Road to Prosperity:

The Effects of Transportation Infrastructure on Village-City Trade

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Using a household survey data on Indonesia, I examine the effects of transportation costs on prices, consumption and wages. I find that transportation infrastructure projects that reduce the costs of transportation lead to lower prices in villages and larger volume of trade between villages and cities. I do not find evidence that it leads to higher real wages in villages, however.

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1 Introduction

Theories suggest that lower trading costs lead to economic gains.[2] An improvement in transportation infrastructure that reduces transportation costs would therefore increase trade and welfare.

Empirical evidence on the effects of transportation costs on trade is scant, however. One recent working paper that looks into this is Donaldson (2009). Using archival data on railroad construction in colonial India, and aided by predictions from a general equilibrium trade model he develops in the paper, he shows that railroads, among others, decrease trade costs, increase trade, and raise real income.[3] He concludes that infrastructure projects are welfare improving because they allow regions to benefit from trade gains.

In this paper, I examine these predictions using a different set of data, i.e., the longitudinal household survey on Indonesia, the Indonesia Family Life Survey (IFLS). From this survey, I collect data on prices of goods typically consumed by Indonesian households in small towns/villages and their provincial capital; per capita consumption of these goods at village level, and the wages of farmer-laborer. I also get data on the costs of transportation between these villages and the provincial capital. By regressing each of the variables, i.e., prices, trade, and wages, on transportation costs and a set of indicators and their interaction terms to control for time-invariant unobserved characteristics, I estimate the effects of transportation costs. I find that, in line with Donaldson (2009), transportation infrastructure projects that reduce costs of transportation lead to lower prices in villages and larger volume of trade between villages and cities. I do not find evidence that it leads to higher real wages in villages, however.

[2] See, for example, Krugman (1980), Eaton and Kortum (2002), and Melitz (2003).

This paper contributes to the literature in two ways. First, I provide some evidence on the positive effect of road infrastructure on trade, which complements Donaldson (2009)'s effects of railroads. Second, Donaldson (2009) does not have the data on transportation costs: He has to estimate them. This key variable is available in the IFLS I use in the paper, and this may help me to provide more reliable estimates of the effect of costs of transportation on trade and income.[4]

This paper proceeds as follows. Section 2 explains the methodology. Section 3 describes the data. Section 4 presents the empirical results. Section 5 concludes.

2 Methodology

I estimate the effects of transportation infrastructure between small towns/villages and cities on prices in the small towns/villages, volume of trade between the villages and cities, and the income in the villages.

2.1 The Effect on Price

To examine the effect of transportation costs on prices, I estimate the following model:

$$ln(Price_{vt}^{k}) = \alpha + \beta ln(Cost_{vt}) + \gamma ln(Price_{ct}^{k}) + \xi_{kt} + \xi_{ct} + \xi_{kc} + \xi_{v} + \varepsilon_{vt} \quad (1)$$

where $Price_{vt}^{k}$ is the price of good k in village v at time t; $Cost_{vt}$ is the transportation costs from village v to its provincial capital at time t; and $Price_{ct}^{k}$ is the price of good k in provincial capital c at time t. The other three sets of explanatory variables are the good-year fixed effect (ξ_{kt}), city-year fixed effect (ξ_{ct}), and good-city fixed effect (ξ_{kc}). These fixed-effects controls for good-specific and city-specific as well as good-city time-invariant determinants of prices. The terms

[3] Donaldson (2009) also finds that railroads reduce the responsiveness of local prices to productivity shocks, and decrease income volatility. I do not explore these predictions of theories in this version of this paper, however.

ξ_v and ε_{vt} are the town/village-fixed effect and the error term, respectively.

I expect the coefficient of *ln(Cost)*, β, to be positive. This means that, after controlling for prices in large cities and a set of time invariant unobserved determinants of prices, an improvement in transportation infrastructure that reduces transportation cost leads to lower prices in villages.

2.2 The Effect on Trade

To examine the effect of transportation costs on the volume of trade, I estimate a variation of Equation 1 as follows:

$$ln(Trade_{vt}^{k}) = \alpha + \beta ln(Cost_{vt}) + \xi_{kt} + \xi_{ct} + \xi_{kc} + \xi_{v} + \varepsilon_{vt} \quad (2)$$

where $Trade_{vt}^{k}$ is the average consumption of good *k* in village *v* at time *t*. The set of indicators and their interaction terms are the same as those in Equation 1. I expect the coefficient of *ln(Cost)* to be negative: The lower the costs of transportation is, the larger the volume of trade between villages and cities will be.

2.3 The Effect on Wages

To examine the effect of transportation costs on income, I estimate the following equation:

$$ln(Wage_{vt}) = \alpha + \beta ln(Cost_{vt}) + \xi_{v} + \xi_{t} + \varepsilon_{vt} \quad (3)$$

where $Wage_{vt}$ is the average real wage of male famer-laborer in village *v* at time *t*. I expect the coefficient of *ln(Cost)* to be negative: The lower the cost of transportation is, the larger the real wage in villages will be.

[4] This version of the paper has some limitations, however, which I address in Section 5.

3 Data

I use the Indonesia Family Life Survey (IFLS), an on-going longitudinal household survey in Indonesia. I focus on the last three waves of the survey, IFLS 2, IFLS 3, and IFLS4, which were done in the year 1997, 2000, and 2007, respectively.[5]

The key variable is intercity costs of transportation, *Cost*. There are a number of measures of costs of transportation available in the community level data of the survey, e.g., transportation costs to the nearest market, district capital, and provincial capital. Because one of the dependent variables, *Price*, is not available in all markets and all district-capital cities, I use the costs of transportation from small towns/villages to the provincial capital as the measure of transportation costs.

The dependent variables are *Price*, *Trade*, and *Wage*. Prices of goods typically consumed by households are collected from one or several markets in each of the towns/villages. As a measure of *Price*, I take the average prices of each of the goods in each area.

I also use *Price* of goods in the provincial capital as one of the explanatory variables in Equation 1.

There is no data on the volume of trade between cities and villages in the survey. As a proxy for *Trade*, I use the information on the consumption of goods bought from markets by households available in the household level data. I calculate the per capita consumption of each of the goods by taking the simple average of per capita consumption of households in each of the towns/villages.

There is information on the wages of famer laborer as well as factory workers in the survey. However, the wages of factory workers are available for a small number of

[5]See Frankenberg and Thomas (2000) and Strauss et al. (2004) for extensive descriptions of this survey.

towns/villages only. Therefore, as a measure of income, *Wage*, I use the wages of farmer-laborer in each of the villages. Wages are available for several processes of agricultural production such as plowing, tilling, and harvesting. Wages for male- and female workers are also available separately, but I use the wages of male workers only. I take the averages of male wages in each area in each waves of the survey, and then deflate them by the Consumer Price Index.

Table 1 shows the summary statistics of these variables.

[**INSERT TABLE 1 HERE**]

4 Empirical Results

4.1 The Effect on Price

Table 2 presents the effect of transportation costs on prices. Columns 1 and 2 use the prices of all products in all small towns/villages available in the data. Some of the towns are actually quite large. To focus on trade between village and cities, Columns 3 and 4 include prices in villages only.

[**INSERT TABLE 2 HERE**]

In Regressions 1 and 2, the coefficient of *ln(Cost)* is about 0.1. It is statistically significant at 1% level. As expected, lower transportation costs are associated with lower prices in villages: A 1% reduction in transportation costs leads to 0.1% fall in prices in villages.

In Regression 3, the coefficient of *ln(Cost)* is smaller, and it is marginally significant as the p-value is only 0.057. After controlling for *Distance* and *Time* in Regression 4, which are the distance between the small town/village and the provincial capital and the time it takes to travel from the village to the city, respectively, *Cost* becomes insignificant statistically, though it

remains positive at about 0.06.

The two additional explanatory variables, *ln(Distance)* and *ln(Time)* in Regression 2 are not significant statistically, however. Once we control for transportation costs, *Distance* and *Time* does not seem to affect *Price*. It is also possible however that the high correlation between *Cost* and *Distance* or *Time* makes it difficult to separate the effect of Cost and the other two measures of transportation costs. This might explain the statistical insignificant of *Cost* in Regression 4 as well.

The coefficient of *ln(Price)* in cities is about 0.2 and it is significant statistically at 1% level: A 1% increase in price of a good in cities leads to 0.2% increase in price of the good in villages.

4.2 The Effect on Trade

Table 3 presents the effect of transportation costs on the volume of trade. Columns 1 and 2 use the consumption of all products in all small towns/villages available in the data; Columns 3 and 4 include data on consumption in villages only. I use *Cost* and *Time* as measures of transportation costs.

[INSERT TABLE 3 HERE]

In all regressions, the coefficient of *ln(Cost)* is about -0.1. It is statistically significant at 1% or 5% level. As expected, lower transportation costs is associated with higher volume of trade between villages and cities.

4.3 The Effect on Wages

Table 4 presents the effect of transportation costs on wages. Columns 1 and 3 use *Cost* as a measure of transportation cost. In both regressions, I find that coefficient of *ln(Cost)* is positive. It is not significant statistically, however.

[**INSERT TABLE 4 HERE**]

Columns 2 and 4 use *ln(Time)* as a measure of transportation costs. The coefficient is also positive and insignificant statistically even at 10% level.

There is no evidence that a decrease in transportation costs between villages and cities leads to higher income. It does not mean that transportation infrastructure projects are not welfare improving, however. I will explore the sign and magnitude of this effect further in the future version of this paper.

6 Concluding Remarks

Using a longitudinal household survey on Indonesia, I find that better transportation infrastructure is associated with lower prices in villages and larger trade between villages and cities. I do not find that it leads to higher real wages in villages, however.

There are some limitations of this paper. First, transportation infrastructure projects in Indonesia, and hence, the transportation costs variable I use in the analyses is not exogenous. Therefore, the regressions may suffer from endogeneity problem. It would be good if I could provide an instrumental variable (IV) estimation of the effects of transportation costs. Fortunately, there is potentially one variable that I can use as instrument, i.e., natural disasters. I will explore the possibility of using this variable as an instrument for the variable of interest,

Cost.

Second, it would be also interesting to see how transportation costs affect price responsiveness and income volatility. Third, I may also need to control for time-invariant determinants of price or transportation cost between village and city pair, ξ_{vc}. Computationally, estimating the model is demanding, however. Fourth, the finding that transportation infrastructure projects do not increase income is rather puzzling, which demands further analyses. In the future version of this paper, I will address some of these limitations.

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Table 1: Summary Statistics

	#obs	Mean	Std Dev
Cost	16,873	21,386.66	29,756.17
Distance	16,926	130.74	136.89
Time	16,710	3.33	3.04
Price	15,524	8,735.37	13,982.12
Wage	10,456	20,629.85	13,415.63
Urban indicator	17,073	0.58	0.49

Table 2: The Effect of Transportation Cost on Prices

Dependent Variable: $\ln(Price_{vt})$				
	All towns/villages		**Villages only**	
	(1)	**(2)**	**(3)**	**(4)**
$\ln(Cost)_{vt}$	0.09	0.08	0.06	0.06
	(0.03)**	(0.03)**	(0.03)+	(0.04)
$\ln(Price)_{ct}$	0.18	0.18	0.18	0.19
	(0.03)**	(0.03)**	(0.04)**	(0.04)**
$\ln(Distance)_{vt}$		0.04		0.10
		(0.03)		(0.04)*
$\ln(Time)_{vt}$		-0.01		-0.09
		(0.04)		(0.04)*
Product * Year fixed effects	Yes	Yes	Yes	Yes
City * Year fixed effects	Yes	Yes	Yes	Yes
Product * City fixed effects	Yes	Yes	Yes	Yes
Village fixed effects	Yes	Yes	Yes	Yes
No. observations	12577	12345	5911	5789
R^2	0.82	0.82	0.82	0.82

Notes: The numbers in parentheses are the robust standard errors; + significant at 10%; * significant at 5%; ** significant at 1%.

Table 3: The Effect of Transportation Costs on Trade

Dependent Variable: ln($Trade_{vt}$)				
	All towns/villages		**Villages only**	
	(1)	**(2)**	**(3)**	**(4)**
$ln(Cost)_{vt}$	-0.12		-0.10	
	(0.02)**		(0.05)*	
$ln(Time)_{vt}$		-0.15		-0.09
		(0.06)**		(0.04)*
Product * Year fixed effects	Yes	Yes	Yes	Yes
City * Year fixed effects	Yes	Yes	Yes	Yes
Product * City fixed effects	Yes	Yes	Yes	Yes
Village fixed effects	Yes	Yes	Yes	Yes
No. observations	7639	4192	7590	4211
R^2	0.73	0.73	0.71	0.71

Notes: The numbers in parentheses are the robust standard errors; + significant at 10%; * significant at 5%; ** significant at 1%.

Table 4: The Effect of Transportation Costs on Wages

Dependent Variable: ln($Wage_{vt}$)				
	All towns/villages		**Villages only**	
	(1)	**(2)**	**(3)**	**(4)**
$ln(Cost)_{vt}$	0.04		0.06	
	(0.04)		(0.05)	
$ln(Time)_{vt}$		0.04		0.02
		(0.14)		(0.05)
Village fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
No. observations	10355	10257	6281	6255
R^2	0.68	0.65	0.71	0.71

Notes: The numbers in parentheses are the robust standard errors; + significant at 10%; * significant at 5%; ** significant at 1%.