# Accessibility of Labor Market, Case Study: Indonesian Cities and Bangkok, Thailand

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**Abstract**: The relationship between city size, urban transport efficiency (speed), employment proximity (distance) and accessibility of labor market is rarely examined particularly in developing countries. This paper reveals the relationship using 2 points of view (active population and company). Moreover the analysis is divided according to 3 transport modes (car, public transport and motorcycle) and takes into account the vehicle ownership rate. It employs data across 111 districts in 4 big cities of Indonesia and 50 districts in Bangkok, Thailand. As a result, speed indicator contributes positively to accessibility of labor market while distance elasticity is negative. In absolute value, elasticity of speed is higher than that of distance.

*Keywords:* Mobility, Accessibility, Active Population, Company, Indonesia, Bangkok

## 1. INTRODUCTION

The efficiency of a city is principally the efficiency of its markets: its labor market and the market for goods and services. The labor market does not only depend on the city size but also the accessibility provided by transport system. The larger the labor market, the better the fit between supply and demand for the various qualifications, the easier the mobilization of large quantities of labor, the faster the adaptation to big changes in the productive system, (Darbera, 1995). A large amount of population will create a small economic market only if there is no sufficient and efficient transport to match workers and job locations.

Indonesia, a developing country, has some agglomerations such as Jakarta, Surabaya, Medan and Semarang. Recently, this country has a big problem concerning the traffic congestion in these agglomerations. The development of highway infrastructure is slower than the growth of traffic, and there is little improvement in public transport infrastructure. Moreover, there is currently a lack of respect of land use rules. Due to this situation, the government proposes the movement of capital of Indonesia, since Jakarta cannot provide any more good transport accessibility for its inhabitants (CMEA, 2012; Prakoso, 2012).

Bangkok Metropolitan Region (BMR), Thailand, covers the large core so-called Bangkok Metropolitan Area (BMA) and five surrounding areas, namely Nonthaburi, Pathumthani, Samut Prakarn, Samut Sakorn, and Nakorn Pathom. BMR has undergone rapid

urbanization and industrialization since 1960. In this paper, Indonesian cities: Jakarta, Surabaya, Medan and Semarang as well as Bangkok Metropolitan Area are selected as the study area.

### 1.1. Objectives

The objective of this research is to show the characteristic of daily mobility and also accessibility to the labor market in 4 Indonesian cities: Jakarta, Surabaya, Medan and Semarang as well as Bangkok, Thailand. It proposes analysis of travel time budget (TTB) and travel cost budget (TCB) according to household income. In the accessibility of labor market section, the analysis is on the relationship between transport accessibility (speed indicator), city size, and commuting needs with the accessibility of labor market. The outline is ordered as follows. The next section describes the study area and the data. Section 3 shows the mobility characteristics. Section 4 presents the effective size of labor market. Section 5 is focused on the scenario. Finally Section 6 is the conclusion.

## 2. THE STUDY AREA

The study area covers 4 Indonesian cities: Jakarta, Surabaya, Semarang and Medan. The first 3 cities are located in Java Island which is the most densely populated island in Indonesia and the latter is located in Sumatera as the second densely populated island. In 2010, as from the population census, these 4 cities contribute up to 6% of 238 million Indonesian people. Regarding the economic situation, they produce 18% of the country's GDP. In 2012, 5,673,560 populations live in Bangkok Metropolitan Area and this area contributes around 30.16 % of the country's GDP. This shows that BMA is a major economic center of the country, where every economic activity can be found in various areas such as high-density business districts, high-density residential areas, heavy industrial estates, etc.

### 2.1. Data

As regards the transport data availability, this work employs the latest transportation planning project which was conducted by each local transportation office. This research used Jakarta and Semarang 2002 transportation database (Pacific Consultants International and Almec Corporation, 2002; Local transport department of Semarang, 2002) as well as Surabaya and Medan 2000 database (GTZ consultant, 2000; Insan Mandiri consultant, 2000). Active population and employment number are provided by the statistical office. Regarding Bangkok study area, transportation data is provided by extended Bangkok Urban Model (e-BUM) project. Office of Transport Planning and Policy has been developed this project since 1997. In accordance with demographic and economic growth, e-BUM project was revised in 2010.

The movement of people over the day is within an envelope, defined by 2 thresholds: the maximum share of income they have to (or want to) allocate to movement and the maximum share of daily time (Orfeuil, 2011). These thresholds will be used as constraints to calculate the effective size of labor market in this paper.

In order to find the travel time and travel cost threshold, it is important to conduct a survey. It has been achieved in 4 Indonesian cities (Jakarta, Surabaya, Medan and Semarang). The sample is up to 500 persons in each city. The survey was conducted in 2009. Local transport office in each city accompanied the surveyor during this survey.

The questions which are incorporated in this survey comprise personal information on respondent and tests of acceptance of commuting times and costs for a new job. It proposes seven values of travel time threshold from 30 up to 90 minutes with 10 minutes of steps. Equally, there were 17 travel cost thresholds from 150,000 Rupiah (Indonesian currency) up to 1 million with a range of 50,000 Rupiah. The thresholds obtained by the surveys were different from one city to others.

By comparing the threshold in each city, in general, travel time and travel cost threshold in Jakarta are the highest of all.

Table 1. Travel time and travel cost threshold – Indonesian cities
(Travel cost value 2009 are converted to 2000 and 2002)

| Income level | Threshold | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Travel time (minute) | | | | Monthly travel cost (Rupiah) | | | |
| | Jakarta (2002) | Surabaya (2000) | Medan (2000) | Semarang (2002) | Jakarta (2002) | Surabaya (2000) | Medan (2000) | Semarang (2002) |
| High | 90 | 60 | 50 | 35 | 150,000 | 130,000 | 83,000 | 85,000 |
| Middle | 90 | 60 | 50 | 40 | 100,000 | 90,000 | 70,000 | 55,000 |
| Low | 90 | 60 | 50 | 40 | 75,000 | 60,000 | 58,000 | 41,000 |
| All | 90 | 60 | 50 | 40 | 100,000 | 85,000 | 65,000 | 47,000 |

Source: Prakoso (2011)

As regards Bangkok case, the worker travel behavior survey was conducted in 2014 with 376 respondents working in 18 districts of Bangkok. Random sampling method was implemented for sampling technique. This survey gives information on the maximum travel time and travel cost which are still accepted by Bangkok workers.

Since the data (existing travel cost and its threshold) has to be related to the same year, it is needed to convert the value of travel cost threshold as in base year data (Jakarta 2002, Surabaya 2000, Medan 2002, Semarang 2002 and Bangkok 2011). The Inflation and interest rate are employed to find the travel cost threshold in base year analysis both in Indonesian cities and Bangkok. The travel time and cost thresholds for Bangkok case increase with income level.

Table 2. Travel time and travel cost threshold – Bangkok
(Travel cost value 2014 are converted to 2011)

| Income level | Threshold | | |
|---|---|---|---|
| | Travel time (minute) | Monthly travel cost (Baht = Thai currency) 2014 | Monthly travel cost (Baht) 2011 |
| High | 77 | 3,754 | 3,199 |
| Middle | 73 | 2,740 | 2,335 |
| Low | 66 | 1,621 | 1,381 |
| All | 72 | 2,704 | 2,304 |

Source: Calculation by the authors, 2014

## 3. MOBILITY CHARACTERISTIC

Initiated by Zahavi, the research of travel time budget (TTB) is a milestone in the development of mobility analysis. Zahavi (Zahavi and Ryan, 1980; Zahavi and Talvitie, 1980) employed the mobility data of several cities in the world (Europe, South America, Canada and the USA). TTB analysis has then revealed that TTB are comparable from one city to another

one, around one hour per day (all-purpose trips) and stale over the time. More recent studies, in France for example, confirm that stability (Orfeuil, 2000). This stability is also observed for the transport cost budget (TCB). TCB is around 5% of household income for a non-motorized household and 15% of household income for motorized households. TCB is examined as the average monthly travel cost that is spent by each person to make his / her trips for all purposes.

Table 3 shows the characteristic of trip in each city for all purposes. In terms of travel time, Jakarta people have a high TTB than other cities.

By comparing travel time budget (TTB) for all trip purposes in each city, the observation reveals certain regularities of average travel time, except for Semarang which is around 35 minutes. The average TTB in other cities is around 50-59 minutes. The examination of travel time according to income level shows the presence of time regularity in Jakarta, Surabaya and Semarang. In term of travel cost, in general, Jakarta inhabitants spend more money than that of other cities. The lowest travel cost is in Semarang case. Medan is distinguished by a low TTB for high income worker.

Table 3. The characteristics of travel time and travel cost
(All trip purposes)

| Income level | Average travel time/person (minute) (TTB) | | | | Monthly transport cost/ person (Rupiah) | | | |
|---|---|---|---|---|---|---|---|---|
| | Jakarta (2002) | Surabaya (2000) | Medan (2000) | Semarang (2002) | Jakarta (2002) | Surabaya (2000) | Medan (2000) | Semarang (2002) |
| High | 58 | 54 | 37 | 32 | 61,800 | 43,150 | 31,100 | 33,500 |
| Middle | 59 | 55 | 53 | 34 | 50,300 | 36,830 | 37,500 | 22,000 |
| Low | 58 | 48 | 60 | 35 | 32,250 | 22,489 | 35,500 | 18,700 |
| All | 59 | 50 | 56 | 35 | 43,300 | 28,888 | 34,800 | 19,750 |

Source: Prakoso (2011)

For all trip purposes, monthly transport cost/person is around 3-5% of household income. In the level of household, each household spends transport cost around 10-14% of monthly income.

Table 4. The weight of trip in household income
(All trip purposes)

| Household income | Transport cost per person/ monthly household income (%) | | | | Transport cost per household/ monthly household income (%) | | | |
|---|---|---|---|---|---|---|---|---|
| | Jakarta (2002) | Surabaya (2000) | Medan (2000) | Semarang (2002) | Jakarta (2002) | Surabaya (2000) | Medan (2000) | Semarang (2002) |
| High | 2.7% | 2.1% | 1.7% | 1.7% | 8.5% | 7.6% | 5.3% | 5.2% |
| Middle | 5.9% | 4.4% | 4.5% | 2.7% | 14% | 13.8% | 11.3% | 8.2% |
| Low | 6.1% | 4.7% | 6.9% | 3.7% | 17.6% | 15.62% | 13.8% | 11.4% |
| All | 5.1% | 3.9% | 5.1% | 3.3% | 13.5% | 12.64% | 11.5% | 9.9% |

Source: Prakoso (2011)

The following table reveals characteristic of travel time and cost for working purpose. The worker who lives in Jakarta spends more money and has higher travel time than in other cities. Regarding the result, there is no stability of travel time according to income level, but it has certain growth with the city size. The proportion of income which is dedicated to transport decreases with income level; it tends to rise with the city size.

Table 5. The characteristics of travel time and travel cost
(Working trip purposes)

| Worker's Income level | Average travel time (minute) (TTB) | | | | Transport cost / monthly worker's income (%) | | | |
|---|---|---|---|---|---|---|---|---|
| | Jakarta (2002) | Surabaya (2000) | Medan (2000) | Semarang (2002) | Jakarta (2002) | Surabaya (2000) | Medan (2000) | Semarang (2002) |
| High | 24 | 32 | 17 | 17 | 9% | 7% | 5% | 5% |
| Middle | 33 | 30 | 25 | 20 | 15% | 14% | 11% | 8% |
| Low | 33 | 26 | 32 | 23 | 19% | 14% | 14% | 11% |
| All | 30 | 27 | 28 | 23 | 14% | 11% | 12% | 10% |

Source: Prakoso (2011)

As a worker travel survey in Bangkok focused on the worker personal information, this table below reveals only transport cost proportion to worker's income. The low income worker has income less than 20,000 baht/month, middle income worker is between 20,000 – 40,000 baht and high income level is more than 40,000 baht/month.

Table 6. The characteristics of travel time and travel cost – Bangkok, 2014
(working trip purpose)

| Income level | Average travel time (minute) | Transport cost/monthly worker's income (%) |
|---|---|---|
| High | 58 | 7.3% |
| Middle | 45 | 10.3% |
| Low | 51 | 12.5% |
| All | 50 | 10.6% |

Source: calculation by the author

From the table above, it can be seen that low income worker has a high pressure of transport cost than other income levels. It is implicitly concluded that low income worker still needs a financial support such as subsidy to relieve a high transportation cost. The average travel time from home to job is 50 minutes for all income workers. This value is around twice as much, compared to that of Indonesian cities in the beginning of 2000.

## 4. EFFECTIVE SIZE OF LABOR MARKET

The past research on urban form and regional productivity (the influence of transport infrastructure investment on economic output) shows "how much" the infrastructure contributes to economic development but they do not deal with "how" this contribution is achieved (Prud'homme and Lee, 1999). In order to answer this question, they created a model where the productivity is a function of active population, speed indicator and the mean distance between residential area and job places. In this model, average speed is the principal variable characterizing the efficiency of transport infrastructure.

Lee (1997) conducted also a research on the impact of urban transport efficiency to the productivity of cities. In the case of South Korean cities, a 10% of growth of effective size of labor market, as a function of active population, speed indicator and distance to work, is expected to increase the productivity around 2,4% . For French cities, 10% of growth of effective size of labor market will rise it around 1,8%. Wenglenski used this methodology to calculate the effective size of the work market for different kinds of workers (from blue collar

to managers) in the Paris context. She concluded on huge differences, linked to residential location, job location and access to travel modes (Wenglenski and Orfeuil, 2004). Cervero (2001) developed a similar research on the relationship between infrastructure and productivity. In the San Francisco region, a 10% of growth of effective size of labor market is expected to increase by 0,6 – 0,8 the worker's productivity. (Prud'homme and Lee, 1999; Cervero, 2001) gives a logical approach to the relationship between urban form, transport efficiency and economic performance in urban area.

Regarding the relationship between accessibility of labor market and regional productivity, this research is in line with the work of Prud'homme (Prud'homme and Lee, 1999) as well as Cervero (2001). The productivity is a function of active population, speed indicator and the mean distance between residential area and job location. In this model, average speed is the principal variable characterizing the efficiency of transport infrastructure. Firstly, it is necessary to calculate the effective size of labor market and then make a relationship between this labor market with its independent variable such as active population, speed indicator and distance to work. Secondly, labor market size becomes independent variable and productivity (productivity per worker) is the dependent variable.

Compared to the previous work, this research does not only use travel time constraint, but also incorporate travel cost since travel cost is sensitive matter in developing countries. Another novelty is that this research produces effective size of labor market analysis based on transport mode such as car, public transport and motorcycle.

Due to the data availability (lack of gross domestic regional product data), here the analysis is only focused on the relationship between the effective size of labor market and its explanatory variable in four Indonesia cities.

A region consists of *n* traffic analysis zones (1,2,..i, j..n) which are characterized by the number of active populations *Aj* and the number of jobs *Ei*. $T_{ji}$ is travel time for commuting from origin zone *j* to destination zone *i*. For all companies in zone *i*, labor market Li(bt, bc) for a given travel time threshold bt and for a given monthly travel cost threshold bc is potentially the total active population in every zone *j* that can reach every zone *i* with a travel time lower than travel time threshold bt AND with a travel cost lower than travel cost threshold bc:

$$Li(bt, bc) = \sum_j Aj \; for \; j: Tji \leq bt \; and \; Cji \leq bc \quad (1)$$

For example, the labor market in 30 minutes and 1 US dollar for zone *i* : Li(30,1), is total active population for which travel time from all origin zones *j* to destination *i* is less than 30 minutes and travel cost less than 1 US dollar.

$L_i$(bt, bc) represents the effective size of the labor market in zone *i*. To get an effective size at the scale of the city *ME*(bt, bc), it has to weight $L_i$(bt, bc) by the proportion of jobs $E_i$ in each zone as below:

$$ME\ (bt, bc) = \sum_i \left[ Li(bt, bc) \times \frac{Ei}{\sum_i Ei} \right] \quad (2)$$

If ME(bt, bc) is an effective size of labor market from the point of view of company, it can symmetrically construct an indicator of effective size of labor market in the point of view of active population; MT (bt, bc) by changing active population as an input data with employment number.

$$Ji(bt, bc) = \sum_j Ej \; for \; j: Tij \leq bt \; and \; Cij \leq bc \quad (3)$$

where,

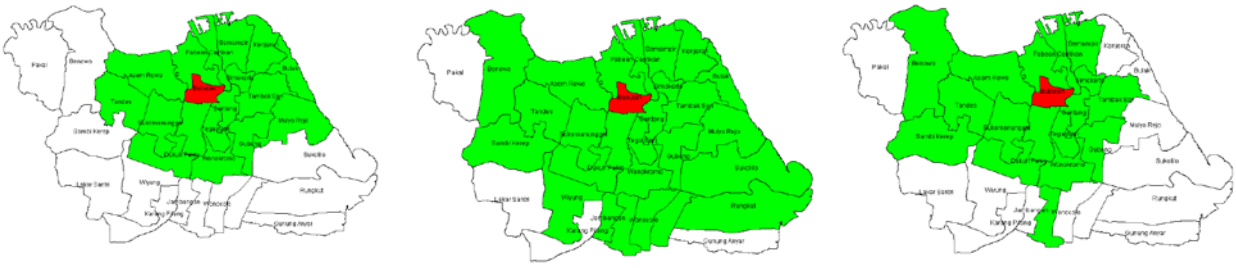
$J_i$(bt, bc) : labor market in zone *i*
Ej : total employment in every zone *j*
Tij : travel time from i to j
Cij : monthly travel cost from i to j
bt : travel time threshold
bc : monthly travel cost threshold

MT (bt, bc) : effective size of labor market in the point of view of active population can be calculated with weighting to the active population in each zone (Ai).

$$MT(bt, bc) = \sum_i \left[ Ji(bt, bc) \times \frac{Ai}{\sum_i Ai} \right] \quad (4)$$

### 4.1. Representation of the access to main zone of employment

Figure 1 below is an example of a pool of employment in Surabaya. Bubutan district (red color) is considered as destination zone. Considering the constraint for Surabaya (travel time threshold 60 minutes and travel cost threshold 85,000 Rupiah per-month); active population's travel time and travel cost by motor cycle from every zone to Bubutan district are lower than travel time and travel cost threshold. In general, the pool of labor market by motor cycle is the most significant, followed by public transport and then by car. Green color zone means that travel cost and travel time to destination zone is lower than travel cost and travel time threshold. The same threshold is adopted for each transportation mode comparison since its definition does not depend on transportation mode characteristics. It is likely to be personal assumption of the traveller. So it is clear that the pool of labor market by motor cycle is the highest as in general motorcycle travel time and cost are lower than that of other modes.



Car Motor cycle Public transport

Figure 1. Example of pool of labor market for Bubutan district, without vehicle ownership constraint

### 4.2. The effective size of labor market at the scale of the city

The calculation of effective size of labor market comprises 2 methods: by taking into account vehicle ownership and not taking into account vehicle ownership. Taking into account vehicle ownership rate means that the analysis corresponds to the existing situation. The second analysis which does not take into account the vehicle ownership rate supposes that each

person will have at least one vehicle (car or motor cycle) in relation to economic growth. It refers to a future situation.

The estimation of effective size of labor market is defined by a constraint on potential commuting trips (monthly travel cost and travel time). By combining these constraints, the analysis produces more relevant result than only uses one constraint such as travel time or travel cost. The trip of a worker is possible if one of the following conditions is accepted:

a) Public transport (PT) travel time is lower than travel time threshold and PT travel cost is lower than travel cost threshold.
b) Worker owns a motor cycle (MC) and his/her travel time is lower than travel time threshold as well as his/her travel cost lower than travel cost threshold.
c) Worker owns a car and his/her travel time is lower than travel time threshold as well as his/her travel cost lower than travel cost threshold.

The effective size of labor market may be analyzed at the level of each transport mode, and then at the level of transport system characterized by performance of 3 modes. The labor market of an employment zone *j* is all workers whose at least one transport mode giving travel time and travel cost lower than the thresholds. If an employment zone *j* is accessible by several transport modes, the maximum value among these modes is computed, to avoid double counting.

The results of effective size of labor market are presented in table 7 and 8**.** In each city, the effective size of labor market by public transport is the highest of all, Jakarta for exception. Jakarta as a capital of Indonesia is much more developed area than other cities. The activity in Jakarta produces a number of trips that is higher than the road capacity. Public transport system, dominated by bus with few dedicated lane is still in traditional system. The traffic congestion produces a poor quality of bus service, and causes a decrease in accessibility of inhabitant.

Motorcycle provides a significant accessibility complement offered by public transport; however Semarang is an exception due to the low level of vehicle ownership. The effective size of labor market by motorcycle would be more important than that of public transport if it does not take into account the vehicle ownership constraint which reflects a future situation (many people could access that vehicle).

In the three more developed cities (Semarang for exception), the effective size of the labor market is around 64 to 82% which is remarkable for a developing country. That is not only related to city size but also to an important utilization of motor cycle as a complement of public transport. These two conditions are correlated because the utilization of motorcycle does not require significant road space compared to that of car.

Effective size of labor market proportion for each transport mode in Medan compared to total employment is the highest, car for exception. Moreover, at the level of total labor market, its proportion is the highest than that of other cities, it’s nearly 82% compared to total employment.

Bangkok effective size of labor market is only analyzed without taking into account vehicle ownership since the author did not get yet car and motorcycle number in each Bangkok district. Moreover e-BUM project provides only transportation data (travel time and cost matrix) for car and motorcycle so that the calculation focused in these two transportation modes. In Bangkok, the result shows that motorcycle offers a better accessibility as its labor market size is greater than that of car.

The estimation of effective size of labor market from the point of view of active population is similar to that of company.

Table 7. Effective size of labor market in the point of view of company

| | Taking into account vehicle ownership | | | | Without taking into account vehicle ownership | | | |
|---|---|---|---|---|---|---|---|---|
| | Car | Motorcycle | Public Transport | All modes | Car | Motorcycle | Public Transport | All modes |
| Surabaya (2000) | 30,822 | 497,720 | 523,237 | 781,318 | 314,807 | 1,016,712 | 523,237 | 1,050,429 |
| % of total employment | 2.7% | 43.5% | 45.7% | 68.2% | 27.5% | 88.8% | 45.7% | 91.7% |
| Medan (2000) | 5,713 | 322,778 | 490,244 | 576,603 | 49,273 | 611,211 | 490,244 | 653,773 |
| % of total employment | 0.8% | 45.9% | 69.7% | 82% | 7% | 86.9% | 69.7% | 92.9% |
| Jakarta (2002) | 125,313 | 1,397,377 | 1,222,855 | 2,072,932 | 613,329 | 2,866,612 | 1,222,855 | 2,966,723 |
| % of total employment | 3.8% | 42.8% | 37.5% | 63.6% | 19% | 88% | 37% | 91% |
| Semarang (2002) | 2,685 | 42,434 | 212,141 | 236,160 | 96,521 | 413,489 | 212,141 | 446,187 |
| % of total employment | 0.5% | 8.5% | 42.6% | 47.4% | 19.4% | 83% | 42.6% | 89.6% |
| Bangkok (2011) | | | | | 613,303 | 3,823,211 | | |
| % of total employment | | | | | 16% | 98% | | |

Source: calculation by the author

Table 8. Effective size of labor market in point of view of active population

| | Taking into account vehicle ownership | | | | Without taking into account vehicle ownership | | | |
|---|---|---|---|---|---|---|---|---|
| | Car | Motorcycle | Public Transport | All modes | Car | Motorcycle | Public Transport | All modes |
| Surabaya (2000) | 30,913 | 497,967 | 548,208 | 808,174 | 329,831 | 1,065,234 | 548,208 | 1,100,559 |
| % of total employment | 2.7% | 43.5% | 47.9% | 70.6% | 28.8% | 93% | 47.9% | 96.1% |
| Medan (2000) | 5,695 | 322,762 | 485,565 | 572,007 | 48,803 | 605,377 | 485,565 | 647,532 |
| % of total employment | 0.8% | 45.9% | 69% | 81.3% | 6.9% | 86% | 69% | 92% |
| Jakarta (2002) | 124,965 | 1,396,991 | 1,200,368 | 2,052,678 | 602,051 | 2,813,900 | 1,200,368 | 2,912,170 |
| % of total employment | 3.8% | 42.8% | 36.8% | 62.9% | 18% | 86% | 37% | 89% |
| Semarang (2002) | 2,579 | 42,379 | 209,317 | 233,634 | 95,236 | 407,986 | 209,317 | 440,246 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| % of total employment | 0.5% | 8.5% | 42% | 46.9% | 19.1% | 81.9% | 42% | 88.4% |
| Bangkok (2011) | | | | | 607,438 | 3,824,068 | | |
| % of total employment | | | | | 15% | 98% | | |

Source: calculation by the author

### 4.3. The effective size of labor market model

This part represents several models of effective size of labor market. Each zone in each city is considered as a statistical sample. There are 111 zones: 31 Surabaya's district, 42 Jakarta's district, 21 Medan's district and 17 Semarang's district. Each of these zones can be seen (active population's point of view) as a residential zone for which it provides the number of employments, or as an employment zone (company's point of view) for which it provides the number of active populations that can reach the zone. The analysis consists in estimating by regression the relationship between the effective size of labor market viewed from each zone (Y) and three elements: total employment in each zone, average distance to work and average travel speed. Bangkok effective size of labor market model is not taken into account in this paper because there is no vehicle number data availability to create the model.

The result of Chang Woon Lee (1997) and Cervero (2001) is that the population and average travel speed have a positive influence on the effective size of labor market, but average distance between residential zone and employment location has a negative influence.

The effective size of labor market analysis in the point of view of company and active population is examined according to each transport mode and the combination of all modes. These models allow estimating elasticity to each independent variable.

There are 14 models, 7 models for the point of view of company and 7 models for the point of view of active population. This part presents models of the effective size of labor market for the point of view of active population, taking into account vehicle ownership constraint (Existing condition).

a. Model 1

The first model produces an effective size of labor market by car.
Effective size of labor market Y is estimated by taking into account a (weak) car ownership. So a potential effective size of labor market is low. Adjustment quality is not good (low $R^2$ and low significant coefficient)

Table 9. Model 1

| Independent variable | Value | t score |
|---|---|---|
| Constant | -2.10 | 0.0916 |
| X1 | 0.58 | 0.0335 |
| X2 | 2.23 | 0.0851 |
| X3 | -0.96 | 0.0126 |
| $R^2 = 0.57$ | | |

where,

Y : Ln potential effective size of labor market by car in zone *i* (taking into account car ownership)
X1 : Ln total employment of city
X2 : Ln average travel speed with car from zone *i*
X3 : Ln average distance from zone *i*

b. Model 2

In this model, effective size of labor market Y is estimated by taking into account motor cycle ownership. Even though this motor cycle ownership is not generalized, it is enough to make a good quality of estimation (good $R^2$, significant coefficient). In absolute value, elasticity (positive) of travel speed is higher than elasticity (negative) of distance from the residence to the workplace.

Table 10. Model 2

| Independent variable | Value | t score |
|---|---|---|
| Constant | -0.48 | 0.1471 |
| X1 | 0.89 | ≤ 0.0001 |
| X2 | 0.79 | 0.0002 |
| X3 | -0.51 | ≤ 0.0001 |
| $R^2 = 0.95$ | | |

where,

Y : Ln potential effective size of labor market by motor cycle in zone *i* (taking into account motor cycle ownership)
X1 : Ln total employment of city
X2 : Ln average travel speed with motor cycle from zone *i*
X3 : Ln average distance from zone *i*

c. Model 3

The third model is the effective size of labor market by public transport. Its quality is lower than previous model ($R^2 = 0.78$), but its coefficient is significant. It is probably due to an insufficient quality of the estimation of speed (effective speed depends on, in each zone, the real distances of residence and employment location to bus stops). It is supposed that a speed coefficient is, in absolute value, lower than average distance coefficient between residence and employment: public transport is less adaptable than motor cycle in more extensive urban form.

Table 11. Model 3

| Independent variable | Value | t score |
|---|---|---|
| Constant | -2.04 | 0.0245 |
| X1 | 1.14 | < 0.0001 |
| X2 | 1.04 | 0.0003 |
| X3 | -1.60 | ≤ 0.0001 |
| $R^2 = 0.78$ | | |

where,

Y : Ln potential effective size of labor market by public transport in zone *i*
X1 : Ln total employment of city
X2 : Ln average travel speed with public transport from zone *i*
X3 : Ln average distance from zone *i*

d. Model 4

Here, the effective size of labor market (Y) is the number of jobs accessible by at least one transport mode, in current vehicle ownership condition.

The first estimation does not introduce explicitly vehicle ownership rate in the list of independent variable. The global adjustment is good ($R^2 = 0.93$), two out of three coefficients are significant (total employment and distance from residence to employment), average travel speed coefficient is less important. The elasticity to total employment is higher than 1, which is a problem. On the other hand, the elasticity to average travel speed is low, that seems also surprising. In spite of its global statistic, this model does not seem to be acceptable and it needs improvement.

Table 12. Model 4

| Independent variable | Value | t score |
|---|---|---|
| Constant | -3.43 | <0.0001 |
| X1 | 1.35 | <0.0001 |
| X2 | 0.15 | 0.3795 |
| X3 | -0.97 | <0.0001 |
| $R^2 = 0.93$ | | |

where,

Y : Ln potential effective size of labor market by all transport modes in zone *i* (taking into account vehicle ownership)
X1 : Ln total employment of city
X2 : Ln average travel speed with all transport mode from zone *i*
X3 : Ln average distance from zone *i*

In order to improve the model, there is an introduction of vehicle ownership rate both car and motor cycle ownership rate as independent variable. Firstly, the explicit introduction of motor cycle ownership rate induces a growth on the elasticity to average speed, that is quite logic. It is noticed that travel speed estimation is based on traffic mode weight. On the contrary, elasticity to total employment is still higher than 1.

Table 13. Model 5

| Independent variable | Value | t score |
|---|---|---|
| Constant | -2.87 | <0.0001 |
| X1 | 1.28 | <0.0001 |
| X2 | 0.22 | 0.2005 |
| X3 | -0.92 | <0.0001 |
| X4 | 0.04 | 0.0511 |
| $R^2 = 0.93$ | | |

where,

Y : Ln potential effective size of labor market by all transport in zone *i*

(taking into account vehicle ownership)
X1 : Ln total employment of city
X2 : Ln average speed with all transport mode from zone *i*
X3 : Ln average distance from zone *i*
X4 : Ln number of motor cycles/ total active population in zone *i*

The introduction of car ownership rate in the model produces a similar result and increases slightly elasticity to average speed. In these two cases, the coefficient of vehicle ownership rate is low and less significant.

Table 14. Model 6

| Independent variable | Value | t score |
|---|---|---|
| Constant | -2.84 | <0.0001 |
| X1 | 1.30 | <0.0001 |
| X2 | 0.17 | 0.3422 |
| X3 | -0.93 | <0.0001 |
| X4 | 0.04 | 0.0764 |
| $R^2 = 0.93$ | | |

where,

Y : Ln potential effective size of labor market by all transport modes in zone *i* (taking into account vehicle ownership)
X1 : Ln total employment of city
X2 : Ln average speed with all transport modes from zone *i*
X3 : Ln average distance from zone *i*
X4 : Ln number of cars/ total active population in zone *i*

Finally, both car and motor cycle ownership rate are introduced in the model. This model does not improve the global statistic quality ($R^2 = 0.93$), however the significance of each variable is better. Moreover, the elasticity of effective size of labor market to total employment is close to the unit (1). It is noticed that motor cycle ownership rate contributes significantly and positively to the effective size of labor market. On the contrary this contribution is in the same range, but negative, for car ownership rate. In most cases, when a car is available, there are also one or more motorcycles available, inducing correlations in explanatory variables. The growth 10% of motor cycle ownership rate produces the increasing 8,4% of effective size of labor market.

This model is not perfect. However this one is the most satisfying model that can be obtained in actual condition of database. The result can be summarized as below:

- The elasticity of effective size of labor market to total employment is almost proportional in each city
- The elasticity to average travel speed is the most important and higher than absolute value (negative) of average distance between residence and employment, consistent to the work of Lee and Prud'homme for Ile-de-France

Table 15. Model 7

| Independent variable | Value | t score |
|---|---|---|
| Constant | -4.49 | <0.0001 |

| | | |
|---|---|---|
| X1 | 1.05 | <0.0001 |
| X2 | 1.32 | 0.0051 |
| X3 | -0.90 | <0.0001 |
| X4 | 0.84 | 0.0084 |
| X5 | -0.81 | 0.0122 |
| $R^2 = 0.93$ | | |

where,

Y : Ln potential effective size of labor market by all transport modes in zone *i* (taking into account vehicle ownership)
X1 : Ln total employment of city
X2 : Ln average travel speed with all transport modes from zone *i*
X3 : Ln average distance from zone *i*
X4 : Ln number of motor cycles/ total active population in zone *i*
X5 : Ln number of cars/ total active population in zone *i*

## 5. SCENARIO

Transport policy implementation has to be done in order to understand the evolution of effective size of labor market among transport mode. There are three scenarios as below:

a. An increase of 10% of the public transport speed
   By increasing 10% of public transport (PT) speed, elasticity of PT speed to labor market size varies between 0.46 – 1.03. Its elasticity for all cities is around 0.72.
b. An increase of 10% of motorcycle fleet
   When the increase 10% of motorcycle number is implemented, labor market size is smaller than that of public transport scenario.
c. An increase 10% of car fleet
   By applying scenario 3, there is no change in labor market size. It seems that travel cost and travel time by car are not competitive comparing to public transport and motorcycle.

Table 16. The influence of scenario to effective size of labor market for all transport mode

| City | labor market for all transport mode (existing) | Increasing 10% of public transport speed | | Increasing 10% of motorcycle number | | Increasing 10% of car number | |
|---|---|---|---|---|---|---|---|
| | | Labor market size | Elasticity | Labor market size | Elasticity | Labor market size | elasticity |
| Semarang | 233,634 | 257,705 | 1.03 | 235,738 | 0.09 | 233,634 | 0.00 |
| Medan | 572,007 | 598,599 | 0.46 | 580,559 | 0.15 | 572,007 | 0.00 |
| Jakarta | 2,052,678 | 2,224,526 | 0.84 | 2,135,453 | 0.40 | 2,052,678 | 0.00 |
| Surabaya | 808,174 | 849,965 | 0.52 | 832,097 | 0.30 | 808,174 | 0.00 |
| All cities | **3,666,493** | **3,930,795** | **0.72** | **3,783,847** | **0.32** | **3,666,493** | **0.00** |

Source: calculation by the author

## 6. CONCLUSION

- *In the level of all agglomerations, there is a regularity of TTB around 1 hour except for Semarang. If the analysis is in disaggregated level according to income household, this regularity of TTB is still present except for Medan.*
  In recent year, terrible traffic jam attacks Indonesian major cities and causes the decrease of average travel speed in urban area. This situation produces a significant travel behavior change notably for low and middle income level. Therefore they prefer to use motorcycle which, according to them, promises the improvement of travel speed compared to public transportation. This motorcycle becomes also preferable road transport mode since its buying condition is easy. It is necessary to review whether the significant appearance of motorcycle can maintain the TTB.
- *The effective size of labor market is quite high in Indonesian cities, but there is a problem especially in Jakarta.*
  With taking into account travel time and travel cost threshold, as well as utilization of individual transport mode in the beginning of 2000: the active population has an access around 47% (Semarang) up to 81% of labor market when it considers all transport modes, and 37% (Jakarta) as well as 69% (Medan) with public transport only. These levels of accessibility seem to be high and suppose that, for the labor market, the cities are already in a "Metropolitan" situation. This good result is without doubt related to the density of city, the concentration of employment on some zones that allows an efficiency of public transport coverage, and the important role of motor cycle. The case of Jakarta is unique, with the accessibility offered by motorcycle already higher than that offered by public transport system. It probably explains the level of congestion in the capital, and the justification of capital moving to relieve the traffic problems. It will be interesting to know, with a recent survey, whether the realization of Bus Rapid Transit (BRT) TRANS JAKARTA during 2004 modifies this observation.
- *The general evolution of effective size of labor market in Indonesia (Jakarta's case).*
  Based on data evolution from 2002 – 2010, mode choice and vehicle ownership change significantly. In Jakarta, the use of motorcycle is dominant and conversely there is a decline of public transport use (CMEA, 2012). This situation can be closely related also to its effective size of labor market. The decreasing of effective size of labor market by public transport is mainly caused by the deterioration of service quality and the increase of fare. The existence of public transport subsidy which contributes significantly to cut the high fare is one of solutions to re-attract private vehicle users.
- Since the author has still limitation on Bangkok data, the calculation of effective size of labor market with taking into account vehicle ownership should be completed in the near future. Its result will allow us to understand the existing situation of labor market in Bangkok and can be used to make a comparative study with Indonesian cities. Without taking into account vehicle ownership, motorcycle gives better accessibility in term of Bangkok size of labor market.

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