Asian Journal of Empirical Research

journal homepage: http://aessweb.com/journal-detail.php?id=5004

Foreign direct investment and infrastructure development in Indonesia: Evidence from province level data

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Abstract

Attracting foreign direct investment (FDI) has been an important policy agenda under institutional and regulatory reforms toward the decentralized system in Indonesia. Infrastructure development has been acknowledged as a crucial condition to attract foreign direct investment. This study empirically examines the relationship between infrastructure development and FDI inflows at the province level in Indonesia by using panel data of 30 provinces over the sample period of 2000-2009. As a proxy to infrastructure development, this study uses four measures of hard infrastructure: electricity, road length, water capacity, and water distribution. Our empirical analysis shows that infrastructure development would promote FDI inflows. In addition, the result presents that provinces with small-sized government, which is measured by government expenditure, attract more FDI inflows. These results are also confirmed by the count data analysis of FDI projects. The need of better infrastructure with small-sized government suggests that the policy authority should utilize private investment through various schemes, such as public private partnership (PPP).

Keywords: Foreign direct investment, infrastructure development, regional economy, Indonesia

Introduction

The globalization of the world economy has contributed to a remarkable growth of foreign direct investment (FDI) inflow into developing countries in the 1990s. FDI inflow is now acknowledged as a key factor of economic development especially for developing countries; since it provides the major financial sources to the transfer of technology, organizational and managerial practices and skills, as well as access to international markets (see, e.g., Shatz and Venables, 2000; Alfaro *et al.*, 2004).[2]In particular, multinational enterprises (MNEs) have played an essential role in shaping the

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[2] Shatz and Venables (2000) categorize FDI into two categories: vertical and horizontal FDIs. Vertical FDI or "export oriented FDI" happens when MNEs divide their production process internationally to minimize

patterns of economic development through their FDI decisions (see, e.g., McCann and Mudambi, 2004). Since the 1997 global economic crisis in international financial markets, many developing countries have been strongly advised to rely primarily on FDI inflow for the promotion of economic development on a sustainable basis. Indonesia has also attempted to attract FDI inflow through several institutional reforms under the decentralization policy, since its economy needs a huge amount of funds to finance and accelerate economic development.[3]

Among various factors as a determinant of FDI inflows, infrastructure development is widely considered as a crucial factor influencing the desirability of investment location. The examination of the role of infrastructure development is important particularly for developing economies, such as Indonesia, since developing infrastructure is one of the main processes to attract domestic and foreign investments. Moreover, discussion at the regional or province level is more important for Indonesia due to an on-going process of decentralization (see, e.g., Silver *et al.*, 2001; Fane 2003).[4] Given these arguments, this study aims at verifying the positive relationship between infrastructure development and FDI inflows at the province level in Indonesia. In addition to the role of infrastructure development, this study also attempts to present some evidence to explain intra-country determinants of FDI inflows within Indonesia. Indeed, an understanding of the determinants of location of FDI inflow could help policy-makers design effective policies to attract FDI inflow into provinces where investment is most needed.

A lot of empirical studies have put more attention on the role of infrastructure development on FDI by using various infrastructure variables covering the quality and the availability of transportations and telecommunication networks.[5] Most of them show the clear evidences supporting that highly developed infrastructure would play a crucial role in attracting FDI inflows at inter- or intra-country level. Concerning the Indonesian economy, several studies have existed on the role of FDI inflows. Lipsey and Sjoholm (2011) study the relationship between growth and FDI in comparison with other East Asian countries. Moreover, Takii (2005) discusses the role of FDI by examining productivity spillovers from foreign multinational plants in Indonesia, and Takii (2011) also examines the effect of FDI on economic growth in relation to the origin of investors in Indonesian manufacturing over the period of 1990–2003.Despite the growing importance of FDI inflows in developing economies, empirical evidence is limited on the determinants of location choice of FDI inflows at their regional level. To the best of our knowledge, no previous empirical research has existed on the relationship between FDI inflows and infrastructure development at the province level in Indonesia. Hence, this study would be the first attempt to empirically verify this important issue.

This study uses panel data covering 30 provinces in Indonesia over the 10-year sample period of 2000-2009.We employ several techniques to estimate the models, such as pooled OLS, random effects, and Tobit estimations with the data of the ratio of FDI inflows to GDP on a provincial basis. In addition, we attempt to check the validity of the empirical results by employing Poisson models

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production costs. On the other hand, horizontal FDI or "market oriented FDI" occurs when MNEs perform same production activities in different countries to take an advantageous position in the local market.

[3] Indonesia's government has been implementing several policies to promote FDI inflow, such as new investment law No. 25/2007, one-stop shop system, and tax incentives.

[4] Indonesia's decentralization was initiated in January 2001 based on Laws No. 22/1999on Regional Government and No. 25/1999 on the Fiscal Balance between the Central Government and Regional Governments. These two laws drastically changed the national-sub national relationships by transferring powers, taxes, funds, and personnel to the provinces. The authority of the central government has been devolved to sub national governments except for defense, diplomatic, judicial, fiscal, and religious policies.

[5] See, e.g., Coughlin, *et al.* (1991), Wheeler and Mody (1992), Head and Ries (1996), Broadman and Sun (1997), Wei, Liu, Parker, and Vaidya (1999), Cheng and Kwan (2000),Coughlin and Segev (2000), Asiedu (2002), Makabenta (2002), Deichman, *et al.* (2003), Boudier-Bensebaa (2005), Fung, *et al.* (2005), Cheng (2006), Mollick, *et al.* (2006), Li and Park (2006), Bellak, Leibrecht, and Damijan (2009), and Yavan (2010).

and negative binomial models (NBM) with the count data of FDI projects. As a proxy to infrastructure development, this study uses four measures at the province level: the logarithms of electricity distribution per area, road length per area, water distribution per population, and water capacity per population. It should be noted that infrastructure is generally classified into hard components and soft (institutional) components, as emphasized in Fung *et al.* (2005). Although soft components in the form of transparent institutions with good governance are important, our focus is only on the role of hard infrastructure.

The main results demonstrate that all infrastructure variables are positively related to FDI inflows in terms of both the ratio of FDI inflows to GDP and the count data of FDI projects. This implies that the environment with better infrastructure could attract more FDI inflows into Indonesia at the province level. Our results have important policy implications since the result of effective infrastructure development would support the recent strategic development plan under the State Ministry of National Development Planning (BAPPENAS-Indonesia). To attract FDI inflows and thus to promote regional development, infrastructure development should be prioritized by provincial governments under the institutional reforms toward the decentralization. The analysis also presents that in general, government expenditure as a proxy to the size of the government is negatively associated with FDI inflows. Provinces with small-sized government would attract FDI inflows more significantly, which is consistent with the argument that government spending would crowd out FDI inflows from abroad. The need of better infrastructure with small-sized government suggests that the policy authority should utilize private investment through various schemes, such as public private partnership (PPP).

The rest of this paper is organized as follows. Section2 summarizes the overview of FDI in Indonesia. Section 3 presents the panel data analysis, which consists of empirical model framework, data, and empirical results. We also discuss some important implications based on the results. Finally, section 4 presents conclusion which covers summary and further possible studies.

Overview of foreign direct investment in Indonesia

Indonesia as a developing country has to deal with several challenges to compete with other countries in the globalized world. Boosting investment and upgrading productivity are the major challenges for Indonesia to meet global standards, accelerate development, and reduce poverty and unemployment. Moreover, Indonesia needs a huge amount of funds to finance development projects and recover its economy after suffering from the financial crisis in 1998. Recognizing that FDI has significant contribution to economic development, like many other developing countries, Indonesia has tried to attract FDI inflows to improve the overall productivity and enhance international trade.

During the period when President Soekarnoinitiated self-sufficiency policy with import substitution, he developed communist sympathies and managed Indonesia as a socialist economy, so that foreign investments from western countries were strictly restricted under his political leadership. However, after the overtaking in 1965, President Soeharto changed its investment policy direction. The government started liberalizing its capital account regime in 1967, when Foreign Investment Law No. 1/1967was introduced. The government then adopted a free-floating foreign exchange system in 1970, which was followed by further liberalization of the financial sector in 1980s. Indonesia has been largely perceived as an attractive destination for foreign investment.

After Foreign Investment Law No. 1/1967 as the first underlying legislation for promoting FDI to Indonesia, the government created a new agency, called the Investment Coordinating Board (Badan Koordinasi Penanaman Modal-BKPM), in 1973in order to improve the efficiency of investment permits. This agency was mandated to boost domestic and foreign direct investment through creating a favorable investment climate. In addition, its goal is not only to attract domestic and foreign

investment, but also to improve the quality of investments that help improve social inequality and reduce poverty. Any application except investment in the oil and gas, mining, banking, and insurance industries, which are handled by relevant technical government agencies, needs approval from BKPM. Several policies toward trade liberalization have also removed some restrictions and barriers to investments from abroad since the 1970s.

In the middle of 1997, Indonesia faced the most severe economic crisis in its history (Levinsohn *et al.,* 1999). Moreover, the Indonesia rupiah depreciated sharply and extremely, even uncontrolled during the 1997 Asian financial crisis. Such instability for domestic individuals and businesses led to foreign investors' panic, resulting in massive capital outflows from Indonesia (Cole and Slade, 1996). Due to this crisis, the investment environment in Indonesia was weakened. To improve investment climate, the government signed an agreement with the IMF for the assistance in overcoming its economic problems with substantial currency depreciation, uprising inflation, and the fragile banking system, and launched a package of reforms to free investors from some of the cumbersome documentary requirements and bureaucratic red tape. In addition, the government allowed foreign investors to acquire domestic firms with reserve of a small stake for the original owner and to rescue "sick" firms by injecting capital in several sectors, although some regulations remained particularly for small and medium sized domestic firms.

In 2007, during the mid-term of the Yudhoyono's government, Indonesia issued the new Investment Law of 2007 with the sole intention of making the Indonesian economy more attractive to foreign investment. On a broad front, BKPM attempted to simplify the procedures for approval of new investments by promoting better coordination between various government institutions, offering tax incentives and special economic zones to make returns to investment more attractive, and persuading major players to capitalize in the large domestic consumer markets. As an implementation of Investment Law of 2007, the government launched the one-stop-shop system in 2010 to mitigate bureaucratic red tape and allow investors to process business licenses faster. To facilitate this system further, the government established the National Single Window for Investment (NSWI) as an electronic platform for investments that enables investors to apply for license and non-license services through the on-line system. Hence, investment climate, such as the efficiency of the investment license process, has been improved drastically.

Given the above environments, investment climate has been changing in Indonesia. Figure 1 shows FDI inflows to Indonesia during the period from 1990 to 2011, excluding FDI inflows in the oil and gas, mining, banking, and insurance industries. The data from Indonesian Investment Coordinating Board over the two decades presents that FDI inflows is in an upward trend both in terms of the number of FDI projects and the value of FDI inflows. Concerning the regional allocation of FDI inflows, Figure 2 shows the polarization among provinces in terms of geographical location over the period from 1990 to 2011.FDI inflows in Indonesia appear to concentrate on Java Island, especially in Jakarta, the capital city. Indeed, Java Island consisting of six provinces attracted 77% of FDI inflows to Indonesia. Moreover, Jakarta solely attracted 31% of FDI, so that Jakarta has consistently been the leading destination, although it accounts for only 17% of Indonesia's GDP and for only 4% of Indonesia's population.

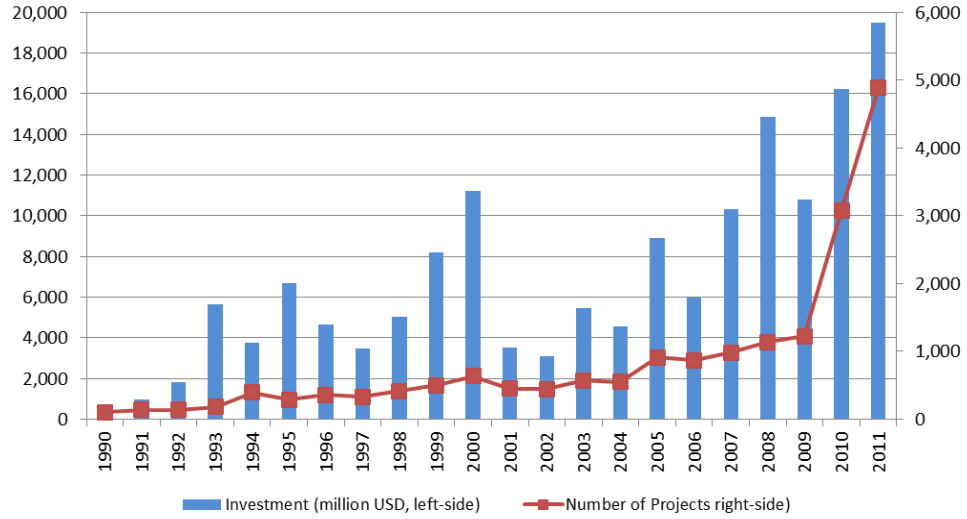

Figure 1: FDI inflows to Indonesia (1990 – 2011)

Source: Investment coordinating board

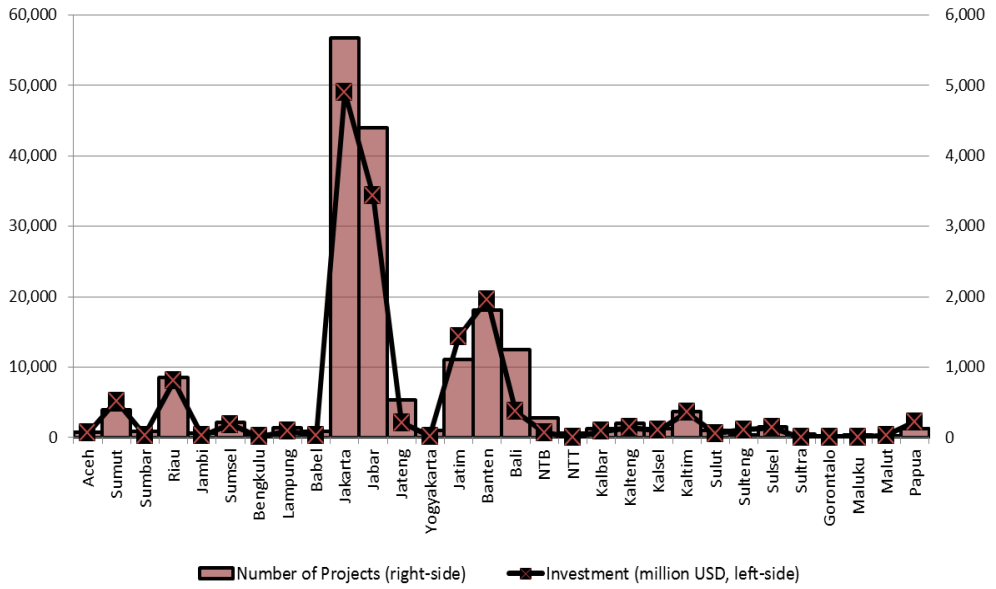

Figure 2: FDI inflows to Indonesia per province (1990 – 2011)

Source: Investment Coordinating Board

At the same time, infrastructure has been a major concern for Indonesian government, since its geographical conditions with thousand islands make infrastructure as a prerequisite for economic development. Table 1 presents the variables related to infrastructure development in 2009, such as electricity per area, road length per area, water distribution per population, and water capacity per population, for 30 provinces of Indonesia. Jakarta achieves the highest ratio related to infrastructure development, while other provinces are generally low. Although the Indonesian government has

attempted to improve infrastructure, it still seems a long way to catch up with developed countries. Infrastructure, such as electricity, roads, and railway, remains to be far from sufficient.

Table 1: FDI and infrastructure in Indonesia (average: 2000-2009)

	Province	Ratio of FDI to GDP (%)	Elect per area	Road per area	Water dist per pop	Water cap per pop
1	Aceh	0.09	0.3434	0.2824	0.0031	0.0003
2	Sumatera utara	0.75	0.6074	0.4365	0.0141	0.0009
3	Sumatera barat	0.59	0.3914	0.3899	0.0092	0.0008
4	Riau	2.43	0.1493	0.1797	0.0079	0.0005
5	Jambi	0.74	0.1126	0.2502	0.0080	0.0008
6	Sumatera selatan	1.53	0.1560	0.1332	0.0064	0.0005
7	Bengkulu	0.46	0.2231	0.3054	0.0059	0.0007
8	Lampung	0.91	0.4939	0.3927	0.0025	0.0003
9	Bangka Belitung	1.51	0.1983	0.1410	0.0064	0.0005
10	Dki Jakarta	6.15	56.3297	10.1440	0.0630	0.0028
11	Jawa barat	4.26	2.2573	0.7222	0.0054	0.0004
12	Jawa tengah	0.43	2.3247	0.8348	0.0063	0.0006
13	Di Yogyakarta	0.48	3.6635	2.0259	0.0069	0.0007
14	Jawa timur	2.46	1.6998	0.7210	0.0092	0.0006
15	Banten	8.00	1.6188	0.2665	0.0054	0.0004
16	Bali	8.50	1.9252	1.1806	0.0248	0.0015
17	Nusa tenggara barat	0.12	0.3596	0.4016	0.0075	0.0009
18	Nusa tenggara timur	0.19	0.1531	0.3866	0.0042	0.0005
19	Kalimantan barat	0.80	0.1091	0.0776	0.0070	0.0005
20	Kalimantan tengah	1.39	0.0421	0.0672	0.0070	0.0006
21	Kalimantan selatan	0.97	0.2925	0.2311	0.0123	0.0007
22	Kalimantan timur	1.17	0.0487	0.0474	0.0218	0.0016
23	Sulawesi utara	0.62	0.4147	0.5699	0.0075	0.0010
24	Sulawesi tengah	0.08	0.1182	0.1739	0.0056	0.0005
25	Sulawesi Selatan	1.01	0.3545	0.5049	0.0066	0.0007
26	Sulawesi tenggara	0.04	0.1429	0.1956	0.0044	0.0005
27	Gorontalo	1.86	0.3545	0.2828	0.0075	0.0010
28	Maluku	0.65	0.0817	0.1320	0.0049	0.0005

29	Maluku utara	0.13	0.0703	0.0652	0.0049	0.0005
30	Papua	2.07	0.0124	0.0426	0.0079	0.0005

Some attentions have been paid to FDI inflows in Indonesia. Although most works on FDI inflows into Indonesia concerns its relationship with trade liberalization and economic growth (see, e.g., Osada, 1994; Sjoholm, 2002; Iman and Nagata, 2005), few empirical studies has existed on the relationship between FDI and infrastructure at the intra-country or provincial level. Given the significant variation in terms of levels of FDI inflows across provinces, this study empirically examines how infrastructure development is related to FDI inflows and what factors account for this unbalanced distribution of FDI inflows within Indonesia. The regional imbalance of FDI location provides us with a motivation to examine the determinants of FDI inflows across provinces.

Empirical analysis

This section empirically examines how infrastructure development affects FDI inflow at the provincial level in Indonesia during the 2000s. The methodology adopted for the model estimation is that specifically designed for panel data. One of the advantages of panel data analysis is the large number of data points. This would increase the degree of freedom and reduce the co linearity problem among explanatory variables, hence improving the efficiency of econometric estimation.All data used in our empirical analysis, except for FDI inflows, is taken from BPS-statistics Indonesia, and the data of FDI inflows is taken from Investment Coordinating Board of Indonesia (BKPM). The panel data set covers information for 30 provinces over the sample period from 2000 to 2009.

Methodology

To discuss the impact of infrastructure development on regional FDI flows, we estimate the following empirical model with panel data:

$$FDI_{it} = \beta_0 + \beta_1 INFRA_{it} + \Sigma_{k=1}^{K} \gamma_k X_{kit} + \varepsilon_{it},$$

Where FDI_{it} is the ratio of FDI inflows to regional GDP in province *i* at year *t*; $INFRA_{it}$ is the measurement of infrastructure development; X_{kit}'s other control variables that are expected to affect FDI inflows; and ε_{it} is the error term with standard properties. Our primary interest in this study is to verify that infrastructure development is positively associated with FDI inflows. The host province with infrastructure development attracts FDI inflows; since good infrastructure facilitates production processes as well as the distribution of output. Thus, the sign of the coefficient on $INFRA_{it}$ is expected to be positive. This study uses four measures of infrastructure development at the province level: the logarithms of electricity distribution per area, road length per area, water distribution per population, and water capacity per population.

Concerning other control variables, we include the ratio of government expenditure of provincial GDP ($GOVEXP_{it}$) and the log of real provincial GDP (GDP_{it}) to capture the government size in terms of expenditure and the size of domestic market demands, respectively. We also include the ratio of the sum of export and import to GDP at the province level ($TRADE_{it}$) and the ratio of industrial value added to GDP at the province level (IND_{it}) to capture trade openness and industrialization, respectively. Moreover, we include the log of labour cost ($LABOR_{it}$) at the province level due to the arguments that labor cost is one of the main concerns for multinational firms, and we include the unemployment rate at the province level ($UNEMP_{it}$) as a measure of labor availability.

To examine the effect of special economic zone with tax incentive on FDI flows, the model incorporates the dummy variable (DUM_{it}) that equals unity if province *i* has special economic (tax free) zones and zero otherwise. Regions that fully represent special economic zones in Indonesia are Batam, Bintan, and Karimun. Those regions are located in Riau province. Tax incentives are offered to firms which operate their businesses in these zones. The forms of those incentives are value added tax (VAT) exemption for firms operating in the islands, import duties nullification for goods which are imported to these zones, and negation of luxury tax for goods entering these islands. There is no special treatment in corporate income tax for firms in these zones.
As for each control variable, we briefly explain the role of each variable in our model as follows.

Government expenditure: Several studies have examined the effect of government expenditure or public investment on FDI inflows. Government policies can be important for guiding FDI inflows by influencing firms' decision to internalize processes (Deichman *et al.,* 2003; Mollick *et al.,* 2006).

The impact of public expenditure on FDI inflows might be ambiguous. Public investment would provide incentives for private investment. On the other hand, government intervention often dismantles the market mechanism so that it crowds out private investment by diminishing the attractiveness of establishing business in a certain place.

Provincial gross domestic product (GDP): The size of market demand is one of the most important location determinants of horizontal FDI or market-oriented FDI inflows in the literature (see, e.g., Shatz and Venables, 2000). The market size of a province is usually measured by its GDP. In general, a larger provincial market would attract more FDI inflows than a smaller one since a larger market size may provide more opportunities for foreign firms to sell their goods or services.

Trade openness: Several studies illustrate that trade openness positively influences FDI inflows into a country, especially export-oriented FDI. Generally, the empirical literature supports the argument that trade policy could be one of the important factors for attracting FDI inflows to the host country. For example, Asiedu (2002) finds that trade openness promotes FDI inflows to Africa. The work of Sahoo (2006) on South Asia states that investors mostly pursue big markets and tend to invest in countries which have regional trade integration and also in countries with greater investment incentives in their trade agreements.

Industry value added: Industrialization is also acknowledged as an important determinant of FDI inflows. In particular, many studies investigate the effect of industrialization, particularly industry agglomeration, on FDI inflows and find that economic agglomeration is positively significant as a determinant of FDI location (Smith and Florida,1994; Disdier and Mayer, 2004; Buch *et al.,* 2005; Pusterla and Resmini, 2007; Hilber and Voicu, 2010; Yavan, 2010). Due to the lack of regional data availability in Indonesia, industry value added is used as a measure of industrialization.

Labor costs: Past literature on the effect of labor costs on FDI inflows provides conflicting results at the regional or country level. Some studies, such as Friedman, *et al*. (1992) and Coughlin and Segev (2000), observe that higher wages deter FDI inflows, while Smith and Florida (1994) and Cheng (2006) find that higher labor costs attract more FDI inflows. Thus, the effect of labor costs on location choice of FDI inflows might generally be unclear.

Unemployment rate: The availability of labor is generally measured by unemployment rate. Similarly to the discussion about the relationship between labor costs and FDI inflows, a change in the unemployment rate would have two opposite effects on FDI inflows. Hogenbirk and Narula (2004) suggest that the high unemployment rate could reflect the low level of local demand and the lack of suitable employees. In this case, the higher unemployment rate could deter FDI inflows, so that the unemployment rate is negatively related to FDI inflows. On the other hand, Coughin and

Segev (2000) state that the high unemployment is also an indicator of labor availability, so that firms can hire workers at lower costs. Thus, the unemployment rate would be positively related to FDI inflows.

Special economic zones: Many studies have shown some evidences supportive of the positive impact of tax incentives, which is closely linked to special economic zones, on FDI inflows. For example, Klemm and Parys (2009) find that lower corporate income tax rates and longer tax holidays are effective in attracting FDI inflows. In addition, Leichbrecht and Riedl (2010) find that effective corporate income rates are significant determinants of FDI inflows, and Morisset and Pirnia (2000) state that tax incentives are effective in promoting FDI inflows. However, the cost of tax incentives may outweigh the benefit associated with FDI inflows. Tax incentives are likely to entail a negative direct effect on fiscal revenues and, more seriously, they frequently create significant opportunities for illicit behavior by tax administrators and companies with corruption.

Results

To estimate the empirical model over the panel data, we first employ pooled ordinary least squares (OLS) and random affects estimation methods for 30 provinces over the period from 2000 to 2009.[6] Table 2 shows the summary of statistics, and Table 3 presents the estimated results, which includes those of OLS and random effects models since the statistics associated with Hausman inference is less significant for all estimated model sat a 5% significance level, except water distribution equation. In our data, some provinces have no FDI flows over a certain period. This kind of zero FDI inflows is considered as a corner solution outcome in the context of economic theory, where typical OLS and random effects estimation may not be appropriate. To mitigate this issue, we estimate our empirical model by applying the standard censored Tobit model or type I Tobit model. Table 3 also presents the estimated results of Tobit model and random effects Tobit model.

Table 2: Summary of statistics

Variable	Observation	Mean	Std. Dev.	Min	Max
FDI	300	1.679	4.718	0.000	67.405
INFRA (electricity distribution)	300	-1.104	1.627	-4.622	4.125
INFRA (road length)	287	-1.185	1.170	-5.065	2.652
INFRA (water distribution)	300	-4.937	0.771	-11.848	-2.416
INFRA (water capacity)	300	-7.364	0.523	-8.687	-5.466
GOVEXP	300	13.956	7.753	1.284	49.086
GDP	300	17.025	1.315	14.203	19.733
TRADE	300	76.046	31.614	8.586	182.602
IND	300	16.448	11.446	1.502	52.639
LABOR	300	2.574	0.688	-0.109	4.554
UNEMP	300	8.479	3.502	1.445	19.681
DUM	300	0.033	0.180	0.000	1.000

Notes: Sample period is from 2000 to 2009. Data of load length is not available during 2000-2002 for Bangka Belitung province, during 2000-2002 for Banten province, during 2000-2002 for Gorontalo province, and during 2000-2003 for Maluku Utara province.

The results in Table 3 show that irrespective of empirical methods, the coefficients on all proxies to infrastructure development are significantly positive for all models. The provinces with the higher level of infrastructure are associated with more FDI inflows. These provide clear evidences supporting that infrastructure development in terms of electricity distribution, road length, water

[6]Nevertheless, this model involves an econometric problem. The issue comes from the potential endogeneity of the explanatory variables.

distribution, and water capacity, plays an important role in attracting FDI into Indonesian provinces. Our findings confirm the conventional wisdom in that the establishment of favorable hard infrastructure could be a crucial condition for FDI inflows. This result has some important policy implications about FDI location choice for the government attempting to attract foreign investment under various decentralization policies.

Concerning the estimated results of other control variables, government expenditure as a proxy to the size of the government generally has a significantly negative relationship with FDI inflows, as shown in Deichman *et al.* (2003) and Mollick *et al.* (2006). The negative effect of government expenditure on FDI inflows can be explained by the argument that public investment crowds out private investment by diminishing the attractiveness of establishing business. Narrowness of a level playing field for foreign firms may cause them to be reluctant to invest in the province.

The result also demonstrates that labor cost has a significantly negative relationship with FDI flows for Tobit models in water capacity and water distribution equations, although the results are insignificant or less clear in electricity and road equations. This is consistent with the finding of Friedman *et al.* (1992) and Coughlin and Segev (2000) in that higher labor costs would deter FDI inflows. Multinational firms would make the importance on labor costs when they decide the location of foreign investment.

On the other hand, the coefficients on regional GDP, trade openness, the degree of industrialization, the unemployment rate, and special economic zones are generally insignificant or less clear for all of four infrastructure equations. The insignificance of the coefficients on regional GDP fail to support the argument of horizontal FDI or market-oriented FDI, discussed in Shatz and Venables (2000), that provinces with larger market demand attract more FDI inflows due to more business opportunities for foreign firms. In addition, in contrast to the argument of several studies such as Yavan (2010), the insignificant effect of industrialization shows that industrial agglomeration might neither attract multinational firms nor enhance FDI inflows in Indonesia. Our empirical results from OLS, random effects, Tobit, and Tobit random effects estimations generally fail to show clear evidence that these variables influence the location choice of foreign investment.

Count data analysis

Depending on the properties of the data set, the empirical literature has applied a number of techniques, such as OLS, logit models, Tobit models, Poisson models, and negative binomial models (NBMs), to examine the determinants of FDI inflows. In the previous subsection, we have presented clear results supporting that infrastructure development would help increase FDI inflows into Indonesia by using the data of the ratio of FDI inflows to GDP at the provincial level as a dependent variable. This subsection attempts to check the validity of the previous results by employing count data models with the count data of FDI inflows, i.e., the number of FDI projects implemented in each province during each period from 2000 to 2009. The data of the number of FDI projects is taken from Investment Coordinating Board of Indonesia (BKPM).

Many studies on FDI location apply count data models (Smith and Florida, 1994; Wu, 1999; Coughlin and Segev, 2000; List, 2001; Makabenta, 2002; Zhou *et al.*, 2002; Roberto, 2004; Meyer and Nguyen, 2005; Yavan, 2010). Since there is no FDI inflow in some provinces, the dependent variable contains many zero counts and takes non-negative integer values. Given the fact, we apply the Poisson models and NBMs as an alternative model for robustness check. As suggested in Greene (2003), the preponderance of zeros and discrete nature of the dependent variable suggest that the Poisson model appears to be suitable. In addition, Arauzo (2005) mentions that the Poisson model could mitigate the zero problem, where the data of provinces with no FDI inflow contains relevant information, since the independent variables of these provinces could help explain the reason why they do not receive any FDI inflows.

Table 3: Regression results

Variables	Electricity				Road				Water Capacity				Water Distribution			
	OLS	RE	Tobit	Tobit RE	OLS	RE	Tobit	Tobit RE	OLS	RE	Tobit	Tobit RE	OLS	RE	Tobit	Tobit RE
INFRA	0.784***	0.782***	0.791***	0.793***	0.876***	0.841**	0.872***	0.855**	1.386**	1.079*	1.991***	1.858**	1.116***	0.904**	1.291***	1.146**
	(0.208)	(0.254)	(0.235)	(0.261)	(0.285)	(0.343)	(0.319)	(0.340)	(0.570)	(0.648)	(0.676)	(0.734)	(0.407)	(0.439)	(0.470)	(0.514)
GOVEXP	-1.167***	-1.169***	-0.242***	-0.237***	-0.143**	-0.149**	-0.209***	-0.206***	-0.155***	-0.154**	-0.237***	-0.229***	-0.145**	-0.147**	-0.217***	-0.212***
	(0.058)	(0.064)	(0.072)	(0.076)	(0.062)	(0.068)	(0.075)	(0.077)	(0.058)	(0.066)	(0.073)	(0.078)	(0.058)	(0.064)	(0.072)	(0.077)
GDP	-0.909**	-0.900*	-0.204	-0.177	-0.745	-0.775	-0.126	-0.110	-0.138	-0.134	0.576	0.608	-0.198	-0.182	0.518	0.560
	(0.414)	(0.490)	(0.483)	(0.528)	(0.479)	(0.559)	(0.544)	(0.571)	(0.356)	(0.437)	(0.418)	(0.464)	(0.357)	(0.420)	(0.419)	(0.467)
TRADE	0.018	0.013	0.023	0.020	0.011	0.004	0.015	0.013	0.017	0.010	0.023*	0.019	0.015	0.010	0.021	0.016
	(0.011)	(0.012)	(0.013)	(0.014)	(0.011)	(0.013)	(0.013)	(0.014)	(0.011)	(0.013)	(0.013)	(0.015)	(0.011)	(0.013)	(0.013)	(0.015)
IND	-0.003	-0.003	-0.038	-0.037	0.022	0.027	-0.008	-0.006	0.007	0.005	-0.025	-0.025	0.008	0.006	-0.027	-0.027
	(0.034)	(0.039)	(0.039)	(0.042)	(0.039)	(0.046)	(0.045)	(0.047)	(0.034)	(0.041)	(0.040)	(0.044)	(0.034)	(0.039)	(0.040)	(0.044)
LABOR	-0.074	0.070	-0.474	-0.375	0.190	0.284	-0.159	-0.123	-1.223*	-0.858	-1.959**	-1.741*	-1.264*	-0.959	-1.834**	-1.591*
	(0.661)	(0.771)	(0.760)	(0.835)	(0.681)	(0.804)	(0.772)	(0.818)	(0.694)	(0.824)	(0.808)	(0.913)	(0.688)	(0.789)	(0.798)	(0.910)
UNEMP	0.110	0.090	0.081	0.069	0.080	0.078	0.062	0.062	0.180*	0.140	0.161	0.139	0.179*	0.146	0.158	0.134
	(0.092)	(0.100)	(0.107)	(0.113)	(0.097)	(0.106)	(0.110)	(0.113)	(0.093)	(0.102)	(0.107)	(0.115)	(0.092)	(0.100)	(0.107)	(0.115)
DUM	1.037	0.952	1.026	0.979	0.479	0.381	0.476	0.440	0.908	0.562	1.392	1.202	1.372	0.991	1.650	1.365
	(1.590)	(1.950)	(1.780)	(1.987)	(1.579)	(1.978)	(1.742)	(1.872)	(1.632)	(2.092)	(1.838)	(2.093)	(1.662)	(2.010)	(1.875)	(2.143)
Constant	18.261**	18.334**	7.887**	7.449**	14.981*	15.720*	5.787	5.505	16.605**	14.182	11.249	9.552	12.997*	11.633	3.546	1.969
	(7.078)	(8.226)	(8.292)	(8.988)	(8.198)	(9.417)	(9.343)	(9.770)	(7.992)	(9.224)	(9.432)	(10.295)	(6.882)	(7.767)	(8.094)	(8.898)
Hausmann Test (p-value)	-	9.19 (0.239)	-	-	-	7.56 (0.373)	-	-	-	12.32 (0.091)	-	-	-	15.17 (0.034)	-	-
Number of observations	300	300	300	300	287	287	287	287	300	300	300	300	300	300	300	300

Notes: *, **, and *** represent the significance at the 10%, 5%, and 1% levels, respectively. Figures in parentheses are standard errors

Poisson regression models assume that the number of FDI projects located in province *i*, y_i, is distributed according to a Poisson distribution with parameter λ_i related to the independent variables vector x_i describing the provincial characteristics. The likelihood of observing a count of FDI projects is written by:

$$\text{Prob}(y_i|x_i) = \frac{e^{-\lambda_i}\lambda_i^{y_i}}{y_i!}, \quad y_i = 0,1,2,\cdots.$$

Parameter λ_i is assumed to be log-linearly dependent on the independent variables vector x_i with

$$\ln\lambda_i = \beta' x_i,$$

where β is a parameter vector to be estimated. However, the assumed equality of the conditional mean and variance can be considered the major shortcoming of the Poisson regression models. Among many alternatives, the most common is the negative binomial models (NBMs). The NBM is an extension of the Poisson regression model by introducing an individual, unobserved effect into the conditional mean:

$$\ln\lambda_i = \beta' x_i + \epsilon_i,$$

Where $u_i = \exp(\epsilon_i)$ follows a gamma distribution, and the disturbance ϵ_i reflects either specification error as in the classical regression model or cross-sectional heterogeneity that could characterize the data.

Table 4 shows the estimated results for the Poisson regression model and NBMs with the same explanatory variables as the baseline models in the previous subsection. Similar to the previous estimation results, the coefficients for all of infra structure development are statistically significant in all count data models except for the Poisson regression model in the water capacity equation. The count models also support that infrastructure development has the positive relationship with FDI inflows into Indonesia, so that provinces with well-developed hard infrastructure would attract more FDI projects.

Table 4: Poisson and NBM regression results

Variables	ELECTRICITY		ROAD		WATER CAPACITY		WATER DISTRIBUTION	
	Poisson	**NBM**	**Poisson**	**NBM**	**Poisson**	**NBM**	**Poisson**	**NBM**
INFRA	0.493***	0.502***	0.664***	0.601***	0.621***	0.451***	0.072***	0.871***
	(0.013)	(0.040)	(0.017)	(0.059)	(0.032)	(0.080)	(0.020)	(0.134)
GOVEXP	-0.018***	-0.039***	-0.019***	-0.057***	-0.024***	-0.034**	-0.028***	-0.028*
	(0.005)	(0.014)	(0.005)	(0.016)	(0.005)	(0.016)	(0.005)	(0.016)
GDP	0.561***	0.694***	0.529***	0.613***	1.112***	1.225***	1.267***	1.288***
	(0.022)	(0.097)	(0.024)	(0.121)	(0.019)	(0.105)	(0.018)	(0.103)
TRADE	0.006***	0.016***	0.007***	0.016***	0.008***	0.017***	0.009***	0.017***
	(0.001)	(0.002)	(0.001)	(0.003)	(0.001)	(0.003)	(0.001)	(0.003)
IND	0.033***	0.004	0.051***	0.025***	0.011***	-0.005	-0.011***	-0.000
	(0.002)	(0.007)	(0.002)	(0.010)	(0.002)	(0.009)	(0.002)	(0.009)
LABOR	-0.090**	-0.422***	0.018	-0.423**	-0.672***	-1.015***	-0.217***	-0.950***
	(0.036)	(0.149)	(0.035)	(0.167)	(0.039)	(0.189)	(0.032)	(0.186)
UNEMP	0.013**	-0.000	0.012**	0.011	0.114***	0.051**	0.115***	0.057**
	(0.005)	(0.021)	(0.005)	(0.024)	(0.004)	(0.025)	(0.004)	(0.025)
DUM	1.071***	1.287***	0.701***	0.931***	0.352***	1.761***	-0.228***	0.898**
		(0.304)	(0.069)	(0.324)	(0.068)	(0.589)	(0.063)	(0.372)

	(0.075)							
Constant	-8.121*** (0.413)	-9.372*** (1.602)	-7.928*** (0.439)	-7.989*** (1.975)	-13.966*** (0.460)	15.611*** (1.788)	-20.002*** (0.396)	-12.886*** (1.847)
Number of observations	300	300	287	287	300	300	300	300

Notes: *, **, *** are significant at 10 percent level, 5 percent level and 1 percent level, respectively; Figure in parentheses are standard errors

Concerning the results of other control variables in the count data analysis, government expenditure in the NBMs shows the negative relationship with FDI inflows. This is consistent with the results in the previous subsection, so that the negative effect of government expenditure on FDI inflows could show that public investment crowds out private investment. In addition, consistently with the previous results; the analysis also shows that labor cost generally has the negative relationship with FDI inflows. Higher labor costs would deter FDI inflows, since multinational firms would make the importance on labor costs when they decide the location of foreign investment.

Differently from the results in the previous subsection, the count data analysis shows some clear evidences that FDI inflows are significantly related to regional GDP, trade openness, industry value added, unemployment rate, and special economic zones. Regional GDP is positively associated with FDI projects, which would support the argument of horizontal FDI or market-oriented FDI that larger market demand attract more FDI inflows. In addition, trade openness is positively associated with FDI inflows, which is consistent with the findings in various studies, such as Asiedu (2002) and Sahoo (2006), that trade openness promotes FDI inflows at the regional level. The recent trend of regional trading integration promotes investment incentives.

Industry value added, as a proxy to industrialization, is positively correlated with FDI inflows in general, although the opposite result is shown in the water distribution equation. This could partly be consistent with the results in studies on industry agglomeration, such as Hilber and Voicu (2010) and Yavan (2010). Moreover, unemployment rate is positively related to FDI inflows. A possible justification may include the argument that the unemployment could be one of the indicators of labor availability, as mentioned in Coughin and Segev (2000). Furthermore, the coefficients on special economic zones are positively associated with FDI inflows, except for the Poisson regression analysis on the water distribution equation. This implies that tax incentives could be effective in attracting FDI projects.

In sum, concerning the effect of infrastructure development, government expenditure (government size), and labor costs, our empirical results from Poisson regression models and NBMs are generally similar with estimation using pooled OLS, random effects, Tobit, and Tobit random effects models. FDI inflows into Indonesia are positively associated with infrastructure development, while they are

negatively related to the government size and labor costs. On the other hand, Poisson regression models and NBMs generally present the results of the effects of regional GDP, trade openness, industry value added (industrialization), and special economic zones on FDI inflows, although non-count models fail to show clear evidences.

Conclusion

This paper has investigated how infrastructure development affects the location choice of foreign investment or FDI inflows in Indonesia by using panel data of 30 provinces over the period of 2000-2009. As proxies to infrastructure development, we used electricity, road length, water capacity, and water distribution. Our empirical analysis showed that infrastructure development would help enhance FDI inflows at the province level. This study also presented that regional government expenditure as a proxy to the size of the government is negatively related to FDI inflows, and the labor cost is also negatively related to FDI inflows. In addition, these results can generally be supported by the count data analysis, such as Poisson regression models and NBMs.

Our results have some important implications about public policy that aims at attracting foreign investment in several specific provinces in Indonesia. Since establishing hard infrastructure is required to enhance FDI inflows, the government should pay more attention to infrastructure development and its quality for foreign firms. Moreover, since the large size of government expenditure causes FDI inflows to decline due to the crowd-out effect, the government should restrict its intervention and promote private investment as well as private economic activities. These results should be taken into account under on-going institutional and regulatory reforms toward effective decentralization in Indonesia.

Our study has several limitations in terms of data and methodology. Similar to other developing countries, we have some difficulty in obtaining province level data. The lack of data prevented us from carrying out comprehensive econometric analysis. In addition, it should be noted that our empirical models would suffer from the typical endogeneity problem related to FDI inflows and infrastructure development. Although we admit these issues, we believe that our empirical study would provide important policy implications of regional FDI allocation to contribute a lot to regional development in Indonesia.

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