Latin America/Caribbean and Asia/Pacific
Economics and Business Association

An initiative of the Inter-American Development Bank and the Asian Development Bank Institute

Third LAEBA Annual Meeting
Seoul, South Korea – November 16, 2006

Road infrastructure and regional trade: Evidence from the GMS

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Prepared for LAEBA-2006 Third Annual Meeting

16-17 November 2006, Seoul

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Organization of the presentation

1. Background of the research and current status in its overall scheme
2. Major findings from econometric analysis for Greater Mekong Subregion
3. Ongoing case study on North-South Economic Corridor Project

Relevant literature

- Economic geography: geographic conditions matter for grade and economic development (e.g., distance and market access, landlocked vs. coastal economies) – e.g., Lao PDR, Bolivia.
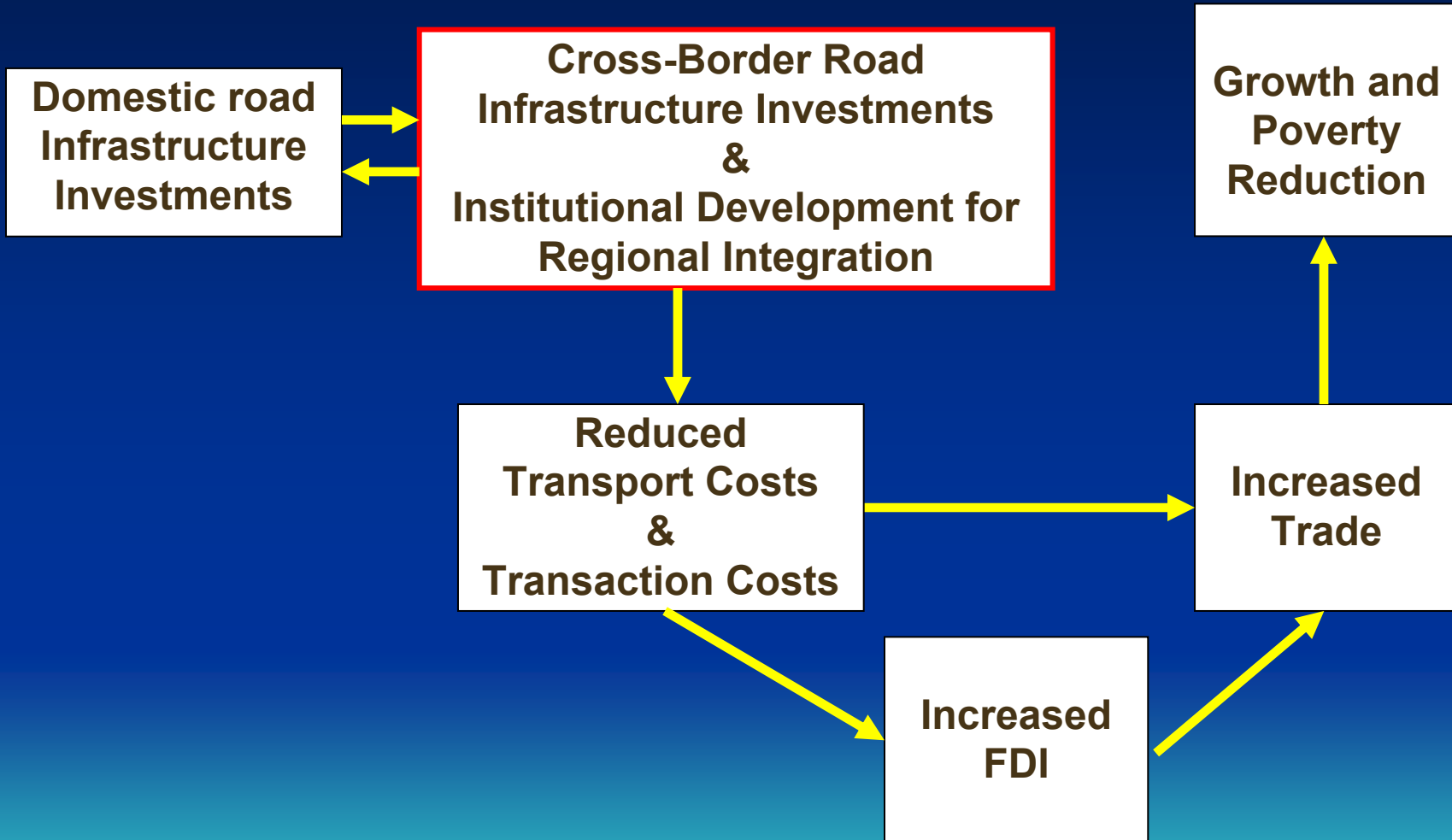
  Limao and Venables (2001), Redding and Venables (2004)

- Trade with transport costs and intra-firm trade: reduced transport and transaction costs increase trade and induce FDI, which, in turn, increase intra-firm trade, leading to trade-FDI nexus.

  Urata (2001); Fukao, Ishido, and Ito (2003)

Impact flow

Feedback of the impact
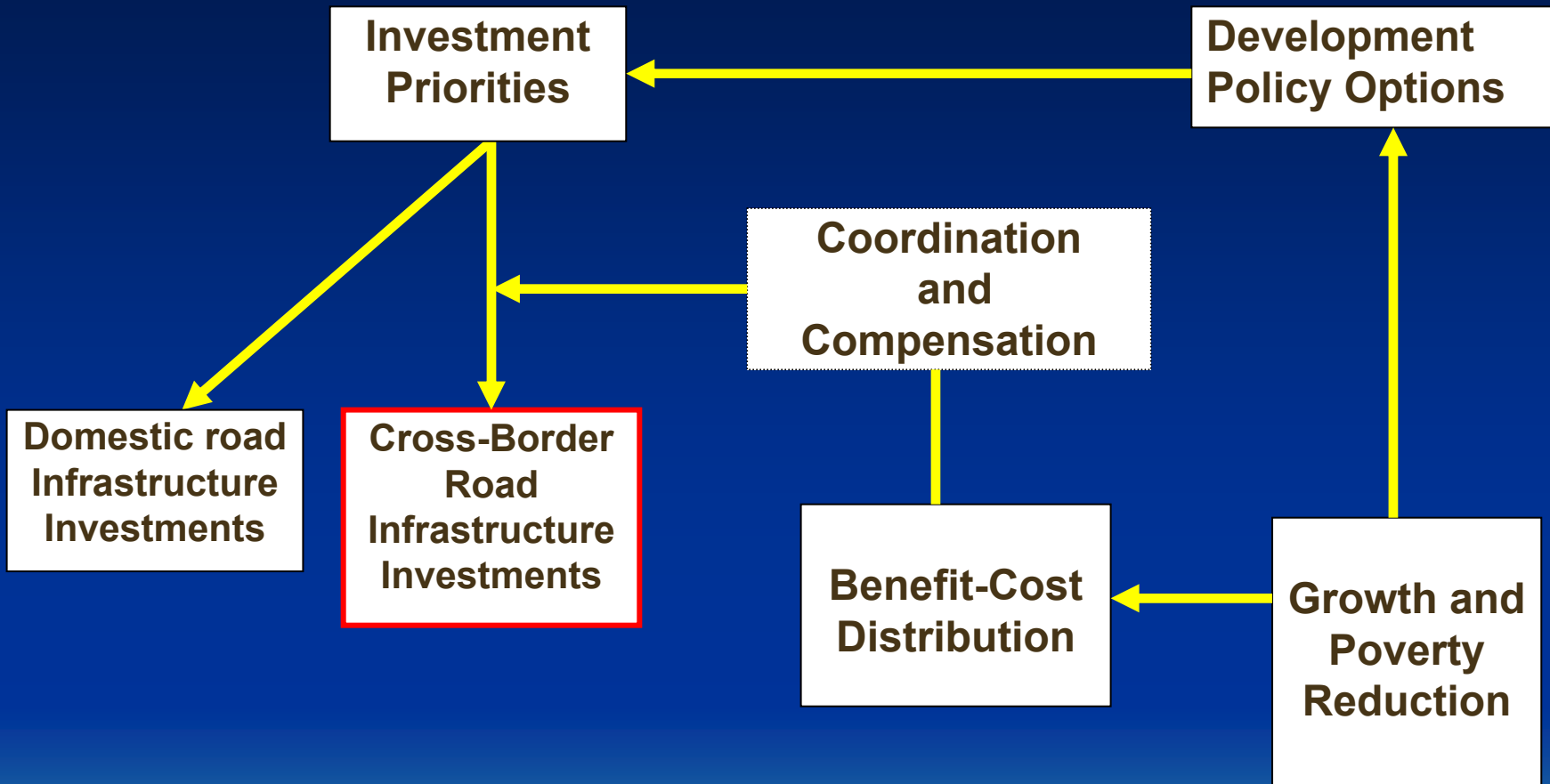
Research questions

1. To what extent does cross-border road infrastructure reduce transport costs and increase trade, and also induce investments?

2. How are the regional benefits and costs associated with cross-border road projects distributed across stakeholders?

3. What are the best coordination/compensation and financing mechanisms to ensure a desired level of supply in cross-border road infrastructure? - avoiding free-rider problems.

Econometric Analysis for GMS

- GMS members: Cambodia, Lao PDR, Myanmar, Thailand, Vietnam, and Yunnan Province of China (Guangxi Autonomous Region joined the GMS in 2005)
- Adequately diverse and complementary in trade.
- Share of intra-GMS trade and FDI has been on a rising trend.
- Trade-FDI nexus may be at work.

Estimation models

Trade equation: $X_{ij} = X(\boldsymbol{E}_i, \boldsymbol{E}_j, \boldsymbol{R}_{ij}, \boldsymbol{R}_{ji}, D_{ij}, F_{ij}, \omega_{ij})$

X_{ij} : exports transported over land from economy i to j

$\boldsymbol{E}_i$, $\boldsymbol{E}_j$: vector of characteristics of economy i (j) related to trade such as GDP, population, land area, and trade barriers.

$\boldsymbol{R}_{ij}$, $\boldsymbol{R}_{ji}$: vector of variables measuring road density in border and non-border areas in economy i (j) with respect to economy j (i).

D_{ij} : distance between economies i and j.

F_{ij} : economy i's foreign direct investment from economy j.

ω_{ij} : other factors not accounted for (model error).

FDI equation: $F_{ij} = F(E_i, E_j, R_{ij}, R_{ji}, D_{ij}, X_{ij}, z_i \, \varepsilon_{ij})$

F_{ij} : economy i's foreign direct investment received from economy j

$E_i, E_j, R_i, R_j, X_{ij}$: same as in the trade equation

z_i : vector of characteristics related to economy i's investment climate

ε_{ij} : other factors not accounted for (model error).

Dataset (Table 1)

- $6 \times 5 = 30$ economy pair is formed from 6 GMS members.

- 30×23 years (1981-2003) = 690 maximum observations for each variable

- However, missing data problems posed challenge in estimating the models.

- Degree of freedom is exhausted quickly as more RHS variables are added.

Data for transport costs

- We would want to estimate transport costs as a function of various determinants including road infrastructure.

- This avenue proved unavailable due to: little data on directly observed transport costs; limited number of GMS economies and unavailable CIF/FOB data disaggregated by trading partners.

- Therefore, we estimate determinants of trade and FDI in one step with road infrastructure variable in RHS.

Data for trade flows

Measure 1: bilateral total exports between GMS economies – taken from IMF-DOTS

Measure 2: "major exports" considered to be transported over land between GMS economies (up to five categories at HS 4-digit level selected based on local customs information)

- Advantage of Measure 2: more relevant to road impact.
- Disadvantage: some subjectivity due to the sketchy local customs information

Data for road infrastructure

- "Cross-border road infrastructure" is represented by the density of paved roads in the provinces/states that contain international crossing point (s) to one or more GMS economies.
  - "cross-border road exporter"
  - "cross-border road importer"

- "Domestic road infrastructure" is represented by the density of paved roads in the provinces/states that do not border with any GMS economy.
  - "domestic road exporter"
  - "domestic road importer"

International crossing points in GMS

Bordering countries A/B	No.	A's border city/town	A's border province/state	B's border city/town	B's border province/state
Cam/Lao	1	Trapeangkreal	Stung Treng Province	Khinak	Champassack Province
Cam/Thai	2	Poipet	Bantreay Meanchey Province	Arayaprathet	Sa Kaeo Province
	3	Cham Yeam	Koh Kong Province	Hat Lek	Trat Province
Cam/Vie	4	Bavet	Xvay Rieng Province	Moc bai	Tay Ninh Province
Lao /Thai	5	Huoayxay	Bokeo Province	Chiang Khong	Chiang Rai Province
	6	Thanaleng	Vientiane Municipality	Nong Khai	Nong Khai Province
	7	Thakhek	Khammouan Province	Nakhon Phanom	Nakhon Phanom Province
	8	Savannakhet	Savannakhet Province	Mukdahan	Mukdahan Province
Lao/Vie	9	Nam Phao	Borikhamxay Province	Cau Treo	Ha Tinh Province
	10	Densavanh	Savannakhet Province	Lao Bao	Quang Tri Province
Lao/Yun	11	Boten	Luangnamtha Province	Mengla	Xishuanbanna Region
Mya/Thai	12	Myawadi	Kayin State	Mae Sot	Tak Province
	13	Tachilek	Shan State	Mae Sai	Chiang Rai Province
Mya/Yun	14	Mongla	Shan State	Daluo	Xishuanbanna Region
	15	Muse	Shan State	Ruili	Baoshan Region
Vie/Yun	16	Lao Cai	Lao Cai Province	Hekou	Wenshan Region

Estimation Procedures

"Random effects" or "robust OLS" estimator is used.

1. The Hausman test determines suitability of "random effects" estimator over "fixed effects" estimator by checking whether strong parametric assumptions required for the former are met.
2. The Breusch-Pagan test evaluates the significance of random effects versus a regular OLS estimator.
3. If the Hausman test does not indicate suitability of random effect estimator, we use "robust OLS" estimator, which is the regular OLS estimator with corrected standard errors taking into account the panel-nature of the data. The fixed effects estimator cannot be applied since key variables of concern (e.g., distances, land areas) are fixed over time.

Major findings (1)

- Economic size (GDP) appears to be a dominant driver of both trade and FDI, and other variables of the gravity model generally perform as expected (except for the estimates of FDI flows.

- The elasticity of trade in major exports likely to be transported over land between GMS economies with respect to developments in cross-border road infrastructure is in the range of 0.6-1.4.

Major findings (2)

- When measures of both cross-border and domestic road infrastructure are considered, cross-border roads have a positive association and domestic roads have a negative association with trade flows (both major exports and total trade).

- Variables for trade barriers (weighted average tariff rates) and a trade environment failed to yield significant associations with trade flows, suggesting a relatively greater impact of unmeasured non-tariff barriers or poor measurement of these proxies for trade policy.

Conclusion from the analysis

- Development of cross-border road infrastructure in the GMS has had a positive effect on the regional trade.
- The result suggests that promotion of regional trade may require deliberate policy shifts toward investments in roads in border areas.
- Sample size constraints associated both with the relatively small number of GMS economies were severe.
- Application of the gravity model to intra-GMS FDI flows appears premature, but could gain relevance as FDI flows become active in the future and the data situation improves.

Ongoing Case Study on North-South Corridor Project

Main road project: upgrades 228 km to paved all-weather road, linking Bokeo and Luang Namtha Provinces of Lao PDR with Chiang Rai Province in Thailand and Yunnan Province in China

How large are the regional benefits and costs, how are they distributed across stakeholders, and how coordination is done?

North-South Economic Corridor
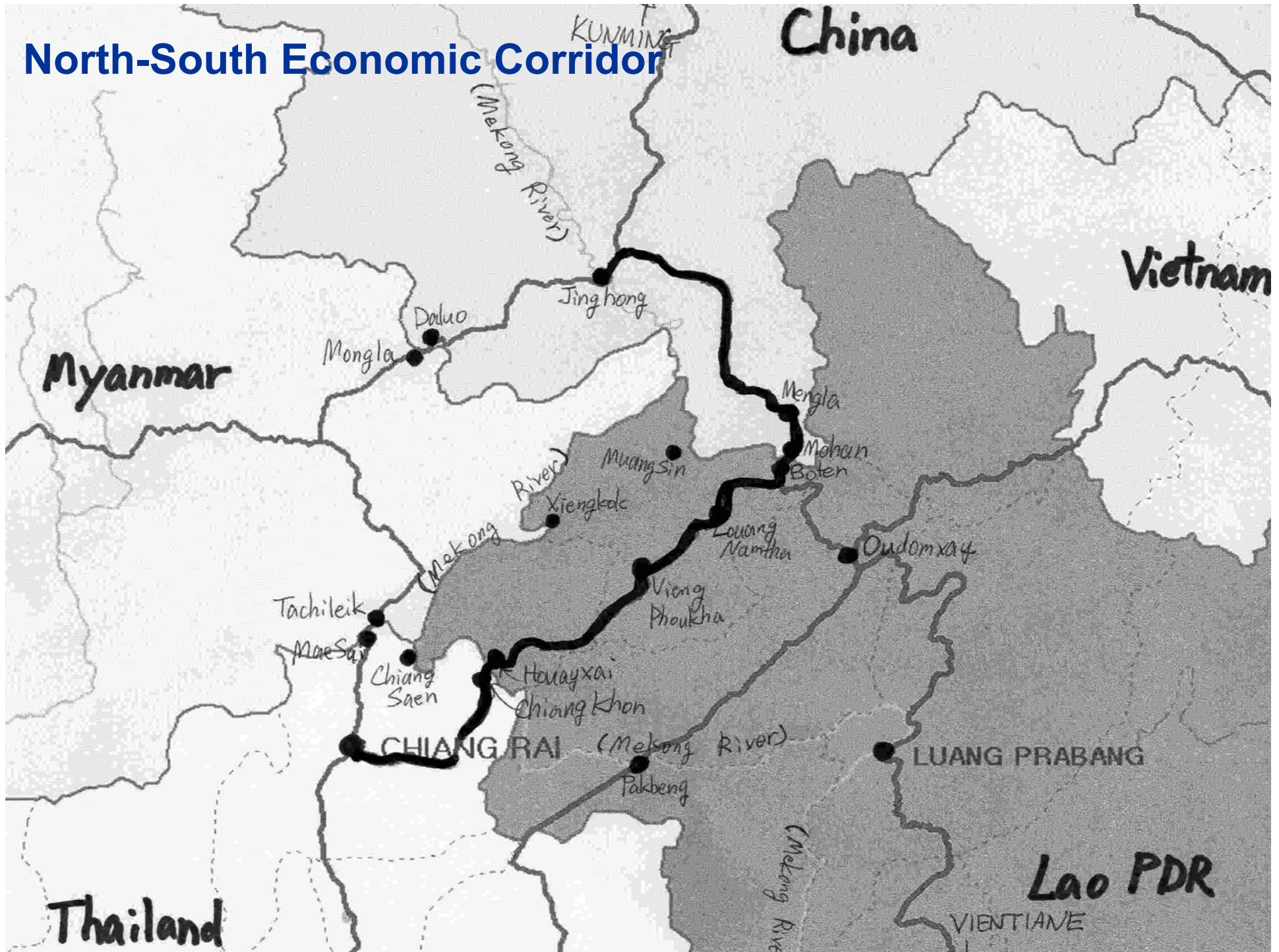
Project summary

- Construction period (panned): Mar 2002 - Feb 2007
- Total cost US$95.8 million with 4-party cost sharing: Thai government US$30 m., ADB US$30 m., PRC government US$28.5 m., and Lao PDR government US$7.3 m.
- Planning and construction of Houayxai-Chiang Khong bridge is currently being negotiated among the same parties.
- Economic activity along the road has been limited to subsistence agriculture, minor trade by traveling merchants, and natural resource extraction (logging, mining).
- Road project includes two 'social developmemt' components
  - area development (AIDS awareness, sanitation, road safety…)
  - capacity building (on-the-job training for the road sector at the provincial level).

Current practice of economic analysis: an illustration
(US$ million in 2002 present value)

Effects	Total by Effect	Lao PDR			Thailand			China		
		Corp.	Consumer	Govt./ Rest of economy	Corp.	Consumer	Govt./ Rest of economy	Corp.	Consumer	Govt./ Rest of economy
Saved Trans. Costs										
Normal traffic	40.10	6.66	9.05	6.23	13.26	0.95	0.78	1.42	0.97	0.78
Generated ---	12.21	6.64	0.87	2.21	0.59	0.18	0.40	0.63	0.21	0.48
Diverted ---	33.92				4.04	7.10	5.82	4.04	7.10	5.82
Toll Revenue	30.2			30.2						
Construction Costs										
Labor	-7.3			-7.3						
Equipment	- 20.8			-20.8						
Materials	- 13.5			-13.5						
Other	-10.4			-10.4						
O & M	-7.6			-7.6						
Finance	0			34.6			-17.3			-17.3
Net Benefits	56.83	13.3	9.92	13.64	17.89	8.23	-10.3	6.09	8.28	-10.22
By economy (share%)	(100)	36.86 (64.9)			15.82 (27.8)			4.15 (7.3)		

Source: Adapted from ADB TA Report No.3817 (Feb 2003)

Implicit coordination mechanisms

- Toll revenue collected by Lao government from road users originating from Thailand and China.

- Concessional loans provided by Thai and Chinese governments to Lao government to finance the road project.

Limitations of current practice

- Benefit quantification: limited to the savings of transport costs

- Cost quantification: limited to road construction and maintenance costs

Expected positive impacts of the Project

- Increased flows of commodities, goods, and passengers between the three economies.

- Improved access to public services and distant labor/goods markets and therefore, improving the welfare and incomes of households along the road.

- Increase in ecotourism visitors.

- May attract investment in small scale manufacturing or processing facilities.

Possible negative impacts of the Project

- Rising land value may displace poor households, depriving access to forest resources for subsistence.

- More unsustainable logging and commercial cultivation of industrial tree crops (e.g., rubber).

- Increase in illegal wildlife trade.

- Increase in transmission of communicable diseases, human trafficking and prostitution.

Detailed modeling currently considered for representative traded goods

- Model market structure of representative commodities whose trade between Laos, Thailand and China will be significantly affected by the road: e.g., rubber, maize, lignite coal, lumber, tropical fruits, temperate fruits and vegetables, – partial equilibrium models.

- Run simulations on the likely impacts of the road on production, consumption, and trade, and distribute the impacts spatially.

Information to be collected

- Current patterns of production, consumption and market characteristics for representative commodities in Laos, Thailand and China

- Detailed land use map associated with these commodities.

- Benchmark prices (farm gate, border, wholesale, and retail prices according to value chain).

- Transport cost share in the prices

- Expected changes in routs and modes of transport for the commodities, and corresponding changes in transport costs

- Elasticity of local supply/demand and trade with respect to transport cost changes; and world market trends likely to affect local responses