# Assessing Socioeconomic Impacts of Transport Infrastructure Projects in the Greater Mekong Subregion

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***Abstract**: This study attempts to quantify the links between infrastructure investment and poverty reduction using a multi-region general equilibrium model, supplemented with household survey data for the Greater Mekong Subregion (GMS). Infrastructure investment is an important step in economic development, with improvements in transportation infrastructure boosting economic opportunities throughout the region, for example by significantly reducing travel times and costs. In this study, we concentrate on quantifying the effects of some of the key linkages between upgraded infrastructure, economic growth and poverty reduction. We model the impact of both reducing transport costs and improving trade facilitation in the GMS region. Not surprisingly, our findings suggest strong gains to the GMS countries as a result of infrastructure development and trade facilitation. The national poverty headcount falls by between 4% and 5% in the countries examined. However, the impact on various segments of these populations is rather different depending on factor returns in agriculture. Across the board, skilled wages rise by more than unskilled wages in the region and this tends to benefit the urban households more than rural ones.*

***Keywords:** Infrastructure, Greater Mekong Subregion**,** General equilibrium and poverty*

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# 1 Introduction and background

The link between infrastructure, economic development and poverty alleviation has been well established.[2] Indeed, the Greater Mekong Subregion (GMS) has invested billions of dollars over the past 15 years to improve its infrastructure base and regional connectivity in an effort to spur growth and development. This study attempts to measure the links between infrastructure investment and poverty reduction using a multi-region general equilibrium model, supplemented with household survey data fore the GMS. Specifically, it examines how improvements in road infrastructure in conjunction with the implementation of the Cross Border Transport Infrastructure Agreement (CBTA) improved trade facilitation and household income in the GMS.

The GMS comprises Cambodia, Lao PDR, Myanmar, Thailand and Viet Nam, as well as Yunnan Province and Guangxi Zhuang Autonomous Region of the People's Republic of China (PRC). At the time of the inauguration of the GMS Economic Cooperation Program (1992), most of the region's infrastructure was of a very poor quality (Ishida, 2007). In response to this, the GMS adopted the Transport Master Plan in 1995 identified priority transport links – mostly road projects – designed to generate the greatest and most immediate improvements in connectivity. This was an important step in economic development, with improvements in transportation infrastructure boosting economic opportunities throughout the region, for example by significantly reducing travel times and costs. As the countries moved away from a strategy of self sufficiency to one of regional cooperation, major efforts have been made to develop the infrastructure linking the GMS and beyond, particularly through the identification of ambitious economic corridor projects. These infrastructure projects have been supported by a number of international agencies, including the Asian Development Bank (ADB), in the hope that they will lead to significantly improved opportunities for the region.

[2] As far back as 1994, the World Development Report focused on the link between infrastructure and Development. The Asian Development Bank's 2008 flagship study (to be released at the 2009 Annual meeting in May) is entitled Seamless Asia and discusses the relationship between infrastructure investment and development in Asia. Finally, for a review of studies on infrastructure and growth in developing countries, see Straub (2008).

Improved transportation infrastructure gives rise to complex economic interactions, with the exact casual relationship between economic growth and infrastructure investment unclear.[3] In this study, we attempt to quantify the effects of some of the key linkages between upgraded infrastructure, economic growth and poverty reduction in the GMS. We use a computable general equilibrium (CGE) framework that is particularly well-suited to this task, since it explicitly accounts for all sectors within an economy, as well as the interactions between them and with other economies. This framework provides a mechanism through which the costs and benefits of improved infrastructure may be traced through impacts on markets to impacts on different household groups, including the implications for poverty alleviation.

We begin by briefly describing the nature of the economies and infrastructure issues in the GMS. We then introduce the global trade model and databases that are used to generate insights into some of the likely impacts of infrastructure development on GMS countries. This is followed by a discussion of the scenarios considered and the results with a particular focus on medium-run and poverty impacts. We briefly discuss some potential negative impacts of infrastructure development before making some concluding remarks.

# 2 Infrastructure and development in the GMS

Almost 320 million people live in the GMS region which bridges South, Southeast and East Asia. While "the Mekong region has the potential to be one of the world's fastest growing areas",[4] economic development continues to elude some member countries and alleviating poverty remains a significant challenge. As stated above, infrastructure development has been shown to be an important mechanism to facilitate growth and development. With this in mind, the GMS has actively pursued an agenda of comprehensive infrastructure improvement.

[3] See Francois and Manchin (2007) for a discussion of the linkages between trade, infrastructure and growth.
[4] See www.adb.org/GMS/about.asp

Table 1 presents summary data for the GMS. Populations range from under 6 million people in Lao PDR to over 90 million in the combined Yunnan/Guanxi region of PRC. Likewise the economies range widely in size, with the value of GDP in Lao PDR around US$3.4 billion while Thailand's GDP is approximately 60 times as large, at over US$206 billion. GNI/GDP per capita ranges from US$500 or under in Cambodia, Lao PDR and Myanmar, to over US$3,000 in Thailand. While there is variation across the GMS, overall it remains a relatively poor region, as shown by the poverty estimates in Table 1.[5]

**Table 1 Selected aggregate indicators for the GMS and PRC, 2006**

| | Population (m) | GDP (US$b) | GNI per capita (USD) | GNI per capita, PPP (US$m) | Poverty[a] | Agriculture (% GDP) |
|---|---|---|---|---|---|---|
| Cambodia | 14.2 | 7.3 | 490 | 1,550 | 35.9 | 30.1 |
| Lao PDR | 5.8 | 3.4 | 500 | 1,740 | 38.6 | 42.0 |
| Myanmar | 48.4 | .. | 281[b] | 838[c] | .. | 48.4 |
| Thailand | 63.4 | 206.3 | 3,050 | 7,440 | 13.1 | 10.7 |
| Viet Nam | 84.1 | 61.0 | 700 | 2,310 | 28.9 | 20.4 |
| PRC: Total | 1,311.8 | 2,644.7 | 2,000 | 4,660 | 4.6 | 11.7 |
| PRC: GMS[e] | 92.3 | 75.4 | 702 | | | |

Source: World Bank (2008), except:
[a] Defined as the percentage of population living below the national poverty line, 2007 (UNESCAP, 2008).
[b] ADB (2008).
[c] Data for GDP per capita PPP, 2005.
[d] Yunnan and Guanxi: Population 2003, GDP 2004, GDP per capita, 2005 (Akrasanee, 2006).

As economies develop, they generally experience a structural shift away from a relative dependence on the agricultural sector and a movement into higher-valued areas of production. This shift can be observed in many of the GMS economies. For example agriculture contributed approximately 39% of Viet Nam's GDP in 1990 but this had fallen to around 20% by 2006 (World Bank, 2008). Despite this, GMS economies continue to rely relatively heavily on the agriculture sector, particularly the lower-income countries, where the contribution of agriculture to the economy is much greater - almost 50% of GDP in the case of Myanmar (final column of Table 1). While the contribution of agriculture to output in the economy tends to decline overtime, this does not undermine the importance of the agricultural sector for economic development. Binswanger and Lutz (2000) argue that because almost all nonfarm activities in rural areas are linked to

[5] We note that the national poverty line for the PRC is set at a relatively low level.

agriculture, growth in agricultural demand is a necessary condition for rural growth, they suggest that rural regions cannot achieve sustained growth in agricultural demand unless they trade. Thus, improved transportation infrastructure allowing rural regions to access export markets, can make an important contribution to agricultural trade and rural poverty reduction. Many agricultural products are produced by poor rural farmers, who need access to roads in order to market their products effectively, particularly as products may deteriorate during extended transportation processes.

Poverty is multi-dimensional, with a range of different measures available.[6] However, regardless of the measure used it remains predominantly a rural problem for most poor countries, including in the GMS. Worldwide, over two thirds of the poor in developing countries live in rural areas, where poverty tends to be more acute in terms of income and nutritional status than in urban areas (e.g. Binswanger and Lutz 2000). The predominantly rural nature of poverty in the GMS is striking (Strutt and Lim, 2005). Table 2 shows that for each GMS country, the rural population is more than 58% of the total population, with rural dwellers comprising almost 80% of the population in Cambodia and Lao PDR. Given the importance of rural communities, a range of studies suggest that rural road investments are likely to bring particularly strong benefits for economic growth and poverty reduction (Jones 2006; Straub et al., 2008). Connecting economic activities to the logistical hubs of the urban area is an important development issue.

In terms of population density and land area, Table 2 indicates significant variation among GMS countries, with land area ranging from under 180 million $km^2$ in the case of Cambodia to over 650 million $km^2$ for Myanmar. Population density ranges from 25 people per square kilometre in Lao PDR to over ten times this density in Viet Nam, at 271 people per square kilometre. It is notable from Table 2 that the poorest countries of Cambodia, Lao PDR and Myanmar all have particularly limited road networks, with less than 15% of roads paved. These are also countries with relatively low population densities and limited resources to provide rural populations with access to markets and the accompanying opportunities.

[6] For an overview, see Chapter 3 of McCulloch et al. (2001).

**Table 2 Selected geographic, population and infrastructure indicators for the GMS, 2006**

| | Land area (mil km$^2$) | Population density (per km$^2$) | Rural Pop (% tot) | Roads (mil km)[a] | Paved roads (% tot)[a] | Rail lines (mil km)[a] |
|---|---|---|---|---|---|---|
| Cambodia | 176.52 | 80.4 | 79.7 | 38.3 | 6.3 | 0.7 |
| Lao PDR | 230.80 | 25.0 | 79.0 | 31.2 | 14.4 | .. |
| Myanmar | 657.55 | 73.6 | 68.7 | 28.0 | 11.4 | .. |
| Thailand | 510.89 | 124.2 | 67.4 | 57.4 | 98.5 | 4.0 |
| Viet Nam | 310.07 | 271.3 | 73.1 | 222.2 | 25.1 | 2.7 |
| PRC | 9,327.49 | 140.6 | 58.7 | 1,930.5 | 81.6 | 62.2 |
| GMS[b] | 630.80 | 150.4 | | | | |

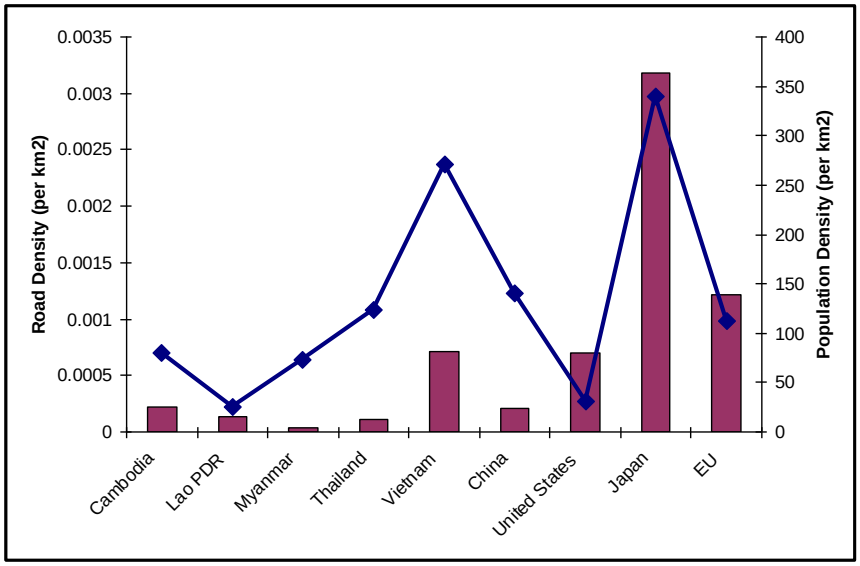
Source: World Bank, 2008

[a] PRC 2005; Cambodia 2004; Lao PDR 2003; Viet Nam Roads and Rail lines 2004, paved roads 1998

[b] Yunnan and Guanxi, source UNESCAP (2008), average population density calculated from 2000 data.

Looking more specifically at land area and road coverage, the kilometers of road per square kilometer of land can be calculated as an indication of road density. For comparison, we present road density along with population density and include the US, Japan and the EU. Results are shown in Figure 1, with the bars referring to road density and the line to population density. As the figure indicates, the population density for all GMS countries is well above road density (the exception being Lao PDR). While the United States and Viet Nam have very similar road density figures (roughly 0.0007 kilometer of road for every square kilometer of land), their population densities are very different (271 for Viet Nam and 31 for the US). If one assumes that the developed regions shown have a roughly appropriate level of road networks, the substantial differences between the level of service in the GMS countries and the US, Japan and the EU provide some indication of the great need to expand transport networks within the GMS.

**Figure 1 Road vs. population density**




Source: Table 2 above and authors' calculations. (Bars refer to road density)

# 3 Modelling framework and databases

The current study aims to provide estimates of the impact of improvements in road transport infrastructure and the accompanying improvements in trade facilitation in the GMS. Economic modelling of transportation infrastructure improvements is undertaken using the Global Trade Analysis Project (GTAP) model. We begin with the GTAP version 7 data base (Narayanan and Walmsley 2008) and utilize this with a modified version of the standard GTAP model (Hertel, 2009). The multi-regional CGE model and database used in this study are widely used internationally, fully documented and publicly available.[7] We augment this model and database to facilitate improved modelling of the GMS, including impacts on poverty.

## *3.1 The GTAP model*

The GTAP model draws on a set of economic accounts for each country/region, with interactions between regions and sectors captured within a consistent framework. The model we use is comparative, static and retains many standard features of the GTAP

[7] See www.gtap.agecon.purdue.edu for detailed information.

model (Hertel, 1997). The behaviour of private individuals, firms and governments, along with responses to changing resource and market conditions scale is modelled. Consumers maximize welfare, subject to their budget limitations, while firms maximize profits using the limited resources available in the economy. In particular, primary factors of production are combined with intermediate inputs, including imports, to produce final output. Armington elasticities allow differentiation between imports from different countries in the GMS and elsewhere, specifying the extent to which substitution is possible between imports from various sources, as well as substitution between imports and domestic production. When the impact of improved infrastructure and trade facilitation improvement is simulated, prices and quantities of marketed commodities, along with impacts on incomes and GDP are endogenously determined within the model.[8] While retaining the simple yet empirically robust assumptions of constant returns to scale and perfect competition, Section 3.3 below describes how we modify the model to shed new light on the distributional consequences of cross-border transport infrastructure projects.

## *3.2 The GTAP database*

We use version 7 of the GTAP database,[9] covering 113 countries or regions and 57 sectors, with a base year of 2004. This release of the GTAP database includes all of the GMS countries: Cambodia, Lao PDR, Myanmar, Thailand and Viet Nam. While PRC is available, Yunnan Province and Guangxi Zhuang Autonomous Region are not separated; therefore we include the PRC in the modeling analysis. We aggregate the database in a way that maintains coverage of all GMS countries with relatively heavy disaggregation of sectors of key importance to the region and to poverty impacts. Details of the regional and commodity aggregation are in Appendix Tables A1 and A2.

The level of trade between GMS economies varies a great deal, depending on the countries and commodities under consideration. Table A3 in the Appendix shows the value of intra-GMS trade, as estimated in the version 7 GTAP database. The country

[8] The model is solved using GEMPACK software (Harrison and Pearson 1996), using the RunGTAP interface.
[9] Candidate 2, released October 2008.

with the highest level of intra-GMS exports in the database is Myanmar, with over 40% of total exports going to other GMS countries. Lao PDR sends over 28% of its exports to the GMS, though trade with Thailand dominates for both Myanmar and Lao PDR. For Thailand and Viet Nam, 12-15% of exports are destined for GMS countries; however, exports to PRC dominate. Excluding exports to PRC, intra-GMS exports are only a little over 3% for Thailand and Viet Nam. Exports from Cambodia to other GMS countries, including PRC, are relatively low at 5.3%. As indicated in Table A3, in addition to variation by country, there is substantial variation by industry.

Of particular relevance to the current study are the international transportation margins included in the GTAP model and database. Margins are included in the database for air, water and other transportation, with the latter including land transportation and therefore of key importance to our study. Table A4 of the Appendix shows the cost of bilateral GMS land transport margins as a proportion of the value of exports, calculated from the GTAP database. Cross-border land transport costs are likely to be relatively significant for poorer economies with less-developed infrastructure. This appears to be reflected to some extent in the database, with cross-border land transport margins appearing most significant for the relatively poor countries of Cambodia, Lao PDR and Myanmar.[10]

## *3.3 Analysis of poverty impacts*

A general equilibrium approach is needed to predict changes in real earnings stemming from infrastructure improvements in the GMS region. Transport infrastructure improvements will not have uniform impacts on poverty across the GMS and we use household survey data to augment the GTAP database so that the implications of infrastructure development for poverty may also be considered for Cambodia, Lao PDR, Thailand and Viet Nam.[11]

[10] In the absence of available actual transportation cost data to produce a complete set of bilateral margins for the GTAP dataset, these transport margins are estimates (Gehlhar and McDougall, 2006).
[11] Poverty assessments for Myanmar and the GMS regions of PRC are not possible with current data availability.

### 3.3.1 Analytical framework

There are many alternative approaches to estimating the change in poverty headcount due to trade reforms (Winters et al., 2004; Hertel and Reimer, 2005; Hertel and Winters, 2006). The approach here builds on those outlined in Hertel et al. (2009), and begins with a consumer demand system and the associated utility function. The *poverty level of utility* is identified based on international poverty levels (using the World Bank's $1/day and $2/day poverty lines).[12] Evaluation of poverty changes thus amounts to calculating the percentage of the population below this poverty level of utility.

We make use of Rimmer and Powell's (1996) AIDADS demand system to represent consumption in the neighbourhood of the poverty line. AIDADS is particularly useful for poverty analysis as it devotes two-thirds of its parameters to consumption behaviour in the neighbourhood of the poverty line (Cranfield et al., 2006). Estimation of this demand system is undertaken using the per capita consumption data set offered by GTAP version 7, with the demand system estimates then calibrated to reproduce base year per capita demands in each country.[13] From there, per capita income is shocked back to the international poverty line in order to identify the poverty level of utility and to estimate consumption quantities at the poverty line.

A key finding in the work of Hertel et al. (2004) is the importance of stratifying households by primary source of income. For example, farm households in developing countries may rely on the farm enterprise for virtually all of their income. And national poverty tends to be concentrated in agriculture-specialized households in the poorest countries in our sample. In these cases, the poor are more likely to benefit from farm price increases. In other countries, the national poverty headcount is dominated by wage earners who will be more susceptible to food price rises. To delineate the patterns of earnings specialization we follow Hertel et al. (2004) in identifying five household groups that rely almost exclusively (95% or more) on one source of income: agricultural self employment, non-agricultural self-employment, rural wage labour, urban wage labour, or

[12] The World Bank has recently released a new measure of poverty based on purchasing power parity and $1.25/day. This poverty line falls between our $1 and $2 measures. For more details on these changes see:
http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/0,,contentMDK:21882162~pagePK:64165401~piPK:64165026~theSitePK:469382,00.html

[13] These were estimated using a pre-release of the database with 96 countries available.

transfer payments. The remaining households are grouped into rural and urban diversified strata, giving seven strata.[14]

Given our interest in comparing results across countries, we take a simplified approach to poverty analysis, focusing solely on the poverty headcount – at both the $1 and $2/day levels. We do so by employing a survey-based *highly disaggregated* poverty elasticity based analysis. In particular, we adopt from Hertel et al. (2009), the following equation for predicting the percentage change in poverty headcount, $\hat{H}_r$, in each of the GMS countries for which household survey data are available:

$$\hat{H}_r = -\sum_s \beta_{rs}\varepsilon_{rs}\sum_j \alpha_{rsj}^p \left(\hat{W}_{rj} - \hat{C}_r^p\right) \qquad (1)$$

The term in parentheses on the right hand side of (1) reports the change in the after tax wage rate for endowment *j* in region *r,* $\hat{W}_{rj}^m$, relative to the change in the cost of living at the poverty line, $\hat{C}_r^p$. This real earnings term is pre-multiplied by several important parameters which deserve additional discussion. The first of these is the share of earnings type *j* in total income of households in the neighbourhood of the poverty line *in stratum s of region r,* $\alpha_{rsj}^p$. This translates a change in, for example, the wage of unskilled labor, into a change in total household income. If wages rise by 10% and this is 95% of household income for households in the neighbourhood of the poverty line in the rural wage earner stratum, then income is predicted to rise by 0.95 * 10% = 9.5%. By definition, the earnings shares sum to one: $\sum_j \alpha_{rsj} = 1$ and summing over the share-weighted change in factor returns yields the total income change for households in the neighbourhood of the poverty line for a given stratum/region combination.

This change in income is, in turn, multiplied by the estimated elasticity of the stratum-specific poverty headcount with respect to income, $\varepsilon_{rs}$. In order to turn these stratum

[14] A clear limitation of this approach stems from the rigidity of a given households' classification by earnings specialization. Some households maybe induced to change their specialization or diversify in response to changing relative factor returns. We believe that the relatively broad definition of strata circumvents this problem for the majority of households in the face of modest earnings changes.

changes into the estimated percentage change in national poverty headcount, they must be weighted by each stratum's share in national poverty:

$$\beta_{rs} = \left[ \left( POP_{rs} * H_{rs} \right) / POP_r \right] / H_r = \left( POP_{rs} * H_{rs} \right) / \sum_k \left( POP_{rk} * H_{rk} \right)$$

Summing across strata, we obtain the national poverty headcount reported in (1).

### 3.3.2 Integrating poverty into the model

To model poverty impacts within the GTAP framework, we introduce factor market segmentation which is important in countries where the rural sector remains a dominant source of poverty (Keeney and Hertel, 2005). Here, farm/non-farm mobility is restricted by specifying a constant elasticity of transformation (CET) function which limits the mobility of labour and capital between the farm and non-farm sectors. Therefore farm and non-farm factor returns may diverge, and this becomes a key driver for our distributional analysis. In order to parameterize these CET factor mobility functions we draw on the OECD's (2001) survey of agricultural factor markets. We assume a constant aggregate level of land, labour, and capital employment, reflecting the belief that the aggregate supply of factors is not overly affected by these transport projects, especially in the medium run.

Implementation of (1) requires us to map factor earnings in the general equilibrium model to household income sources. Agricultural labour and capital receive the corresponding farm factor returns from the general equilibrium model, as do non-agricultural labour and capital. Wage labour for diversified households reported in the surveys presents a problem because information is lacking to allocate it between agricultural vs. non-agricultural activities. We simply assign to it the composite wage for labour determined by the CET endowment function. Finally, transfer payments are indexed by the growth rate in net national income.

### 3.3.3 Data and elasticities

While conceptually simple, this approach to poverty analysis is actually quite data intensive. The household surveys for Lao PDR and Cambodia were processed (Komoto,

2009), and this, coupled with previously processed estimates for Viet Nam and Thailand (Hertel et al., 2004), permitted this approach to be implemented for these four countries in the GMS region.

Table 3 reports the estimated earnings shares in the neighbourhood of the $1/day poverty line in the four countries, $\alpha_{rsj}^{p}$ . Endowments are disaggregated into ten categories, including: agricultural land, self-employed agricultural labour (both unskilled and skilled), self-employed non-agricultural labour (both unskilled and skilled), wage labour (both unskilled and skilled), agricultural capital, non-agricultural capital, and transfer payments. The most difficult part of estimating these earnings shares derives from the need to impute returns to factors of production when the source of income is self-employment. This is achieved matching self-employed household members with similar wage-earning individuals in the household survey and assigning the average earned wage for this class of workers (ideally, same sex and age, same skill level, same sector, same region). The residual earnings are assigned to capital in the case of non-agricultural income and shared between capital and land in the case of farming.[15]

**Table 3 Household earnings shares, by endowment-type, stratum and country: $1/day (%)**

| Cambodia | Agriculture | Non-agriculture | Urban labor | Rural labor | Transfers | Urban diversified | Rural diversified |
|---|---|---|---|---|---|---|---|
| Land | 16.0 | 1.8 | 1.0 | 1.2 | 2.2 | 4.4 | 5.1 |
| Ag. unskilled labor | 72.5 | 0.0 | 0.0 | 0.0 | 0.0 | 19.1 | 26.7 |
| Ag. skilled labor | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Non-agr. unskilled | 3.5 | 84.6 | 0.0 | 0.0 | 0.0 | 19.5 | 19.3 |
| Non-ag. skilled | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.6 | 4.8 |
| Wage labor unskilled | 3.3 | 0.0 | 46.4 | 50.3 | 0.0 | 20.2 | 17.2 |
| Wage labor skilled | 0.0 | 0.0 | 51.5 | 45.9 | 0.0 | 17.6 | 18.2 |
| Agricultural Capital | 2.2 | 0.2 | 0.1 | 0.2 | 0.3 | 0.6 | 0.7 |
| Non-ag. capital | 1.3 | 11.7 | 0.0 | 1.0 | 0.0 | 3.9 | 3.0 |
| Transfers | 1.2 | 1.7 | 0.9 | 1.4 | 97.5 | 8.0 | 5.0 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Lao PDR | Agriculture | Non-agriculture | Urban labor | Rural labor | Transfers | Urban diversified | Rural diversified |
| Land | 9.4 | 0.0 | 0.0 | 0.0 | 0.1 | 2.4 | 3.6 |

[15] To split non-wage income between capital and land, we use the factor payment shares from the GTAP data base, which are based on econometric studies of cost shares in agriculture.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Ag. unskilled labor | 57.8 | 1.0 | 0.0 | 0.0 | 0.0 | 15.8 | 21.0 |
| Ag. skilled labor | 23.1 | 0.0 | 0.0 | 0.0 | 0.0 | 9.4 | 11.5 |
| Non-agr. unskilled | 1.6 | 31.8 | 0.0 | 0.0 | 0.0 | 15.6 | 14.2 |
| Non-ag. skilled | 0.0 | 33.0 | 0.0 | 0.0 | 0.0 | 14.5 | 11.0 |
| Wage labor unskilled | 1.9 | 1.8 | 50.7 | 39.4 | 0.0 | 12.5 | 9.0 |
| Wage labor skilled | 2.0 | 0.0 | 49.3 | 60.6 | 0.0 | 14.5 | 13.8 |
| Agricultural Capital | 1.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.5 |
| Non-ag. capital | 1.8 | 32.4 | 0.0 | 0.0 | 0.0 | 8.4 | 9.6 |
| Transfers | 1.1 | 0.0 | 0.0 | 0.0 | 99.9 | 6.7 | 5.9 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Thailand | Agriculture | Non-agriculture | Urban labor | Rural labor | Transfers | Urban diversified | Rural diversified |
| Land | 8.2 | 0.0 | 0.1 | 0.0 | 0.1 | 1.9 | 4.1 |
| Ag. unskilled labor | 79.6 | 0.0 | 0.1 | 0.1 | 0.1 | 24.0 | 20.8 |
| Ag. skilled labor | 7.4 | 0.0 | 0.0 | 0.0 | 0.0 | 4.1 | 2.6 |
| Non-agr. unskilled | 0.0 | 90.8 | 0.0 | 0.0 | 0.0 | 3.8 | 3.1 |
| Non-ag. skilled | 0.0 | 6.2 | 0.0 | 0.0 | 0.0 | 0.4 | 0.7 |
| Wage labor unskilled | 0.3 | 0.4 | 98.0 | 97.8 | 0.7 | 28.1 | 23.6 |
| Wage labor skilled | 0.1 | 0.1 | 1.5 | 1.5 | 0.1 | 5.2 | 7.1 |
| Agricultural Capital | 4.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.9 | 2.0 |
| Non-ag. capital | 0.0 | 2.3 | 0.0 | 0.0 | 0.0 | 1.3 | 1.5 |
| Transfers | 0.5 | 0.2 | 0.3 | 0.5 | 98.9 | 30.5 | 34.6 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Viet Nam | Agriculture | Non-agriculture | Urban labor | Rural labor | Transfers | Urban diversified | Rural diversified |
| Land | 3.1 | 0.0 | 0.0 | 0.0 | 0.0 | 3.8 | 1.0 |
| Ag. unskilled labor | 95.6 | 0.2 | 0.0 | 0.0 | 0.0 | 43.1 | 8.6 |
| Ag. skilled labor | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Non-agr. unskilled | 0.0 | 57.9 | 0.0 | 0.8 | 0.0 | 11.3 | 13.7 |
| Non-ag. skilled | 0.0 | 0.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Wage labor unskilled | 0.0 | 0.0 | 98.7 | 78.8 | 0.0 | 1.9 | 0.0 |
| Wage labor skilled | 0.0 | 0.0 | 0.0 | 18.3 | 0.0 | 0.0 | 0.0 |
| Agricultural Capital | 1.4 | 0.0 | 0.0 | 0.0 | 0.0 | 1.7 | 0.4 |
| Non-ag. capital | 0.0 | 39.9 | 1.0 | 1.6 | 0.0 | 24.2 | 55.2 |
| Transfers | 0.0 | 1.1 | 0.3 | 0.5 | 100.0 | 14.0 | 21.0 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

From the entries in Table 3, we can see a number of important points. Firstly, in the case of the agricultural stratum, in which households earn more than 95% of their income from agricultural self-employment, the bulk of their income is imputed unskilled labor income. The poor are poor, in part because they don't control a lot of productive assets. Returns to land and capital are most important in Cambodia, with very little residual remaining

after wage imputation in Viet Nam. Non-agricultural, self-employed households (column 2) in the neighbourhood of the poverty line, in the GMS region appear to get more of their income from non-labour income. This is particularly true in Viet Nam, where this figure reaches 40%.

Turning to the wage labour households (columns 3 and 4), we see that the share of income coming from skilled labour is relatively high, particularly for Cambodia and Lao PDR, the poorest of the four economies. This is perhaps not surprising, as increased education and training is often required in order to access the formal labour market. The rural and urban diversified households are just that – highly diversified. This diversification is further accentuated by the fact that we have created this earnings profile by taking all households within +/-5% (i.e. 10% of the total stratum population) of the poverty line in each stratum. This diversified group earns income from agricultural activities, as well as non-farm activities, it receives transfer payments (quite significant in the case of Thailand) and also receives income from capital (particularly in the case of Viet Nam).

As we have seen from equation (1), the earnings shares translate wage changes into income changes, but it is the poverty elasticities, $\varepsilon_{rs}$, that translate the latter into poverty changes, by stratum. Table 4 reports these stratum-specific poverty elasticities for the 4 focus countries in this study. These are so-called 'arc elasticities', obtained by examining the change in income as we move across the stratum deciles surrounding the poverty line. As these are expressed in elasticity form, we expect these elasticities to diminish as the total poverty headcount in the stratum rises (i.e., it is harder to reduce poverty by 1% when it represents 28% of the population, as in Lao PDR, as opposed to less than 2% in Thailand). Accordingly, in Cambodia and Lao PDR, the poverty elasticities are under 1.0 in all cases, while it is above 2.0 for all strata in Thailand ($1/day poverty line) and is nearly 9 in the rural labor stratum of Viet Nam, where there are many households clustered around the poverty line, and the poverty headcount is relatively low (see below). For the same reason, the poverty elasticity tends to diminish as we move from $1/day to $2/day – there are simply more households below the poverty line.

**Table 4 Poverty elasticity, by stratum and region**

| $1/day Stratum | Cambodia | Lao PDR | Thailand | Viet Nam |
|---|---|---|---|---|
| Agriculture | 0.64 | 0.58 | 2.30 | 0.48 |
| Non-Agriculture | 0.71 | 0.46 | 2.42 | 1.12 |
| Urban Labor | 0.62 | 0.59 | 2.98 | 2.81 |
| Rural Labor | 0.54 | 0.62 | 2.45 | 8.98 |
| Transfers | 0.33 | 0.18 | 2.78 | 0.84 |
| Urban Diversified | 0.68 | 0.70 | 2.42 | 0.86 |
| Rural Diversified | 0.65 | 0.72 | 2.60 | 1.01 |
| $2/day Stratum | Cambodia | Lao PDR | Thailand | Viet Nam |
| Agriculture | 0.42 | 0.44 | 1.07 | 0.47 |
| Non-Agriculture | 0.57 | 0.43 | 2.32 | 0.73 |
| Urban Labor | 0.48 | 0.52 | 2.83 | 5.81 |
| Rural Labor | 0.45 | 0.34 | 1.69 | 2.35 |
| Transfers | 0.21 | 0.14 | 0.63 | 0.14 |
| Urban Diversified | 0.55 | 0.54 | 1.47 | 1.26 |
| Rural Diversified | 0.49 | 0.55 | 1.01 | 0.77 |

Table 5 reports the share of national poverty in each of these strata, $\beta_{rs}$. From this table we see that poverty is predominantly a rural phenomenon, with the bulk of the poor concentrated either in the agricultural specialized (Lao PDR) or the rural diversified stratum (Thailand) or both (Cambodia and Viet Nam).

**Table 5 Share of national poverty by stratum (%)**

| $1/day Stratum | Cambodia | Lao PDR | Thailand | Viet Nam |
|---|---|---|---|---|
| Agriculture | 39.3 | 77.0 | 6.3 | 38.9 |
| Non-Agriculture | 3.2 | 4.0 | 1.9 | 1.1 |
| Urban Labor | 2.0 | 1.3 | 0.4 | 1.1 |
| Rural Labor | 2.1 | 0.3 | 5.6 | 1.1 |
| Transfers | 1.1 | 0.8 | 11.4 | 10.0 |
| Urban Diversified | 6.3 | 5.4 | 6.6 | 3.3 |
| Rural Diversified | 46.1 | 11.2 | 67.8 | 44.4 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 |
| $2/day Stratum | Cambodia | Lao PDR | Thailand | Viet Nam |
| Agriculture | 32.0 | 69.3 | 7.0 | 24.5 |
| Non-Agriculture | 5.1 | 3.2 | 3.5 | 1.4 |
| Urban Labor | 1.9 | 1.6 | 1.8 | 1.2 |
| Rural Labor | 1.9 | 0.3 | 9.5 | 1.2 |
| Transfers | 0.6 | 0.3 | 8.3 | 2.7 |
| Urban Diversified | 8.8 | 7.3 | 8.8 | 9.8 |
| Rural Diversified | 49.8 | 18.0 | 61.0 | 59.3 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 |

Finally, Table 6 reports the average expenditure share, at producer prices, on the 10 broad commodity aggregates in our consumer demand system, at the two poverty lines ($1/day and $2/day). Food clearly dominates the budgets of the poorest ($1/day) households in all four countries – but particularly for Cambodia and Lao PDR. Therefore the cost of living at the $1/day poverty line will be very sensitive to the price of foodstuffs.

By the time income rises to the $2/day level, the share of crop products in total expenditure has declined by nearly half in Cambodia and Viet Nam, while at the same time, the share of total expenditure devoted to manufactures and services, including housing and education, rises sharply.

**Table 6 Average budget share at the poverty line**

| $1/day Category | Cambodia | Lao PDR | Thailand | Viet Nam |
|---|---|---|---|---|
| Crops | 45.7 | 40.2 | 28.7 | 31.4 |
| Meat & fish | 2.3 | 3.9 | 3.7 | 7.7 |
| Other foods | 28.5 | 31.5 | 19.6 | 22.9 |
| Textiles & apparels | 5.0 | 3.0 | 8.4 | 7.6 |
| Utilities | 0.5 | 1.5 | 2.2 | 3.6 |
| Wholesale & retail trade | 2.6 | 3.2 | 7.1 | 1.3 |
| Manufactures | 8.4 | 4.8 | 11.5 | 12.7 |
| Transport & communication | 1.3 | 4.0 | 10.0 | 3.3 |
| Business services | 0.6 | 0.2 | 1.0 | 2.5 |
| Housing & education | 5.1 | 7.7 | 7.9 | 7.0 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 |
| $2/day Category | Cambodia | Lao PDR | Thailand | Viet Nam |
| Crops | 23.1 | 33.0 | 17.1 | 16.6 |
| Meat & fish | 9.4 | 5.5 | 5.3 | 12.8 |
| Other foods | 22.4 | 32.6 | 14.4 | 16.9 |
| Textiles & apparels | 5.8 | 2.5 | 10.0 | 9.2 |
| Utilities | 2.0 | 2.1 | 3.1 | 6.0 |
| Wholesale & retail trade | 6.1 | 4.1 | 9.8 | 1.1 |
| Manufactures | 11.4 | 4.0 | 13.8 | 16.9 |
| Transport & communication | 5.3 | 5.8 | 14.2 | 5.5 |
| Business services | 1.1 | 0.1 | 1.6 | 4.6 |
| Housing & education | 13.5 | 10.3 | 10.7 | 10.3 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 |

With this information in hand, we can evaluate the impact of land transport infrastructure projects in the GMS region on poverty.

# 4 Modelling improved GMS infrastructure and trade facilitation

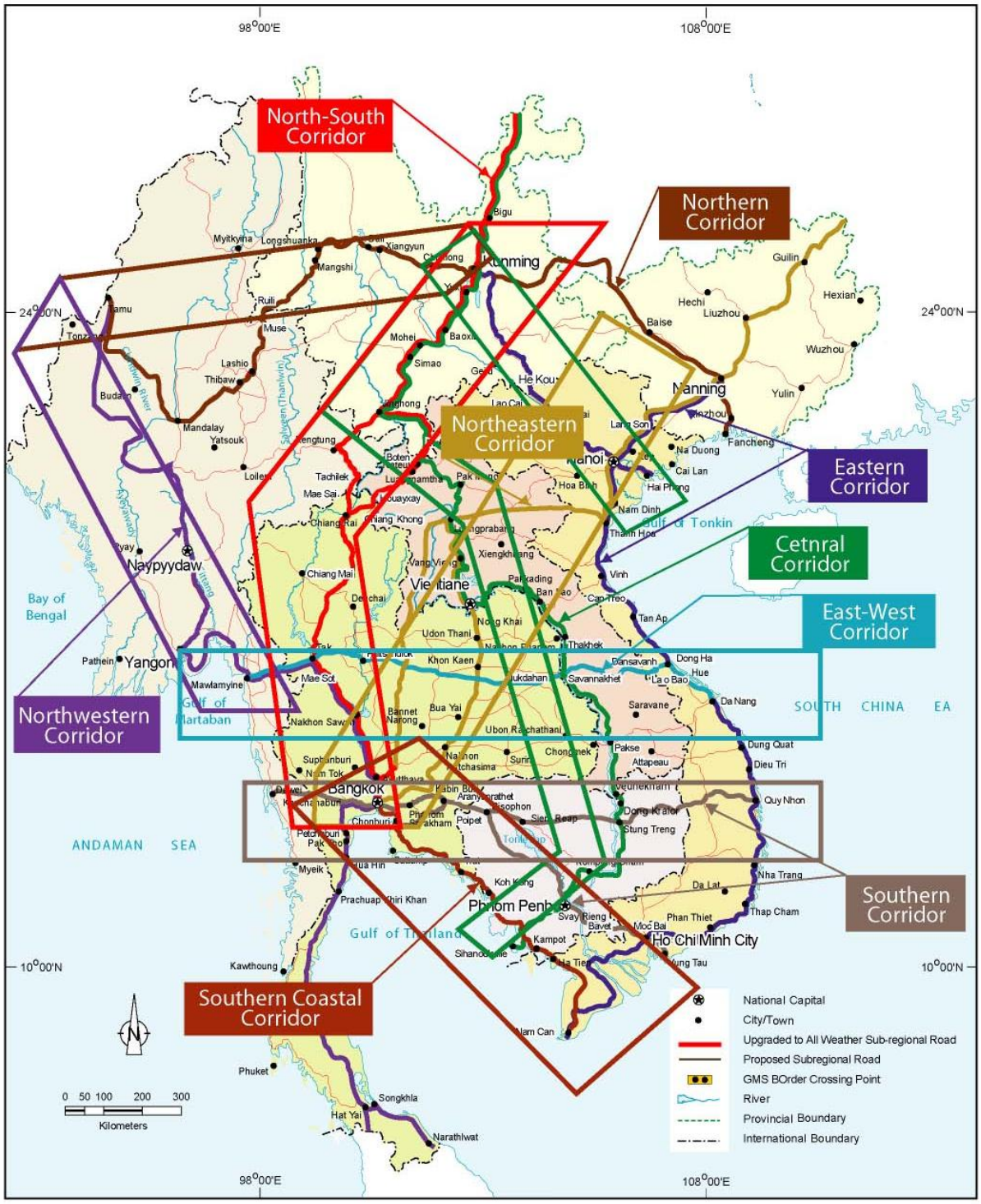
This study aims to provide insights into the impacts of infrastructure improvements on the poor in the GMS. Inadequate infrastructure can be a significant cost factor in economic activity. As shown by Henderson, Shalizi and Venables (2001) transport costs in many developing regions of the world are far from negligible. For example, costs measured by the cif/fob ratio can rise to as much as 40% in landlocked countries. The crude measure of transport costs introduced earlier (Appendix A4) shows these values can be quite significant in the GMS, for example in exports of crops, other foods, and textiles.

Road infrastructure improvements reduce transport costs through a number of channels, including: reduction in vehicle operating costs including maintenance and prolonging the life of the asset; reduction in the time in transport and ensuing labour cost benefits; better inventory management; and improvement in the overall productivity associated with transport as additional services are obtained from the same resource base (i.e. more deliveries by the same truck and driver). Economy-wide, better transport systems lead to economies of scale and different patterns of agglomeration; improved access to markets; network externalities; more efficient market clearing and enhanced competition as a result of improved information flows (for example, Jensen, 2007; Hulten et al., 2005). Improved infrastructure connecting the GMS economies is also necessary for many of the benefits of trade facilitation efforts to be realised.

## *4.1 GMS infrastructure improvements*

Since 2005, nine economic corridors have been proposed for the region and these are currently at varying stages of implementation (figure 2). The goal of the development of these economic corridors is to enhance regional linkages among neighbouring countries in order to facilitate trade and develop logistics for better access to global markets. The development of economic corridors goes beyond improvements in physical infrastructure to include enhanced trade facilitation and so-called software linkages. While the GMS has negotiated the CBTA, it has yet to be fully implemented. Without the implementation of the CBTA, the physical investment remains a necessary, but far from sufficient condition for development in the region.

**Figure 2 Proposed GMS Economic Corridors**




To date, evaluations of the benefits of economic corridor development in the GMS have tended to be qualitative. However, several attempts at more quantitative measures have been made. Fujimura and Edmonds (2008) estimate the impact of road infrastructure on

trade and FDI flows in the GMS. They found a positive relationship between trade in major goods on both the export and import side of the border but results for FDI were inconclusive. Menon and Warr (2008) examined the relationship between road improvement and poverty in Lao PDR. They report that reducing transport costs through rural road improvements generates significant reductions in poverty incidence, though the type of road was shown to be a major factor in the results. The ADB conducted 3 case studies covering border provinces in Cambodia, Lao PDR and Viet Nam. The studies found that poverty incidence is higher in "less integrated areas" compared with "more connected areas". This was manifested in improved job opportunities, greater access to high quality goods and health facilities as well as the acquisition of better farming techniques (Singh and Mitra 2006).

While these studies provide broad linkages between economic impacts and infrastructure investment, there are few that estimate the actual cost reductions associated with these investments. This is due to a lack of reliable data that are far from comprehensive. Nonetheless, some attempts to estimate cost savings and other benefits have been made. For example ADB produced estimates of reduced travel times and transportation costs expected from the full implementation of the East-West Economic Corridor (EWEC) Project.[16] The East-West Corridor is a road link of almost 1,500km; it will be the only direct land route between the Indian Ocean and the South China Sea, with great potential to accelerate economic development in the region. The route runs from Mawlamyine-Myaddy in Myanmar, through Mae Sot-Phitsanulok-Khon Kaen-Mukdahan in Thailand, though Savannakhet-Dansavanh in Lao PDR, to LaoBao-Hue-Dong Ha in Viet Nam. The EWEC intersects a number of north-south arterial links, facilitating improved transportation throughout the region. Full implementation of the route is expected to reduce transport costs between 25% and 30% (ADB, 2005).

The Japan International Cooperation Agency (JICA) also prepared a report including estimates of cost savings from several cross border GMS projects (JICA , 2007). For example the report provides some data for the route from Hanoi to Bangkok, via the Second Mekong International Bridge completed in December 2006. Estimates here

[16] To be included in the forthcoming Completion Report of the Greater Mekong Subregion's East-West Transport Corridor Project.

report reductions in transit costs of between 25% and 50% (JICA 2007). In addition, the Japanese External Trade Organization (JETRO) has developed an 'ASEAN Logistics Network Map'. This map estimates costs and travel time in the region, based on surveys of Japanese companies.[17]

The corridor which has progressed furthest in the GMS is the North-South Economic Corridor (NSEC) which links Kunming in Yunnan province of PRC, to Bangkok and the Gulf of Thailand. This corridor is expected to provide access to the shipping routes of the South China Sea for output from Yunnan and Northern Thailand.

In undertaking analysis of the NSEC, Banomyong (2007) constructed a model based on a detailed logistical activity map of certain identified products moving along the corridor. The model describes the cost and time components of these movements, as well as highlighting delays at borders and other inspection points. As shown in Table 7, the estimated cost reductions across all three routes are substantial. Via the R3W, costs per ton are reduced by 26.5% between 2000 and 2006, and almost 43% between 2006 and 2015. Transit times are expected to drop almost 35% between 2006 and 2015. Via the Lao PDR route the reductions are even greater. Between 2000 and 2006, costs and transit times are expected to fall by about 30% and 35% respectively. Between 2006 and 2015 costs should fall by over 46% and transit times by 41%. The Lao PDR route experiences the greatest increase in perception of reliability.[18]

[17] The map is still under development thus documentation is, as yet, unavailable.
[18] The 2015 projections are based on the para-rubber industry and are thus illustrative of the kinds of savings to be expected along the routes. For details of the measurements, including reliability measures, see Banomyong (2007).

**Table 7 Trends on the Bangkok-Kunming corridor**

| Bangkok-Kunming | $ per Ton | % change | Transit Time (hours) | % change | Perception of reliability (5 point scale) |
|---|---|---|---|---|---|
| **R3W (via Myanmar)** | | | | | |
| • 2000 | 639 | | 77 | | 2.2 |
| • 2006 | 470 | 26.5 | 46 | 40.3 | 3.0 |
| • 2015 | 269 | 42.8 | 30 | 34.8 | 3.5 |
| **R3E (via Lao PDR)** | | | | | |
| • 2000 | 563 | | 78 | | 2.6 |
| • 2006 | 392 | | 51 | | 3.3 |
| • 2015 | 210 | 30.4 | 30 | 34.6 | 4.0 |
| | | 46.4 | | 41.2 | |
| **Via Mekong** | | | | | |
| • 2000 | 406 | | 128 | | 2.7 |
| • 2006 | 271 | 33.3 | 88 | 32.0 | 3.4 |
| • 2015 | 107 | 60.5 | 70 | 54.3 | 3.7 |
| **Hai phong-Kunming** | | | | | |
| • 2000 | 105 | | 85.0 | | 2.4 |
| • 2006 | 87 | 17.0 | 58.0 | 32.0 | 2.7 |
| • 2015 | 43 | 50.5 | 26.5 | 54.3 | 3.8 |

Source: Banomyang (2007) and authors' calculations

## *4.2 Scenarios modelled*

While the importance of transport infrastructure is clear, measuring the impact of changes made to it is not. Modelling infrastructure improvements is fraught with difficulty, going beyond the basic problem of obtaining a satisfactory measure of infrastructure services. Physical proxies may be relatively bad proxies for the services they are meant to capture. For example, measuring the impact of improved pavement capacity does not necessarily capture the changes in the economic value of the goods transported along this pavement. Measures of public or private investment spending also have difficulty capturing service flows. In developing countries, the problem is even more acute as official costs of investment are often disconnected from their effective value. In an effort to rise above these challenges, modellers have applied a variety of proxies to attempt to capture the key impacts of transport and infrastructure services. Traditional measures use simple proxies such as distance, ad valorem shares of trade volumes or real freight expenditures such as vehicle operating costs. Indeed Straub (2008) points out that simple time and distance measures do relatively well in cross-section settings.

In the current study, to model the gains from physical investment in transport infrastructure, we reduce land transport margin costs. This approach captures reductions in real freight expenditures, in the same vein as Menon and Warr (2006). However, this approach is not without shortcomings. Applying a reduction to the land transport margin has the benefit of impacting the variable most relevant to the question at hand: how do improvements in road transport affect economic activity? However, as alluded to above, the measurement of this variable is problematic. First, in GTAP, these transport margins apply to traded goods only and are based on the ratio of cif/fob prices rather than the actual cost of transport. Using cif/fob ratios means these measures only account for inter-country trade only and do not allow for intra-country trade. Using the land transport margin as a proxy for road improvements in the GMS has another difficulty. It does not allow for the specification of any particular route or region within a country. That is, there is no ability to measure the spatial dimension. As the literature has shown, geography matters (see for example, Rimmer and Dick, 2009). Where a road or transport corridor is located affects the location of supporting logistics operation, industrial development, etc. These, in turn, impact the level of agglomeration and resulting spillovers (Rosenthal and Strange, 2004). Finally, the land transport value reported in the GTAP database includes road, rail and pipeline. Singling out roads, let alone a particular road, is all but impossible.

The focus here is on exploring the region-wide impacts of infrastructure improvement based on estimated cost reductions along those GMS routes where implementation is relatively advanced. We include cross-border physical road infrastructure and trade facilitation measures that will lower the costs of transporting goods between GMS countries. Improvements in both transport infrastructure and trade facilitation can bring substantial gains to the region. Some estimates suggest that indirect costs from time delays can have a greater impact on trade volumes that direct costs (OECD, 2003). As discussed above, we can adjust the direct costs of transport through the international transport margins. Within the model, however, it is also possible to capture the impacts on trade costs from improvements in trade facilitation through the CBTA. Both aspects are captured here, which examines the impact of reducing transport costs and improving trade facilitation in the GMS region.

The first component of this approach attempts to capture improvements in the physical connectivity associated with the GMS Transport Strategy. Estimates of the cost savings through reduced VOC, improved efficiency of trucks and drivers and other cost savings are proxied by a reduction in the international land transport costs. Based on estimates of land transport cost reductions resulting from the NSEC and other studies presented above (see also studies reviewed in Stone and Strutt 2009), we apply a reduction in land transport costs of 45%.[19] For PRC, we assume that land transport costs with the GMS related region equivalent to a 25% reduction in its transport margins. While Yunnan and Guangxi make up a relatively small part of the overall Chinese economy, much of the trade with the GMS for goods transported by land is likely to enter and exit PRC through these provinces. However, given the relative uncertainty of the overall reduction of transportation costs with PRC, we take some care when analysing results to separate out these impacts.

The second component of this scenario encompasses the benefits of implementation of the CBTA. Through improved border crossing, harmonization of registration processes and other bureaucratic matters, trade facilitation should improve throughout the GMS. Many studies have found the ensuing price reductions have the potential to surpass the benefits of tariff reductions over time. To include the effects of an improvement in trade facilitation measures, we implement an approach introduced in Hertel, Walmsley and Itakura (2001) and further refined in Minor and Tsigas (2008). The approach allows for region specific shift in the Armington demand function, effectively lowering the foreign market price. Based on the studies of expected time savings if the CBTA were to achieve improved facilitation to world standards we assume a reduction in effective import prices of 25%. For the reasons discussed above, we need to differentiate the shock for PRC; we assume a 5% cost reduction between the GMS and PRC as a whole.

# 5 Results and discussion

[19] These transportation cost reductions are proxied by productivity improvements in the transportation margin sector covering land transportation.

In this section, we present results of the simulation described above, followed by detailed analysis of the poverty implications.

## *5.1 Impacts of transport improvements on the GMS region*

The results for this scenario are reported in table 8. Here, projected changes for each GMS economy at the aggregate level, including real output, exports and economic welfare are shown. These results suggest that changes in real GDP are highest for those countries with relatively large transport costs – namely Cambodia and Lao PDR. The projected changes in real GDP for the region total over $5.5 billion (over $4.3 billion excluding gains accruing to PRC). All of the GMS economies experience increases in GDP of between 1.1% and 8.3%, with the highest percentage increase in Cambodia, followed by Lao PDR, Myanmar, Viet Nam and Thailand. Since only a relatively small part of PRC is included in the GMS, the gains for PRC, in percentage terms, are relatively small. As shown in the third row of Table 8, the exclusion of the impact of improved infrastructure and trade facilitation with PRC affects the GMS economies in a range of ways. For Viet Nam and Thailand, the impact of improved transportation with PRC appears to be an important driver of the GDP results. Viet Nam's GDP gains are significantly lower in the absence of transportation and trade facilitation cost reductions with PRC and Thailand's gains are eroded by over 36%. Other GMS economies appear much less reliant on gains from improved transportation with PRC. For Myanmar, the impact on GDP would be reduced by less than 14%, about 7% for Cambodia and for Lao PDR, less than 2%.

**Table 8 Aggregate impacts of reduced costs of road transport and trade facilitation**

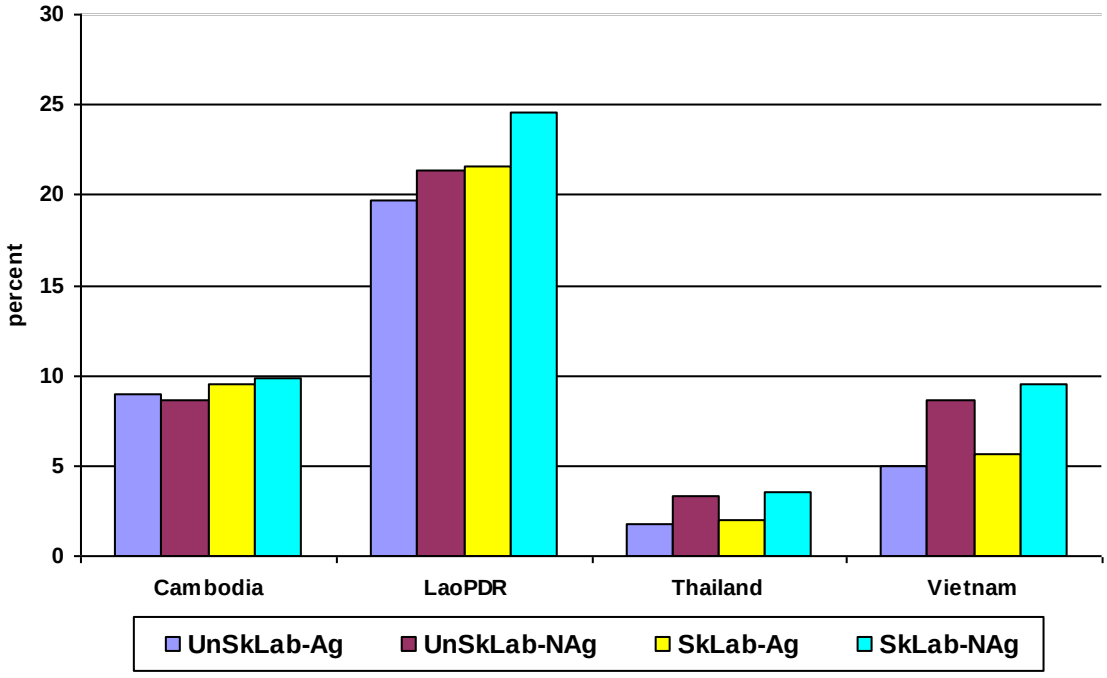
| | Cambodia | Lao PDR | Myanmar | Thailand | Viet Nam | PRC |
|---|---|---|---|---|---|---|
| GDP (US$m) | 403.9 | 173.4 | 363.2 | 1,822.3 | 1,539.2 | 1,201.8 |
| GDP % | 8.3 | 7.1 | 4.7 | 1.1 | 3.6 | 0.1 |
| GDP% *excluding PRC* | 7.7 | 6.9 | 4.1 | 0.7 | 2.4 | 0.0 |
| Exports (US$m) | 226.6 | -28.1 | 50.5 | 3,356.8 | 1,201.0 | 1,787.1 |
| Exports (%) | 5.3 | -4.3 | 1.7 | 2.8 | 3.7 | 0.3 |
| EV (US$m) | 480.6 | 261.3 | 618.6 | 2,955.5 | 2,157.9 | 1,441.0 |
| EV *excluding PRC* | 460.4 | 259.5 | 557.6 | 1,734.9 | 1,390.7 | -206.5 |
| % Contribution to welfare | | | | | | |
| Allocative efficiency | 12.6 | 4.8 | 12.5 | 16.8 | 5.0 | 6.0 |
| Improved terms of trade | 10.5 | 22.6 | 37.3 | 39.9 | 21.8 | 15.7 |
| Improved transport | 0.1 | 3.6 | 3.9 | 2.8 | 5.7 | 2.2 |
| Improved trade facilitation | 71.8 | 62.7 | 47.2 | 45.0 | 66.7 | 77.4 |

For all GMS economies with improved infrastructure, the change in economic welfare, as measured using equivalent variation (EV) in income, is positive. The total change in welfare for the region is US$7.9 billion, however, this would be reduced to $6.5 billion if there is no reduction of costs between PRC and other GMS countries (see row 7). For all GMS economies, allocative efficiency improves with better transportation facilitating the movement of resources into more productive activities. This impact is particularly strong for Thailand, contributing almost 17% of the increase in welfare. Terms of trade improvements are experienced by all GMS economies, again leading to increased welfare. This impact is primarily due to an increase in the regional export prices, while regions outside the GMS tend to experience a decline in their regional export prices. This relative change, however, does not adversely impact the export performance of the region, with the exception of Lao PDR, which experiences a decline in total exports. Lao PDR's exports decline due to the relative rise in export prices cvis a vis their regional trading partners. The reduction in the transport and trade costs were not enough to offset the increase in their labour costs, especially *vis a vis* Cambodia.

Figure 3 shows the relative changes in the wages for the four countries examined. Lao PDR's labour costs increase much more than its neighbours. This can be attributed to, as started above, the fact that the model restricts mobility of farm to non-farm labour the model. So, while Loa PDR and Cambodia experienced the same overall transport cost reduction, this represented a greater share of sector costs in Camboida than in Lao PDR (Appendix table A4b). That, coupled with the differential in relative wage increases caused Cambodia to expand certain regional markets, at Lao PDR's expense. However, as will be discussed below, Lao PDR's intra-regional export growth is over 80%, implying large potential gains as the GMS market growths.

The direct contribution to economic welfare of improved land transportation productivity is shown in Table 8 to be small but significant, with the exception of Cambodia. This is not surprising as land transport costs are a larger part of exports in Cambodia. Land transport costs as a percentage of total GMS exports are 17 times higher than for Cambodia's total exports. This compares with 4 times in Lao PDR, 2 times in Thailand and no real difference for Viet Nam.

**Figure 3 Changes in wages, by region and labor type**




The final row of Table 8 reports the improvement in equivalent variation due to trade facilitation and this contributes the bulk of the welfare gains in the region. These gains are made by effectively lowering import prices through reductions associated with improvements in the 'software' accompanying the transportation 'hardware'. This result illustrates the great potential impact of measures that facilitate the efficient movement of goods across borders, once the physical infrastructure is in place.

While Table 8 indicates that total exports are expected to increase for GMS countries (except for Lao PDR), the impact on intra-GMS exports is perhaps of even greater interest. Table 9 presents details of changes in the value of intra-regional export flows. All of the economies increase exports within the region by between US$150m and almost US$10 billion. For all of the countries, with the exception of Cambodia, the largest increases in bilateral exports are to Thailand. This underscores the importance of lower land transportation and trade facilitation costs with Thailand for most of the GMS. In the case of Cambodia, it is exports to Viet Nam that are expected to increase by the most, at

over US$272m. For Thailand, increases in exports are spread between all GMS countries, with largest dollar increases, in exports to Viet Nam and PRC.

**Table 9 Change in the value of intra-GMS exports, (US$m)**

| Into: / From: | Cambodia | Lao PDR | Myanmar | Thailand | Viet Nam | PRC | Total |
|---|---|---|---|---|---|---|---|
| Cambodia | | 1.3 | 0.4 | 207.1 | 272.1 | 3.8 | 484.7 |
| Lao PDR | 0.1 | | 0.0 | 123.4 | 28.9 | -3.2 | 149.2 |
| Myanmar | 0.1 | 0.0 | | 486.2 | 16.2 | 2.9 | 505.5 |
| Thailand | 552.1 | 224.9 | 818.8 | | 4,174.9 | 4,222.1 | 9,992.8 |
| Viet Nam | 160.6 | 15.9 | 14.9 | 2,715.5 | | 646.5 | 3,553.5 |
| PRC | -65.2 | -39.4 | -71.9 | 2,477.4 | 1,020.8 | | 3,321.6 |

Changes in sector output are reflected in table 10. Given the poverty discussion focuses on four countries within the GMS – Cambodia, Lao PDR, Thailand and VietNam – the following discussion will do the same.

Looking at table 10, the sectors with the greatest gains are not necessarily the country's largest producers but nor are they the industries with the largest land transport costs as a percent of exports (see Appendix 4b). For example, other foods have relatively high transport costs in Cambodia, yet output in this sector declines. Crops have a very high rate of land transport costs in Lao PDR, yet the sector experiences a relatively small increase in output. For Viet Nam, manufacturing has a very small share of land transport costs but has the largest sectoral increase examined.

Rather these results reflect a diversification due to reduced transport costs for Cambodia and Lao PDR and a consolidation for Thailand and Viet Nam. Manufacturer output increase across the board, while traditional textile and apparel are reduced. Crops, however, remain an important source of output in Cambodia and Loa PDR, but we see the greatest labour market expansion in other industries.

In all countries, skilled labour demand increases are greater than unskilled. This is, in part, a reflection of the move into manufacturing, especially electronics. Lao PDR and Cambodia experience larger gains in demand for workers reflecting the larger percentage increases in output in these economies. Lao PDR shows a very large increase, reflecting the small base. For instance, pre simulation, Lao PDR's skilled labour base had a value of $161 million, compared with over $1 billion for Thailand.

Even Lao PDR's unskilled labour base is small: $734 million versus $1.25 billion for Cambodia and $2.8 billion in Thailand. The small labour market base coupled with restricted mobility causes the much greater percentage increase in wages noted above.

**Table 10 Selected Industry Changes**

| | Crops | Meat & fish | Other foods | Textile, apparel & leather | Manufs. | Utilities | Total |
|---|---|---|---|---|---|---|---|
| Cambodia | | | | | | | |
| Output | 3.6% | -0.3% | -6.9% | -3.5% | 14.8% | 4.4% | 8.3% |
| Skilled | 11.0% | 8.3% | 0.1% | 3.3% | 25.3% | 9.1% | 9.8% |
| Unskilled | 10.6% | 7.6% | 0.3% | 3.3% | 25.9% | 10.0% | 8.7% |
| Lao PDR | | | | | | | |
| Output | 2.7% | -1.3% | -2.0% | -31.7% | 12.0% | 11.1% | 7.1% |
| Skilled | 24.3% | 18.2% | 17.4% | -17.9% | 21.7% | 24.5% | 24.5% |
| Unskilled | 23.0% | 16.9% | 17.8% | -17.0% | 16.4% | 26.7% | 20.6% |
| Thailand | | | | | | | |
| Output | -0.5% | 0.0% | -0.6% | -2.0% | 2.5% | -2.0% | 1.1% |
| Skilled | 1.1% | 2.3% | 2.8% | 1.3% | 5.5% | 3.5% | 3.5% |
| Unskilled | 1.0% | 2.1% | 2.9% | 1.3% | 5.3% | 3.7% | 3.1% |
| Viet Nam | | | | | | | |
| Output | -1.3% | 2.8% | -0.9% | -3.1% | 0.3% | 6.7% | 3.6% |
| Skilled | 2.8% | 10.0% | 7.6% | 4.7% | 8.0% | 7.9% | 9.5% |
| Unskilled | 2.4% | 9.4% | 7.7% | 5.1% | 7.4% | 8.5% | 8.1% |

Changes for Thailand and Viet Nam are smaller given both have a smaller dependence on regional trade as well as a smaller share of land transport. Indeed, there is less diversification in these economies and more expansion of existing strengths. Thailand increases its output of manufactures, notably electronics, despite this sector having relatively small trade costs as well as having the smallest domestic to imported price differential after the policy shock. A similar story applies to Viet Nam.

## *5.2 Impacts on poverty*

Turning now to the poverty impacts, we begin with the poverty drivers reported in Table . These real earnings changes suggest that, in nearly all cases, factor earnings are rising relative to the cost of living at the poverty line. While the wage changes for a given type of factor are the same for both groups of poor ($1/day and $2/day), their cost of living differs, so the entries in the top of Table ($1/day) differ from those in the bottom ($2/day) by a common factor (the difference in cost of living at the different poverty lines).

Consistent with the change in wages shown in figure 3, in table 11 we see that the largest earnings increases are for the non-agricultural factors – particularly skilled labor. This may be driven by the increase in output in manufacturing sectors experienced by these economies. Land generally experiences the most modest rise in real earnings, and real land rents actually decline in the case of Thailand.

**Table 11 Deflated endowment price changes, by country**

| $1/day Endowment | Cambodia | Lao PDR | Thailand | Viet Nam |
|---|---|---|---|---|
| Land | 7.79 | 6.71 | -0.60 | 0.49 |
| Unskilled Agricultural | 7.51 | 7.52 | 0.63 | 3.49 |
| Skilled Agricultural | 8.09 | 9.22 | 0.86 | 4.16 |
| Unskilled Non-agricultural | 7.20 | 9.06 | 2.11 | 7.11 |
| Skilled Non-agricultural | 8.43 | 11.91 | 2.33 | 7.98 |
| Unskilled Waged | 7.26 | 8.40 | 1.87 | 6.60 |
| Skilled Waged | 8.42 | 11.86 | 2.33 | 7.97 |
| Agricultural Capital | 7.75 | 7.63 | 0.83 | 3.81 |
| Non-agricultural capital | 7.74 | 8.69 | 2.28 | 7.33 |
| Transfers | 10.46 | 10.53 | 2.83 | 6.09 |
| $2/day Endowment | Cambodia | Lao PDR | Thailand | Viet Nam |
| Land | 7.94 | 7.07 | -0.72 | 0.37 |
| Unskilled Agricultural | 7.67 | 7.89 | 0.51 | 3.37 |
| Skilled Agricultural | 8.25 | 9.60 | 0.74 | 4.03 |
| Unskilled Non-agricultural | 7.35 | 9.43 | 1.98 | 6.98 |
| Skilled Non-agricultural | 8.58 | 12.29 | 2.21 | 7.85 |
| Unskilled Waged | 7.42 | 8.77 | 1.75 | 6.47 |
| Skilled Waged | 8.58 | 12.24 | 2.21 | 7.84 |
| Agricultural Capital | 7.91 | 8.00 | 0.70 | 3.69 |
| Non-agricultural capital | 7.89 | 9.07 | 2.16 | 7.21 |
| Transfers | 10.62 | 10.91 | 2.71 | 5.96 |

Applying the stratum-specific poverty elasticities to the real earnings changes in Table , gives the percentage changes in poverty headcount by stratum in Table . Note that the changes are relatively even across many strata within each country. However, the small change in poverty headcount in transfer dependent households in Cambodia and Lao PDR is notable. This follows from relatively low poverty elasticities, suggesting a low density of the transfer dependent households around the poverty line in those countries. Also notable is the extremely large reduction in poverty for the wage labour households in Viet Nam, where the poverty elasticity is very large.

**Table 12 Percentage change in poverty headcount, by stratum and country**

| $1/day Stratum | Cambodia | Lao PDR | Thailand | Viet Nam |
|---|---|---|---|---|
| Agriculture | -4.56 | -4.36 | -1.31 | -1.59 |
| Non-Agriculture | -4.88 | -4.23 | -4.97 | -7.44 |
| Urban Labor | -4.58 | -5.53 | -5.41 | -16.46 |
| Rural Labor | -3.99 | -6.16 | -4.46 | -44.91 |
| Transfers | -3.24 | -1.77 | -7.43 | -4.82 |
| Urban Diversified | -5.05 | -6.22 | -4.23 | -4.19 |
| Rural Diversified | -4.72 | -6.22 | -4.63 | -6.27 |
| Total | -4.65 | -4.66 | -4.71 | -4.79 |

| $2/day Stratum | Cambodia | Lao PDR | Thailand | Viet Nam |
|---|---|---|---|---|
| Agriculture | -3.11 | -3.46 | -0.55 | -1.19 |
| Non-Agriculture | -4.14 | -3.98 | -4.49 | -4.83 |
| Urban Labor | -3.58 | -5.18 | -4.84 | -32.97 |
| Rural Labor | -3.31 | -3.54 | -2.92 | -13.99 |
| Transfers | -2.08 | -1.39 | -1.66 | -0.8 |
| Urban Diversified | -4.19 | -4.95 | -2.35 | -7.02 |
| Rural Diversified | -3.72 | -4.79 | -1.65 | -4.35 |
| Total | -3.57 | -3.84 | -1.91 | -4.19 |

Table 13 converts these percentage changes into number of individuals lifted out of poverty. Here, we see that for the GMS-4 total (Cambodia, Lao PDR, Thailand and Viet Nam combined), more than 400,000 people are moved out of extreme poverty, with another 1.75 million being lifted above the $2/day poverty line. The largest share (about half) of the extreme poverty alleviation is in Cambodia. This reflects Cambodia's large share in $1/day poverty in the region. On the other hand, Viet Nam dominates the $2/day poverty reduction in the region, as it dominates the poverty headcount at this higher level of income. At the stratum level, across the GMS-4 region, the bulk of the poverty reduction comes in the rural areas, with rural diversified households accounting for almost one-half of the poverty reduction at both poverty levels. This provides strong evidence that road improvements and improved connectivity benefit rural poor in the region.

**Table 103 Change in poverty headcount, by stratum and country (number of individuals)**

| $1/day Stratum | Cambodia | Lao PDR | Thailand | Viet Nam | GMS-4 |
|---|---|---|---|---|---|
| Agriculture | 83,504 | 54,483 | 936 | 7,720 | 146,643 |
| Non-Agriculture | 7,289 | 2,760 | 1,087 | 1,035 | 12,171 |
| Urban Labor | 4,272 | 1,121 | 230 | 2,280 | 7,903 |
| Rural Labor | 3,905 | 303 | 2,879 | 6,219 | 13,306 |
| Transfers | 1,658 | 236 | 9,670 | 6,010 | 17,574 |
| Urban Diversified | 14,858 | 5,409 | 3,206 | 1,741 | 25,214 |
| Rural Diversified | 101,467 | 11,323 | 35,994 | 34,762 | 183,546 |
| Total | 216,953 | 75,635 | 54,002 | 59,767 | 406,357 |

| $2/day Stratum | Cambodia | Lao PDR | Thailand | Viet Nam | GMS-4 |
|---|---|---|---|---|---|
| Agriculture | 106,708 | 102,610 | 6,263 | 62,333 | 277,914 |
| Non-Agriculture | 22,648 | 5,472 | 25,440 | 14,039 | 67,599 |
| Urban Labor | 7,291 | 3,640 | 14,010 | 82,203 | 107,144 |
| Rural Labor | 6,747 | 409 | 44,533 | 34,885 | 86,574 |
| Transfers | 1,333 | 190 | 22,142 | 4,560 | 28,225 |
| Urban Diversified | 39,558 | 15,507 | 33,258 | 146,793 | 235,116 |
| Rural Diversified | 198,348 | 36,923 | 161,429 | 549,520 | 946,220 |
| Total | 382,633 | 164,751 | 307,075 | 894,333 | 1,748,792 |

## *5.3 Some mitigating factors*

We should emphasise that our results report the anticipated gains, given the set of assumptions made. If the necessary supportive policy and institutional environment that will allow GMS economies to adapt and exploit new opportunities is absent, these gains are far from assured.

The gains from improvements in transport and trade facilitation presented above must also be tempered by the potential negative impacts of enhanced transport networks in the region. For example, as transit countries Lao PDR and Cambodia, having less resources and lower economic competitiveness, may suffer from worsening traffic safety. Traffic accidents are a concern across the developing world. An ADB (2005) study provided estimates of annual economic loss from road accidents for GMS countries to be over $4.7 billion or over 2% of annual GDP. This value is substantiated by EU estimates

which state that road crashes cost approximately 1 to 3% of GDP in India.[20] Lost time, damaged cargo and vehicles, lack of insurance, injuries and even death all add to the high costs of traffic accidents. There are also concerns about deterioration of the natural environment as a result of growing flows of transit cargo and a concern among residents that only foreign multinational companies will reap the benefits of cross border trade expansion (JICA, 2007).

There may be adverse human health impacts accompanying improved infrastructure. For example, the spread of HIV and AIDS has been known to closely follow the progress of economic integration in the GMS. It was reported for instance that the number of HIV-positive persons and AIDS patients rose sharply in Savannakhet while the Second Mekong Bridge was under construction (Takao, 2007).

Furthermore, concern exists that improved infrastructure may accentuate problems of human trafficking and illegal trade in narcotics. These issues are deeply rooted in the problem of poverty. According to a report on Laotian villages, those who wanted to work outside their own countries were often victimized (ADB 2006), with a third given false information about their earnings or forced to work in a job different from the initial promise (often prostitution in the case of women).

This brief discussion of possible adverse impacts is far from complete, and further case studies that explore these issues and more (including environmental damage) will be very useful. However, potential negative impacts need to be viewed in the context of further positive effects that may occur within the region. Increased exposure to new businesses that comes with wider and greater exposure increases the opportunities for improved technological adaptation. Indeed it has been shown that improving connectivity has been shown to raise productivity and land values for poor farmers (Iimi and Smith 2007). . Evidence has shown that improved transport has increased school attendance (Levy 2004), increased material and natal care (Ishimori 2003), improved working conditions and wage levels (Singh and Mitra 2006) and increased levels of FDI (Luanglatbandith 2007). None of these dynamic, positive effects have been explicitly

[20] See, http://www.ertico.com/en/subprojects/euindia/about_eu-india/road_safety_in_india/

considered in this study. Thus, the net outcome of the dynamic interaction between the negative potential impacts and the positive is very difficult to assess.

# 6 Concluding remarks and future directions

This paper marks the first effort to undertake a general equilibrium assessment of the impact of infrastructure development across the whole GMS region. Supporting databases developed for this study facilitated much improved modelling capacity for assessing outcomes, including effects on poverty, across the whole GMS region in a way that has not previously been possible. Our findings suggest strong gains to the GMS countries should result from infrastructure development and trade facilitation, with particularly positive impacts incomes and poverty levels in the relatively poor countries of Cambodia and Lao PDR. While we find particularly significant gains from trade facilitation in the GMS region, it must be remembered that these gains will not be possible without first improving physical connectivity to enable efficient road transportation between countries in the region.

We need to be mindful of the need for a supportive institutional and domestic policy environment that allows markets to develop and take advantage of the new opportunities offered by improved infrastructure and trade facilitation measures. We also acknowledge that serious data issues remain in the GMS region, including matching domestic data to international frameworks and also the problem of unrecorded border trade. Informal trade appears to account for a significant share of cross-border trade in the GMS region, perhaps in the order of 20-30% of trade (Athukorala, 2007). There are also a number of limitations in the types of simulations we are able to undertake, particularly since estimates of benefits such as reduced travel costs are sparse and there are challenges in translating these into modelling scenarios that will appropriately capture the impact of the infrastructure development in the GMS. We also note that there are difficulties in trying to separate the benefits of cross-border transport infrastructure development from domestic infrastructure. Despite these and other limitations, we hope that the current study offers useful insights into a key development issue for the GMS.

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# Appendices

**Appendix Table A1 Regional aggregation**

| Region | Detailed Description |
|---|---|
| Cambodia | Cambodia |
| Lao PDR | Lao PDR |
| Myanmar | Myanmar |
| Thailand | Thailand |
| Viet Nam | Viet Nam |
| PRC | PRC |
| Other ASEAN | Indonesia, Malaysia, Philippines, Singapore |
| High Income Asian | Japan, Korea, Hong Kong and Taiwan |
| South Asia | Bangladesh, India, Pakistan, Sri Lanka, Rest of South Asia |
| ANZ | Australia & New Zealand |
| Europe | EU25, EFTA, Rest of Europe |
| NAFTA | Canada, USA, Mexico |
| CAREC | Central Asia Regional Economic Cooperation |
| ROW | Rest of the World |

**Appendix Table A2 Commodity aggregation**

| Aggregated sectors | Modelled sectors | Original GTAP sectors |
|---|---|---|
| Crops | Paddy rice | pdr |
| | Vegetables and fruit | v_f |
| | Other crops | wht gro osd c_b pfb ocr |
| | Forestry | frs |
| Meat & fish | Livestock | ctl oap rmk wol |
| | Fishery | fsh |
| Other foods | Processed animal products | cmt omt mil |
| | Processed rice | pcr |
| | Processed foods | vol sgr ofd b_t |
| Textiles, apparels, leather | Textiles | tex |
| | Wearing apparel | wap |
| | Leather products | lea |
| Manufactures | Petroleum | oil p_c |
| | Other minerals | omn |
| | Wood and paper products | lum ppp |
| | Electronic equip. & machin. | ele ome |
| | Other manufactures | crp nmm i_s nfm fmp mvh otn omf |
| Wholesale & retail trade | Wholesale-Retail Trade | trd |
| Utilities | Utilities | coa gas ely gdt wtr |
| | Construction | cns |
| Business services | Business Services | ofi isr obs |
| Housing & education | Housing, Health and Educ. | ros osg dwe |
| Transport & communication | Communications | cmn |
| | Other transport | otp |
| | Water transport | wtp |
| | Air transport | atp |

**Appendix Table A3a GMS exports (US$m)**

| | Crops | Meat & fish | Other foods | Text., apparel & leather | Manufs. | Whsale & retail trade | Utilities | Business services | Housing & educ. | Transport & commun. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cambodia** | | | | | | | | | | | |
| Lao PDR | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 |
| Myanmar | 0.0 | 0.0 | 0.2 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 |
| Thailand | 3.8 | 2.4 | 1.1 | 0.5 | 37.5 | 0.6 | 0.5 | 0.1 | 1.5 | 2.3 | 50.4 |
| Viet Nam | 16.4 | 0.2 | 1.0 | 2.0 | 103.6 | 0.1 | 0.0 | 0.0 | 0.4 | 0.7 | 124.4 |
| PRC | 0.3 | 1.3 | 1.2 | 7.9 | 16.5 | 4.0 | 0.3 | 0.6 | 6.6 | 9.1 | 48.0 |
| World | 33.8 | 17.7 | 83.8 | 3,099.1 | 311.3 | 67.1 | 21.1 | 19.1 | 216.7 | 358.7 | 4,228.3 |
| *GMSC (% world trade)* | *60.9* | *22.1* | *4.2* | *0.3* | *50.8* | *7.1* | *4.0* | *3.9* | *3.9* | *3.4* | *5.3* |
| **Lao PDR** | | | | | | | | | | | |
| Cambodia | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 |
| Myanmar | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Thailand | 13.1 | 2.0 | 0.2 | 1.4 | 81.6 | 0.1 | 2.0 | 0.0 | 0.4 | 0.5 | 101.2 |
| Viet Nam | 21.5 | 2.1 | 2.0 | 1.1 | 41.1 | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 | 68.2 |
| PRC | 6.0 | 0.0 | 0.5 | 0.1 | 2.5 | 0.2 | 0.1 | 0.1 | 1.5 | 2.1 | 13.0 |
| World total | 62.0 | 4.3 | 16.7 | 181.7 | 185.4 | 6.8 | 8.9 | 3.1 | 97.2 | 75.0 | 641.1 |
| *GMSC (% world trade)* | *65.4* | *95.7* | *16.2* | *1.5* | *67.7* | *4.1* | *22.9* | *2.9* | *2.1* | *3.7* | *28.5* |
| **Myanmar** | | | | | | | | | | | |
| Cambodia | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 |
| Lao PDR | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Thailand | 74.2 | 59.3 | 11.1 | 0.3 | 97.2 | 0.5 | 771.0 | 0.3 | 0.2 | 0.3 | 1,014.3 |
| Viet Nam | 7.3 | 0.8 | 3.0 | 0.5 | 6.6 | 0.1 | 0.0 | 0.1 | 0.1 | 0.1 | 18.6 |
| PRC | 79.9 | 0.5 | 5.9 | 0.7 | 57.3 | 3.6 | 0.1 | 0.8 | 0.6 | 0.5 | 149.9 |
| World total | 703.6 | 76.0 | 219.7 | 610.6 | 341.6 | 39.2 | 772.9 | 45.9 | 41.4 | 74.2 | 2,925.1 |
| *GMSC (% world trade)* | *23.0* | *79.6* | *9.1* | *0.3* | *47.2* | *10.7* | *99.8* | *2.4* | *2.1* | *1.3* | *40.4* |

Source: GTAP Version 7,C2 database, October 2008

**Appendix Table A3b GMS exports (US$m)**

| | Crops | Meat & fish | Other foods | Text., apparel & leather | Manufs. | Whsale & retail trade | Utilities | Business services | Housing & educ. | Transport & commun. | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Thailand** | | | | | | | | | | | |
| Cambodia | 0.9 | 5.6 | 106.2 | 67.5 | 377.5 | 0.6 | 3.9 | 0.1 | 0.1 | 1.2 | 563.5 |
| Lao PDR | 6.7 | 1.0 | 74.3 | 58.4 | 313.6 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 454.2 |
| Myanmar | 3.7 | 0.3 | 153.3 | 53.8 | 404.8 | 0.1 | 0.0 | 1.1 | 0.1 | 0.3 | 617.5 |
| Viet Nam | 21.7 | 2.4 | 91.4 | 177.0 | 1,712.6 | 4.0 | 1.2 | 6.5 | 2.7 | 15.1 | 2,034.5 |
| PRC | 476.0 | 15.1 | 506.1 | 575.7 | 12,401.6 | 138.0 | 9.3 | 57.0 | 51.3 | 207.0 | 14,437.1 |
| World total | 1,814.1 | 259.0 | 11,886.0 | 9,587.2 | 80,386.6 | 2,014.8 | 290.4 | 3,521.3 | 1,660.3 | 8,045.5 | 119,465.2 |
| *GMSC (% world trade)* | *28.1* | *9.5* | *7.8* | *9.7* | *18.9* | *7.1* | *5.0* | *1.8* | *3.3* | *2.8* | *15.2* |
| **Viet Nam** | | | | | | | | | | | |
| Cambodia | 5.0 | 2.5 | 39.5 | 27.5 | 121.2 | 0.1 | 1.5 | 0.1 | 0.1 | 0.2 | 197.6 |
| Lao PDR | 2.3 | 0.1 | 2.4 | 20.3 | 25.7 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 50.8 |
| Myanmar | 0.0 | 0.0 | 0.5 | 1.8 | 11.3 | 0.0 | 0.0 | 0.2 | 0.1 | 0.0 | 13.9 |
| Thailand | 12.5 | 9.0 | 31.6 | 22.3 | 601.6 | 2.0 | 66.8 | 7.7 | 2.7 | 4.0 | 760.1 |
| PRC | 111.4 | 5.3 | 103.7 | 108.4 | 2,419.8 | 16.9 | 176.0 | 24.3 | 11.9 | 10.8 | 2,988.6 |
| World total | 1,651.5 | 274.7 | 3,626.6 | 10,942.2 | 12,470.8 | 157.3 | 551.7 | 1,124.0 | 655.0 | 742.7 | 32,196.5 |
| *GMSC (% world trade)* | *7.9* | *6.1* | *4.9* | *1.6* | *25.5* | *12.0* | *44.3* | *2.9* | *2.3* | *2.0* | *12.5* |
| **PRC** | | | | | | | | | | | |
| Cambodia | 3.2 | 0.1 | 27.4 | 368.9 | 121.1 | 7.6 | 2.5 | 0.4 | 0.7 | 1.6 | 533.4 |
| Lao PDR | 0.5 | 0.0 | 0.5 | 9.6 | 62.3 | 0.0 | 0.1 | 0.0 | 0.2 | 0.1 | 73.4 |
| Myanmar | 13.5 | 0.4 | 29.5 | 149.4 | 627.8 | 0.1 | 0.0 | 1.9 | 0.4 | 0.5 | 823.6 |
| Thailand | 80.4 | 27.3 | 176.7 | 673.9 | 6,128.4 | 206.9 | 33.7 | 43.1 | 56.6 | 87.8 | 7,515.0 |
| Viet Nam | 184.9 | 12.9 | 94.0 | 1,058.3 | 3,746.1 | 39.9 | 7.0 | 13.7 | 12.5 | 20.9 | 5,190.1 |
| World total | 5,661.5 | 2,960.9 | 16,344.6 | 134,033.5 | 472,484.8 | 15,614.3 | 5,706.5 | 7,079.2 | 7,689.4 | 13,191.0 | 680,765.6 |
| *GMSC (%world trade)* | *5.0* | *1.4* | *2.0* | *1.7* | *2.3* | *1.6* | *0.8* | *0.8* | *0.9* | *0.8* | *2.1* |

Source: GTAP Version 7,C2 database, October 2008

**Appendix Table A4a Ratio of land transport margins to bilateral export value (%)[a]**

| | Crops | Meat & fish | Other foods | Text., app. & leather | Manufs. | Utilities | Total |
|---|---|---|---|---|---|---|---|
| **Cambodia** | | | | | | | |
| Lao PDR | n/a | 7.02 | 2.66 | 9.32 | 0.70 | n/a | 0.91 |
| Myanmar | n/a | n/a | 0.25 | 0.02 | 0.01 | n/a | 0.13 |
| Thailand | 13.67 | 14.02 | 6.25 | 5.45 | 30.03 | n/a | 24.24 |
| Viet Nam | 38.16 | 12.97 | 28.88 | 8.61 | 12.10 | n/a | 15.50 |
| PRC | 0.01 | 0.07 | 0.13 | 0.04 | 0.17 | n/a | 0.07 |
| World | 21.45 | 2.83 | 1.31 | 0.78 | 7.95 | n/a | 1.37 |
| **Lao PDR** | | | | | | | |
| Cambodia | n/a | n/a | 0.03 | n/a | 0.16 | n/a | 0.14 |
| Myanmar | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Thailand | 16.05 | 4.55 | 9.63 | 8.00 | 16.71 | 28.70 | 16.33 |
| Viet Nam | 8.63 | 4.22 | 12.99 | 6.11 | 10.34 | n/a | 9.57 |
| PRC | 9.70 | n/a | 3.00 | 3.10 | 11.27 | n/a | 6.75 |
| World total | 7.98 | 4.30 | 2.12 | 1.50 | 10.89 | 6.36 | 4.52 |
| **Myanmar** | | | | | | | |
| Cambodia | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Lao PDR | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Thailand | 15.04 | 19.36 | 7.26 | 6.45 | 6.24 | 4.68 | 6.47 |
| Viet Nam | 1.14 | 1.01 | 3.32 | 1.44 | 0.72 | n/a | 1.33 |
| PRC | 8.53 | 7.87 | 4.62 | 15.60 | 9.37 | 8.05 | 8.42 |
| World total | 3.82 | 15.32 | 1.77 | 1.88 | 5.83 | 4.67 | 3.76 |

[a] Service sectors do not have land transport margins therefore are not included in this table (however the value of service trade is included in the total column.
n/a – not applicable.
Source: GTAP Version 7,C2 database, October 2008

**Appendix Table A4b Ratio of land transport margins to bilateral export value (%)[a]**

| | Crops | Meat & fish | Other foods | Text., app. & leather | Manufs. | Utilities | Total |
|---|---|---|---|---|---|---|---|
| **Thailand** | | | | | | | |
| Cambodia | 0.07 | 0.10 | 0.11 | 0.06 | 0.09 | 0.14 | 0.09 |
| Lao PDR | 6.01 | 3.87 | 7.82 | 3.74 | 4.82 | 0.04 | 5.19 |
| Myanmar | 10.17 | 5.68 | 8.30 | 5.08 | 5.56 | n/a | 6.21 |
| Viet Nam | 2.72 | 3.51 | 4.11 | 1.68 | 1.55 | 0.03 | 1.67 |
| PRC | 0.89 | 0.05 | 0.24 | 0.04 | 0.03 | n/a | 0.06 |
| World total | 9.19 | 2.62 | 3.75 | 1.00 | 0.91 | n/a | 1.21 |
| **Viet Nam** | | | | | | | |
| Cambodia | 0.85 | 0.04 | 0.16 | 0.07 | 0.06 | n/a | 0.10 |
| Lao PDR | 14.58 | 2.78 | 5.62 | 3.05 | 2.56 | 0.88 | 3.44 |
| Myanmar | n/a | n/a | 0.06 | 0.02 | 0.01 | n/a | 0.01 |
| Thailand | 9.27 | 2.84 | 4.58 | 3.26 | 1.15 | 1.12 | 1.48 |
| PRC | 22.27 | 5.91 | 21.24 | 8.18 | 2.00 | 10.20 | 4.10 |
| World total | 3.88 | 2.19 | 4.04 | 1.23 | 1.70 | 3.58 | 1.81 |
| **PRC** | | | | | | | |
| Cambodia | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Lao PDR | 2n/a | n/a | 4.42 | 3.59 | 2.13 | n/a | 2.46 |
| Myanmar | 20.46 | 3.11 | 6.26 | 5.50 | 3.58 | 0.10 | 4.29 |
| Thailand | 18.58 | 3.59 | 6.64 | 3.01 | 1.60 | 0.12 | 1.94 |
| Viet Nam | 21.63 | 7.14 | 8.68 | 7.40 | 7.98 | 0.06 | 8.22 |
| World total | 6.39 | 2.08 | 2.68 | 1.45 | 1.02 | 0.29 | 1.12 |

[a] Service sectors do not have land transport margins therefore are not included in this table (however the value of service trade is included in the total column.
n/a – not applicable.
Source: GTAP Version 7,C2 database, October 2008