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# The Impact of Infrastructure on Trade: The Case of Malaysia

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***Abstract:*** *This study examines the role of infrastructure on trade in Malaysia from 1990 to 2013. Main objectives include testing the addition of infrastructure into the augmented gravity equation and examining trade costs reduction through improvement in infrastructure. A panel data analysis is employed to determine the impact of infrastructure on trade between Malaysia and 36 countries. After testing the robustness of the results using a fixed effect model, the findings show that all of the infrastructure variables are significant and positively related tot the value of trade between Malaysia and its trading partners.*
***Keywords:*** *gravity model, infrastructure, Malaysia, trade, trade costs*

## I. Introduction

The economic growth of many countries is mostly owed to the expansion of international trade. To capitalize from the benefits of trade, cooperative efforts among countries have become more vigorous in recent years. They share the same objectives of economic integration that include reducing trade barriers. An empirical study on border costs shows that tariff barriers are now low in most countries, averaging at less than five per cent for rich countries, and between 10 to 20 per cent for developing countries (Anderson and van Wincoop, 2004). Following the substantial reductions of tariffs over the past decades, it has been widely acknowledged that tariffs are no longer a major obstacle to trade. Furthermore, major non-tariff barriers such as import quotas and voluntary export restraint agreements have also diminished significantly.

Meanwhile, the aspects of infrastructure have begun to receive greater attention as it plays an increasingly important role in international trade. Without sufficient and good quality infrastructure, developing countries struggled to compete in the global economy and face competitive prices for export products. Domestic and cross-border infrastructures benefit trade through reductions in costs, as high trade costs hinder potential gains from trade. Production and distribution of a widening array of intermediate goods and services are pushing countries to reduce their costs through upgrading the quantity and quality of infrastructures. The expansion of infrastructures in Asia, particularly in East Asia, decreases trade costs and shifts the comparative advantage between countries in the region. As found by Brooks (2008), greater fragmentation of production supply chains are spurring the region’s intraregional trade in intermediate products.

Massive development of supporting infrastructures is required to cope with the demands of a rapidly expanding economy. It is also to ensure that the competitiveness in global markets will not be compromised by the lack of good infrastructure. In the current economic environment, overcoming geographic and institutional obstacles that increase trade margins are more important for regional trade expansion. Improvements in infrastructure reduced trade costs and widen trading opportunities. In this view of this advantage, the objective of this paper is to examine the role of infrastructure on trade in Malaysia. The paper is outlined as follows: an overview of previous studies on the subject followed by a description of data and methodology used to evaluate the effect of infrastructure on trade. Next, discussion of empirical results and a conclusion are discussed.

## II. Literature Review

Asia’s trade expansion has been facilitated and encouraged by the development of supporting infrastructures (Brooks, 2008). Previous studies which have examined the relationship between trade and infrastructure found a positive and significant impact of infrastructure on trade (Park and W. Koo, 1995; Fujimura and Edmonds, 2006; Rojas, Calfat and Forest Jr., 2005; Tham, Devadason and Heng, 2009). Since tariffs are no longer considered as a major trade barrier, infrastructure-induced reductions in trade costs have become relatively more important. De (2008) found that a reduction in tariffs and transportation costs by ten per cent each would increase bilateral trade by two per cent and six per cent, respectively. Therefore, trade is more likely to increase with a reduction of transport costs, rather than a reduction in tariffs.

Access of transportation and distance from major markets has a strong impact on shipping costs. Analysis on bilateral trade within Sub-Sahara African (SSA) countries by Limao and Venables (2001) using gravity model indicated that their relatively low level of trade flow is largely due to poor infrastructure. This study estimated that the differences in infrastructure account for 40 per cent of the variation in transportation costs for coastal countries and up to 60 per cent for landlocked countries. Additionally, De (2009) showed that trade transportation costs across South Asia are very expensive and vary across goods. Landlocked countries have relatively high costs of transportation and trade can be facilitated through the upgrading of transportation facilities and infrastructures.

Rojas, Calfat and Forest Jr. (2005) analyzed the relevance of including infrastructure in the augmented gravity equation while testing whether reducing transport costs can reduce 'distance' between bilateral partners. Their findings indicated that trade has been negatively affected by geographical distance, which is defined as the physical distance in kilometers and modified by an infrastructure index. With better infrastructures, transportation costs that tend to increase with distance can be reduced. Furthermore, Tanzi (2005) argued that by reducing transportation and telecommunication costs, the market for labor as well as goods and services can be broadened.

On the other hand, financial infrastructure is important to estimate the number of consumers and the value of transactions for credit bureaus, payment systems and remittances. Financial markets have a critical role in economic development and stability because they provide an efficient mechanism for evaluating risk and return to investment. They also offer means of managing and allocating risk and resources across the economy (Financial Infrastructure Report, 2009). Hur, Raj and Riyanto (2006) found that economies with higher levels of financial development have higher export shares and trade balance in industries with more intangible assets while Pham (2009) argued that there will be even more significant restraints to trade due to the disadvantage of not having access to credit.

## III. Methodology

The gravity model is used to evaluate the impact of infrastructure on trade as it is among the widely used approach in the empirical literature of international trade flows. This model explains the main link between trade barriers and trade flows by introducing additional infrastructure variables in order to evaluate the effect of infrastructure on trade (Nordas and Piermartini, 2004; Francois et al., 2006; De, 2009; Pham, 2009). Soft infrastructures are essential for physical infrastructures to function efficiently, thus variables which represent both types of infrastructures are included in this model. By upgrading its infrastructures, Malaysia can drive internal competitiveness and enables export of goods at competitive prices. Thus, the coefficient for infrastructure is expected to be positive. The model is specified below;

$$X_{ijt} = \beta_0 + \beta_1 LY_{it}Y_{jt} + \beta_2 LEN_{ijt} + \beta_3 LEX_{ijt} + \beta_4 LDIS_{ijt} + \beta_5 BORDER_{ijt} + \beta_6 LOCKED_{ijt} + \beta_7 LINFRS_{it} + u_{ijt}$$

Where;

$X_{ijt}$ = value of exports from country *i* to country *j*;
$LY_{it}Y_{jt}$ = log of GDP from both countries;
$LEN_{ijt}$ = log of relative endowment between country *i* and country *j*;
$LEX_{ijt}$ = log of multiplication of exchange rates between country *i* and country *j*;
$LDIS_{ij}$ = log of distance between country *i* and country *j*;
$BORDER_{ij}$ = dummy variable to represent a common border between partners;
$LOCKED_{ij}$ = dummy of landlocked countries;
$u_{ij}$ = disturbance term
$INFRS_{it}$ = Physical infrastructures; ($LRoad_i$)
Non-physical infrastructures; ($LTeli_i$)
Soft infrastructures ($LFin_i$)

Gravity models have traditionally been estimated using cross-sectional data to examine trade effects and trade relationships for a certain time of period. However, the use of cross-sectional estimation is criticized for its inability to deal with bilateral (exporter and/or importer) heterogeneity (Serlenga and Shin, 2007). When unobserved country heterogeneity was not considered, results could lead to distortion estimates. Cheng and Wall (2005) proved that ignoring heterogeneity generated biased estimates of bilateral trade relationships. In this regard, researchers have turned towards panel data (cross-sectional data observed over several time periods) in which such heterogeneity can be modelled by including individual country-pair effects. Panel data estimation usually gives researchers a large number of data points, increases the degrees of freedom and reduces co-linearity among explanatory variables, hence improves the efficiency of econometric estimates (Hsiao, 2003).

As an advantage, the random effects model and the fixed effects model enable control of all time-invariant unmeasured variables which could affect the dependent variable. These time-invariant variables do not change over the period of observation. The major difference between the two models is that the omitted time-invariant variables are assumed to be uncorrelated with the included time-varying covariates in the random effects model. On the contrary, in the fixed effects model, they are allowed to correlate (Mundlak, 1978). The commonly used method of choosing between the random or fixed effects models is by running a Hausman Test that compares between a more efficient model and a less efficient but consistent model. This test ensures that when the random effects model is valid, the fixed effects estimator produces consistent estimates of identifiable parameters.

## IV. Empirical Results

Table 1 shows estimation results based on three models: pooled ordinary least squares (OLS), random effects model (REM) and fixed effects model (FEM). The variables for infrastructures are divided into three sections: physical, non-physical and soft infrastructures. The coefficient for $LY_{it}Y_{jt}$ is positive and statistically significant, implying that larger economic space poses larger trade potential between two countries. It also suggests that trade increases when GDP increases. The coefficient for $LEN_{ijt}$ shows a positive sign and indicates that Malaysia prefer to trade with countries that has a similar income level. Meanwhile, the coefficient for $BORDER_{ij}$ also shows a positive sign, implying neighboring countries tend to trade more with each other. The coefficient for $LEX_{ijt}$ shows a negative sign, suggesting that trade increases when the currency depreciates as exports became more competitive due to cheaper price of domestic goods. Similarly, the coefficients for $LDIS_{ij}$ (distance) and $LOCKED_{ij}$ (landlocked) are also negative. Transportation costs are lower when the distance between two trading countries is shorter, thus increasing trade volume. For landlocked countries, trading has to depend on a transit country where it implies higher transaction costs.

According to Ismail (2009), OLS estimations tend to show biased results due to heterogeneity problem, which can be carried from individual country characteristics and business cycle. Therefore, FEM was employed in which such heterogeneity can be modelled by including country-pair individual effects. The Hausman test results also indicated that FEM is most suitable since the null hypothesis of consistent and efficient REM was rejected. However, employing FEM means time-invariant variables such as distance, border and landlocked have to be omitted. According to FEM results, $LROAD_i$ showed high impact where a ten per cent increase induces a 18 per cent increase in trade. Good access by road between ports and inland markets helped to reduce dwell time and transaction costs. $LTELI_i$ increases Malaysian trade by 6.3 per cent when the number of mobile and fixed-line telephone subscribers increased by ten per cent. Thus, the availability of communication infrastructures correlates with the costs of entering and monitoring contracts with suppliers, domestic and abroad. Finally, $LFIN_i$ which represents financial infrastructures is found to be statistically significant. It showed a positive relationship between financial infrastructures and Malaysian trade volume. However, it has a relatively small effect where a ten per cent increase in financial infrastructure development only increases trade volume by 0.1 per cent. Hence, complementarities between different modes of infrastructure imply that improvement in infrastructures helped to substantially boost Malaysian trade.

**TABLE 1:** Regression Results

| **Variables** | | **REM** | | | **FEM** | |
|---|---|---|---|---|---|---|
| | **6** | **7** | **8** | **11** | **12** | **13** |
| **CONST** | -36.51 | -7.86 | -13.03 | -1.31 | -11.22 | -16.75 |
| | (15.24)** | (2.51)*** | (2.87)*** | (2.55) | (2.27)*** | (3.86)*** |
| **$LY_iY_j$** | 2.56 | 1.11 | 1.7 | 0.82 | 0.72 | 1.2 |
| | (0.04)*** | (0.09)*** | (0.1)*** | (0.1)*** | (0.11)*** | (0.17)*** |
| **$LEN_{ij}$** | -0.25 | -0.21 | -0.06 | -0.23 | -0.21 | -0.06 |
| | (0.04)*** | (0.04)*** | (0.04)*** | (0.04)*** | (0.04)*** | (0.03)** |
| **$EX_{ij}$** | -0.005 | -0.003 | 0.0009 | 0.003 | 0.002 | 0.003 |
| | (0.001)*** | (0.001)** | (0.001)*** | (0.001)*** | (0.001)*** | (0.001) |
| **$LDIS_{ij}$** | -2.43 | -1.35 | -1.69 | .. | .. | .. |
| | (0.26)*** | (0.26)*** | (0.27)*** | | | |
| **$BORDER_{ij}$** | -0.9 | -0.12 | -0.09 | .. | .. | .. |
| | (1.01) | (0.97) | (1.03) | | | |
| **$LOCKED_j$** | -0.97 | -2.11 | -1.67 | .. | .. | .. |
| | (0.65) | (0.62)*** | (0.66)** | | | |
| **$LROAD_i$** | -1.6 | - | - | -1.8 | - | - |
| | (2.03)** | | | (2.03)** | | |
| **$LTELI_i$** | - | 1.08 | - | - | 1.26 | - |
| | | (0.06)*** | | | (0.09)*** | |
| **$LFIN_i$** | - | - | 0.04 | - | - | 0.06 |
| | | | (0.01)*** | | | (0.01)*** |
| **Obs** | 1026 | 921 | 572 | 1026 | 921 | 572 |
| **R sq** | 0.71 | 0.73 | 0.76 | 0.42 | 0.39 | 0.36 |
| **Adj R sq** | 0.70 | 0.69 | 0.75 | 0.29 | 0.27 | 0.35 |
| **Time** | - | - | - | F(35, 959) | F(35, 857) | F(35,518) |
| **Effects** | | | | = 100 | = 93.6 | = 133.61 |

*Notes: The asterisks *, **, and *** indicate significance at one, five and ten per cent level. "…" shows that the variables are omitted in FEM*

## V. Conclusion

This study examines the role of infrastructure on trade in Malaysia for the period of 1990 to 2013. A gravity model is regressed by including infrastructure variables which are classified as physical, non-physical and soft infrastructures. The definition of infrastructure is not limited to public usage and may also refer to information technology and software development tools which support the economic system. The result indicates all of the infrastructure variables show positive impact towards the Malaysian export volume. Hence, the findings provide evidence that an improvement in infrastructures can enhance Malaysian trade to greater heights.

Non-physical infrastructures are important to facilitate the service sector while physical infrastructures can reduce production costs in industrial and manufacturing sectors. Therefore, harmonizing and strengthening soft infrastructures will complement the expanding physical infrastructures. The results show that the communication infrastructures are significant and have a positive impact on the level of Malaysian exports. This suggests that the use of communication and information infrastructures has vastly improved efficiency in trade and possibly reducing the need to travel among traders. In order to ensure that high quality communication services are provided at competitive prices, the government and the private sector should focus more on research and development of communication infrastructures. Domestic credit to private sectors strengthens the view that financial infrastructures will continue to help accelerate exports in Malaysia. Policy makers can support the development of financial infrastructures and formulate an equitable financing access for businesses from all sectors in the economy.

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