ISET POLICY INSTITUTE

INCEPTION REPORT

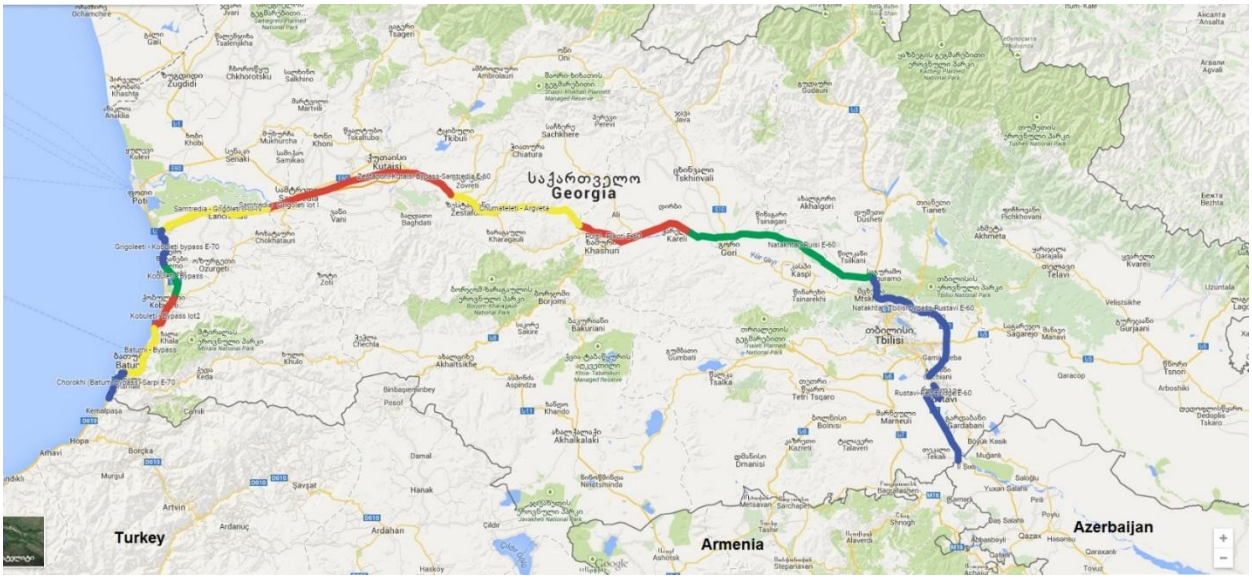
GEORGIA: IMPACTS OF EAST-WEST HIGHWAY CORRIDOR (P154067): CGE MODELING CONSULTANCY

MARCH 25, 2015

Introduction

The East-West Highway (EWH) is the Georgian main transport artery of 392 km, going from Red Bridge (border with Azerbaijan) to Poti port in Georgia (Picture 1) and carrying over 60 percent of the total foreign trade. It is a part of the European route E-60, the second longest E-road. It runs from Brest, France, to Irkeshtam, Kyrgyzstan.

Picture 1: East-West Highway in Georgia



Source: http://www.georoad.ge/?lang=geo&act=project&uid=1395214926

Prospective Projects

Completed Projects

Ongoing Projects

Planed Projects

In recent years, the Government has made significant progress in constructing the EWH. It is seen as a central piece in the Government's strategy of transforming Georgia into a transport and logistics hub for trade between Central Asia and the Far East on the one hand and Turkey and Europe on the other hand.

It is expected that the EWH reconstruction will be completed by 2020 upgrading of the highway to international motorway standards (2x2 lanes). The reconstruction is financed by the Georgian Government and a number of international organizations including World Bank, the Asian Development Bank, the European Investment Bank, and the Japanese International Cooperation Agency.

Table 1: Status of East – West Highway Development

Road Section	Length (km)	Financier	Completion date
Rustavi-Red Bridge	36	Project under consideration	
Tbilisi - Rustavi	21	ADB	Ongoing, 2015
Tbilisi – Natakhari	11	State Budget	Completed, 2007
Natakhari - Aghaiani	16	State Budget	Completed, 2009
Aghaiani - Ruisi	50	World Bank	Completed, 2013
Ruisi - Agara	19	World Bank	Ongoing, 2015
Agara – Zemo Osiauri	12	World Bank	Ongoing, 2015
Zemo Osiauri - Chumateleti	14	World Bank	Under Preparation
Chumateleti - Argveta	51	Project under consideration	
Argveta - Samtredia	59	JICA	Ongoing, 2015
Samtredia – Choloki	70	EIB	Planned, 2016
Choloki – Kobuleti bypass	33	ADB	Planned, 2016

Objective and scope of work

In line with the ToR, the consultancy is aimed at providing "an analytical foundation to assess the indirect economic benefits of continued donor investment in the EWH corridor, including the assessment of the indirect impacts of cumulative investments along the corridor".

In the framework of the consultancy, the researchers are seeking to answer the following questions:

- How will the EWH lower the transportation costs for producers of goods and services?
- What are the economy wide impacts of the EWH Corridor on employment, real GDP growth, investment, trade and poverty?
- Could EWH foster an increase in production of goods and services? Could these effects translate into higher household income and consumption? What will be the impact on poverty?

- Could the corridor help bridge the existing economic divide between rural and urban areas in Georgia?

The study will test whether the EWH as a large-scale infrastructure investment project can bring significant productivity and trade stimulus to foster the economic growth and welfare in the country.

Work plan and deliverables

The consultancy will follow the working plan presented below:

No	Activity	March 4-6	March 9-13	March 16-20	March 23-27	March 30 – April 3	April 6-10	April 13-17	April 20-24	April 27 - May 1	May 4-8	May 11-15	May 18-22	May 25-29	June 1-5	June 8-12	June 15-19	June 22-26	June 29-30
1	Inception Report Writing				D1														
2	Supplementary Data Collection / Transport costs estimate																		
3	CGE Modeling																		
4	Draft report writing													D2					
5	Work on comments / Final report																		D3

The team will submit the deliverables:

			Terms
D1	Deliverable 1	Inception Report	3 week after contract issuance (March 25, 2015)
D2	Deliverable 2	Draft Report	May 30, 2015
D3	Deliverable 3	Final Report & Non-Technical Presentation	2 weeks after comments received, but not later than June 30, 2015

The report will cover the following issues:

- **Brief literature review**
- **Description of Social Accounting Matrix** with the focus on transportation sectors

- **Assessment of changes in transportation costs** associated with the reconstruction of the EWH, both due to time savings and reduction in vehicle operation costs; to the extent possible, mapping transport costs reduction effects with specific sectors
- **Description of the CGE model** for Georgia, focusing on modifications (increasing returns to scale, modeling of transport margin, modeling of transit) and explanation of transmission mechanisms
- **Analysis of results of simulations**, including macroeconomic impact, sector impact, distributional effects
- **Sensitivity checks**
- **Conclusions and recommendations**, including description of potential extensions of the model

Description of data and methodology

Social Accounting Matrix

The ISET Policy Institute has constructed detailed Social Accounting Matrix based on 2013 data. De-facto, we have three types of SAMs:

- SAM 15x15x20: 15 activities and 15 commodities and 20 representative household groups (rural and urban areas of 10 regions, including Tbilisi).
- SAM 45x67x1: 45 sectors of production and 67 product groups following GeoStat classification, but with 1 representative household.
- SAM 15x15x5: 15 activities and 15 commodities, and 5 household groups classified by income levels.

All SAMs have three types of factor of production: capital, hired labor, and self-employed labor. They also include Trade and Transport Margins as a separate account and the following taxes: VAT, excise tax, import tax, subsidies, and other taxes. Government and Rest of the World are included in the SAM as separate accounts.

Within this consultancy, we plan to work with the most disaggregated SAM (45 sectors of production and 67 product groups), adding to the SAM disaggregated household dimension (low, medium and high income groups, rural and urban households).

The matrix incorporates data from different sources: National Statistics Office of Georgia (GeoStat), National bank of Georgia (NBG), Ministry of Finance (MoF). More specifically, we used Integrated Household Survey Data to calculate households' expenditure on different services and goods, including land transportation. Input-output tables of GeoStat also provide information about production and consumption of different services and goods by different economic activities.

Importantly, the Input-Output Tables provided by GeoStat contain detailed information about different types of transport sectors, including land and rail transport as separate sector allowing proper assessment of the role of land transportation – and the EWH as its large component – in the economy. For each sector, we know exactly the value of land transport services in the structure of sector's production. For example, mining and quarrying sector has used 16.6 million GEL worth land transportation services in 2013.

In addition, Input-output tables include information about Trade and Transport Margins, which basically reflects the difference between producer and consumer prices.

Transport Cost

In order to calculate indirect overall economic benefit of East-West Highway (EWH) using CGE model, first we would need to estimate reduction in transport cost for different economic sectors and households, assuming that the EWH is fully constructed.

It is worth noting that as of now Georgian data seems to be sufficient to estimate changes in transport costs, and we don't need to develop proxies using data of other countries.

The task includes the following sub-tasks:

Sub-task 1: Calculate usage of EWH in terms of vehicle kilometers (by vehicle types), based on Road Department Statistics.

From the Road Department we received transport intensity statistics on international roads of Georgia (AADT). Types of vehicles include: cars, microbus, bus and trucks, Trailers (and >3 axis). The data is collected at 38 points, from which 17 points lay on EWH, out of 17, 4 points are already on constructed part of the EWH and another 13 points are on the planned territory of EWH. Using transport intensity numbers we will estimate total vehicle kilometers driven on EWH by different types of vehicles during the 2013.

Sub-task 2: Calculate average time saving per kilometer of EWH, using feasibility and pre-feasibility studies of different sections of EWH.

For Tbilisi bypass and Kareli-Rikoti sections for which, this information is not available, we will use the other similar section of the road to estimate the time saving. According to the WB feasibility studies of five different sections of EWH, total of 98km, the average time saving per kilometer is about 0.24 minutes (varies from 0.2 to 0.3 minutes per kilometer), which is 30% of required time without EWH.

Sub-task 3: Monetize time savings using average wage rate, unemployment statistics and GDP per capita.

This action also includes assumptions regarding number of passengers in different types of vehicles and their travel purposes (according to the WB feasibility studies it was assumed that 2/3 of passenger trips are for work and 1/3 for other purposes).

Sub-task 4: Calculate vehicle operating cost saving per kilometer of EWH, using feasibility and pre-feasibility studies with updated price and wage rates.

Sub-task 5: Identify sectors potentially using the highway based on Input-output tables, regional GDP and interviews with key stakeholders (large businesses, logistics and transportation companies), in order to split overall transport cost saving among different economic sectors and households.

In addition to vehicle operating cost saving and time saving, we will obtained data about fares and freight charges through interviews with transportation companies and survey of public transport providers. This baseline data will help WB to monitor the financial consequences to road users of corridor improvements.

Trade Statistics

Detailed trade data (HS 6 digit, 1136 commodity groups) is available at GeoStat. In addition, we have number and type of transport crossing Georgia's borders, which we may use to estimate transit as a separate sector. Georgian National Tourism Administration database[1] provide unified transport statistics, describing the dynamics of inbound and outbound means of transportation within the territory of Georgia, registered at 19 border checkpoints:

- Air - Tbilisi International Airport, Batumi International Airport
- Sea - Poti port, Batumi port, Kulevi port
- Land - Tbilisi, Akhkerpi, Guguti, Vale, Vakhtangisi, Ninotsminda, Sadakhlo, Sarpi, Kazbegi, Tsodna, Tsiteli Khidi, Gardabani, Samtatskaro, Kulevi

Information on the following means of transportation is provided: Air transport, Bus, car, truck. Land transport statistics are provided by the Information Centre in the Information and Analytical Department of the Ministry of Internal Affairs of Georgia. Air transport statistics are available from the Transport Policy Department of the Ministry of Economy and Sustainable Development of Georgia. Air transport statistics include regular and charter flights.

CGE model

Constructing the current model we followed Mathiesen (1985)[2] and Rutherford (1995; 1999)[3] and set up an Arrow–Debreu equilibrium as a mixed complementarily problem. Three types of weak inequality conditions are satisfied simultaneously: zero profit, market clearance and income balance.

[1] http://stats.georgia.travel/Default.aspx

[2] Mathiesen, Lars. 1985. "Computational Experience in Solving Equilibrium Models by a Sequence of Linear Complementarity Problems." *Operations Research* 33 (6) (November 1): 1225–1250. doi:10.2307/170635

[3] Rutherford, Thomas F. 1995. "Extension of GAMS for Complementarity Problems Arising in Applied Economic Analysis." *Journal of Economic Dynamics and Control* 19 (8) (November): 1299–1324. doi:10.1016/0165-1889(94)00831-2; 1999. "Applied General Equilibrium Modeling with MPSGE as a GAMS Subsystem: An Overview of the Modeling Framework and Syntax." *Computational Economics* 14 (1-2): 1–46

Households exchange labor effort for wage, which is assumed to be fully employed and mobile across sectors with flexible real wages. They transfer (receive) funds from the government and the rest of the world, and pay tax to the government. The government receives income from collecting taxes and tariffs, and also receives (transfers) funds from domestic households and the rest of the world. The government then purchases commodities to distribute public goods and services, and saves a fixed proportion of the income.

Firms produce a single good using a multi-level, differentiable, constant return to scale production function that combines factor inputs[4] (Figure 1) with intermediate goods. The capital and labor bundle assume a Cobb-Douglas function, while the combination of the capital and labour is combined with intermediate inputs using the Leontief function. Similar to Hosoe et al. (2010)[5] and Rutherford et al. (2002),[6] we use a constant elasticity of transformation (CET) function to split production into export and domestic consumption. Then, domestic consumption and imports are aggregated to form the Armington final good (Armington 1969).[7]

The rest of the world (ROW) is modeled as a simple agent that demands foreign savings (in the domestic economy). Its budget is equal to ownership of domestic capital (if any), net remittances, and demand for net imports. In the model, all of these agents operate in a small open economy (SOE) environment in which the country cannot affect world prices. Export and import prices quoted in foreign currency are exogenously given.

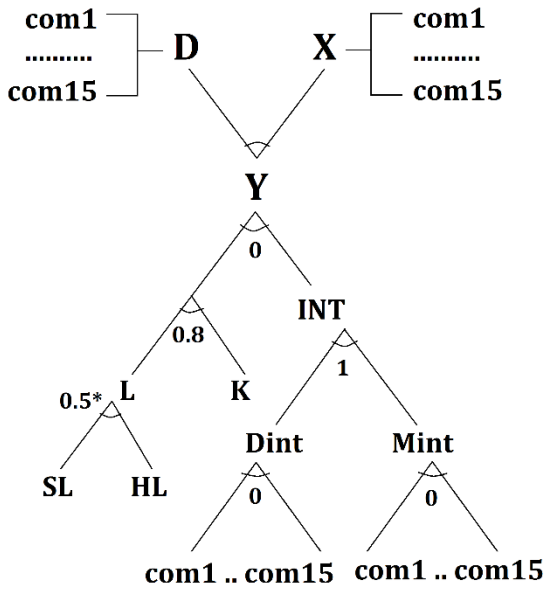
[4] Elasticity of substitution between self-employed and hired labor is assumed to be 0.5. We make an exception for agricultural sector where we assume that self-employed and hired labour are perfect substitutes.

[5] Hosoe, Nobuhiro, Kenji Gasawa, and Hideo Hashimoto. 2010. *Textbook of Computable General Equilibrium Modelling: Programming and Simulations*. Palgrave Macmillan.

[6] Rutherford, Thomas F., Miles K. Light, and Gustavo Adolfo Hernandez. 2002. "A Dynamic General Equilibrium Model for Tax Policy Analysis in Colombia". MPRA Paper 28435.

[7] Armington composite goods are used to account for cross hauling (two-way trading) of the same good, i.e. the same type of goods are both imported and exported. See Armington, P. 1969. "A Theory of Demand for Products Distinguished by Place of Production". IMF Staff Papers 16. New York: International Monetary Fund

Figure 1: production functions



Y	Output
D	Domestic Supply
X	Export
L	Labour
K	Capital
SL	Self-Employed Labour
HL	Hired Labour
INT	Intermediate Input
Dint	Domestically Produced INT
Mint	Imported INT
Com	Commodity

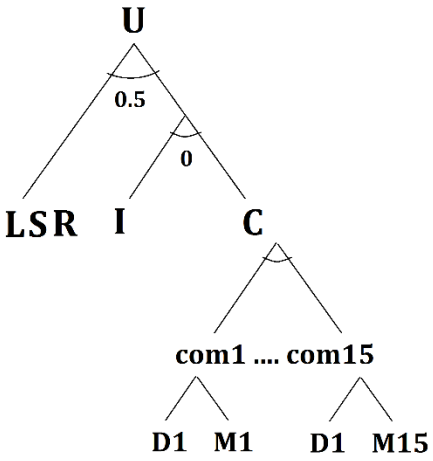
* Elasticity of substitution between SL and HL is 1 in Agriculture sector

Households maximize a multi-level utility function (Figure 2) taking into account their disposable income. Households get utility from leisure time, saving and consumption of commodity bundles, including imported or domestically produced products. We use a Cobb-Douglas function of consumption of goods, which is assumed to be in fixed proportion with savings. The elasticity of substitution between leisure and the consumption-saving bundle is assumed to be 0.5.

The government levies taxes and receives transfers from the ROW, and makes transfers to households and to the ROW. The remainder is used to purchase commodities (government consumption) and save/invest. Income tax revenue is allowed to endogenously adjust so that the level of government services is fixed to its baseline level for all counterfactual scenarios.

The ROW demands foreign savings and its budget comes from ownership of domestic capital, net remittances, and demand for net imports.

Figure 2: Utility functions



U	Utility
LSR	Leisure
I	Saving/Investment
C	Consumption of Goods & Services
com	Commodity
D	Domestically produced
M	Imported

We will assess the economic and social impacts of the construction of the EWH focusing on reduction in transportation costs for different sectors within the economy and also for foreign trade and transit. The assessment of the changes in transportation costs is described above.

We will revise the production structure of the CGE model for Georgia. Currently all sectors of the model are considered as being perfectly competitive and thus featuring constant returns to scale (CRTS). In revised version of the model, all sectors will be modeled as imperfectly competitive of Dixit & Stiglitz (1977)[8] type allowing economies of scale. There are several firms in each sector, and each firm in each sector produces one and only one variety of the product of that sector. It is assumed that all firms producing different varieties have identical fixed and marginal costs, leading to constant output per firm for all firm types. Production for each firm features increasing returns to scale (IRTS) as implied by existence of fixed costs in addition to marginal costs and thus equilibrium mark-up.

Presence of mark-up in the equilibrium is decisive, as it provides the way to introduce transport costs in the model. Transport cost mark-up enters into the model as a part of equilibrium mark-up following Oosterhaven & Knaap (2003).[9] The Dutch SCGE model RAEM, which is considered as the most relevant example for our study, applies bi-modal freight/people transport cost mark-up. This mark-up is a function of traditional iceberg transport costs of freight and passenger transportation (Bröcker, 1998)[10] and parameter π that gives importance of freight transportation. In turn, iceberg transport cost functions depends on distances and travel time,

[8] Dixit, A. K., Stiglitz, J. E. (1977), Monopolistic Competition and Optimum Product Diversity, American Economic Review, Vol. 67, pp. 297-308

[9] Oosterhaven J., Knaap T. (2003) Spatial Economic Impacts of Transport Infrastructure Investments. Appeared in: A. Pearman, P. Mackie & J. Nellthorp (eds) Transport Projects, Programmes and Policies: Evaluation Needs and Capabilities, Ashgate, Aldershot, 2003, pp. 87-1 http://regroningen.nl/oosterhaven/doc/Transtalk%2703%20RAEM%20ZZL.pdf

[10] Bröcker, J. (1998), Operational Spatial Computable General Equilibrium Modeling, The Annals of Regional Science, Vol. 32, pp. 367-387

which is different for different types of transportation and/or their combination. It is planned to consider several modes of transportation (road, railway etc.) in the model.

Lesser transport costs are expected to free resources that will be used to boost production, thus increase demand for labor, thus increase income and consumption. Also, cheaper transport will exert downward pressure to domestic prices, making products more affordable for consumers. Higher production is expected to boost exports. In addition, cheaper transport should boost transit as cheaper transportation will stimulate demand for road transportation services, benefiting transport sector and government. Higher government revenues are expected to positively affect welfare of households depending on social transfers.

The study will simulate several counterfactual scenarios including baseline, optimistic and pessimistic scenarios of transport cost reduction. The assessment will be given on macro-level, sector level and household group level. We will conduct robustness check exploring sensitivity of model results in respect to different elasticity.