Trade in goods as a share of GDP is the sum of merchandise exports and imports, measured in current U.S. dollars, divided by the value of GDP in U.S. dollars.
Telephone mainlines (per 1,000 people)	Telephone mainlines are telephone lines connecting a customer's equipment to the public switched telephone network. Data are presented per 1,000 people for the entire country.