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Georgia

Assessing Economy Wide Indirect Impacts of East-West Highway Investments through CGE Modeling

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CURRENCY EQUIVALENTS

(Exchange Rate Effective May 30, 2015)

Currency Unit – Georgian Lari
Georgian Lari 2.30 = 1 USD

WEIGHT AND MEASURES
Metric system

FISCAL YEAR
January 1 – December 31

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ABBREVIATIONS AND ACRONYMS

AADT	Average Annual Daily Traffic
ADB	Asian Development Bank
CET	Constant Elasticity of Transformation
CGE	Computable General Equilibrium
CRTS	Constant Returns to Scale
CTC	Caucasus Transit Corridor
EIB	European Investment Bank
EWH	East-West Highway
GAMS	General Algebraic Modeling System
GDP	Gross Domestic Product
GEL	Georgian Lari
GIZ	*Deutsche Gesellschaft für Internationale Zusammenarbeit* (GIZ)
GoG	Government of Georgia
HIS	Integrated Household Survey
IFI	International Financial Institution
ISET	International School of Economics at Tbilisi State University
JICA	Japan International Cooperation Agency
KM	Kilometer
MPGSE	Mathematical Programming System for General Equilibrium Analysis
NPISH	Non-Profit Organizations Serving Households
ROW	Rest of the World
SAM	Social Accounting Matrix
TC	Transport Costs
TRACECA	Transport Corridor Europe Caucasus Asia
USD	United States Dollars
VAT	Value Added Tax
VOC	Vehicle Operating Cost

ACKNOWLEDGEMENTS

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EXECUTIVE SUMMARY

The objective of this study was to assess the economy wide indirect benefits of investments in the East West Highway (EWH). This study has used a computable general equilibrium (CGE) model, which simulates indirect benefits associated with the completion of the upgraded road corridor. The transmission channel modeled is the reduction in transportation costs—reduction in vehicle operating costs and time savings—resulting from the investments in the EWH. This reduction in transportation costs is normally assessed when conducting cost-benefit analysis of road projects, but without assessing the indirect impacts their reduction has on the wider economy. Explicitly excluded from the analysis are the direct impacts associated with the civil works of the EWH investment program, which would have large impacts on real GDP and employment.

The model results reveal that the indirect benefits from the EWH investment program have an overall positive impact on key macroeconomic and welfare variables over the medium and long-term. Real GDP is assessed to increase by 1.5 percent over medium-term horizon and 4.2 percent over a long-term horizon. Both exports and imports are expected to expand in the long-run, with exports growing on average faster in the long-run. Infrastructure development contributes to growth in welfare of all categories of households, although the first two quintiles with the lowest income gain relatively less than other household groups. On average, rural households are expected to gain more than urban households, in line with a priori expectations. Sensitivity analysis suggests the results are robust to parameter changes.

Table E1: EWH Indirect Impacts, Cumulative Percentage Change from 2013 Baseline

	Medium-Term	Long-term
	Macroeconomic	
Real GDP	1.5	4.2
Real household consumption	1.5	4.4
Real government consumption	0.7	1.1
Real exports	-0.4	4.7
Real imports	-0.3	1.6
Unemployment	-2.8	-4.4
	Distributional	
Household income quintile 1	1.8	2.6
Household income quintile 2	2.1	3.2
Household income quintile 3	2.3	3.8
Household income quintile 4	2.5	4.0
Household income quintile 5	2.8	4.4

Note: Household income quintile 1 has the lowest income level, and quintile 5 the highest.
Sources: World Bank, ISET Policy Institute.

INTRODUCTION

1. Located at the crossroads of Europe and Central Asia, Georgia is a transit country connecting several important economic regions with a total population in excess of 800 million people, including the EU (503 million), CIS (277 million), Turkey (75 million) and the Caucasus Region (17 million). The Caucasus Transit Corridor (CTC) is a key transit route between Western Europe and Central Asia for transportation of oil and gas as well as dry cargo. CTC is part of the international and regional corridor TRACECA. The TRACECA corridor is the shortest route between Europe and the Caucasus and Central Asian countries through the Black sea ports. TRACECA is an alternative to the north corridor running through the Russian Federation and Belarus and the southern corridor running through Turkey and Iran, the latter has become less competitive due to international sanctions imposed on Iran. The East-West Highway (EWH) traversing Georgia is part of the CTC.

2. The EWH carries over 60 percent of total foreign trade and 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.[1] The EWH runs from the Red Bridge at the Azerbaijan Border to the Poti Port at the Black Sea coast for around 392 kilometers—2 percent of the Georgian road network length, and slightly less than a quarter of the international road network—with an average traffic of around 7,800 vehicles per day and traffic annual growth rate of around 7.0 percent. The EWH accounts for 23 percent of vehicle utilization in Georgian roads and 47 percent of vehicle utilization of Georgian international roads. The investments will improve connectivity between the Caspian and Black Sea, lower the cost of transport and logistics, and improve Georgia's connection to global markets.

3. The Government of Georgia is committed to completing the EWH investment program by 2020. The Government has in recent years accorded high priority to completing the upgrading of the EWH (392 km) to international motorway standards (2x2 lanes). In addition to the time savings generated from the upgrade to international motorway standard, which raises the travel speed, the introduction of new alignments in some sub-sections of the EWH will reduce the overall length of the corridor and further contribute to reduce travel time. The Government has opted to financing this important investment program using its own budget and significant support of the international financing institutions (IFIs). The total estimated cost of upgrading the EWH is USD 2.265 billion, which is equivalent to 13.7 percent of Georgia's GDP in 2014.[2] The World Bank has financed four road improvement projects along the EWH to complement the Government's initial investment from Tbilisi, and financing is also being provided by other IFIs (Table 1). Approximately 130 kilometers of the EWH have already been upgraded, of which 70 km were funded by the World Bank through the first two highway improvement projects (Highway Improvement Project 1 and 2). Works are

[1] The East West Highway is part of the European route E-60, which is the second longest E-road running from Brest, France (on the Atlantic coast), to Irkeshtam, Kyrgyzstan (on the border with People's Republic of China).
[2] As per the IMF's World Economic Outlook database of April 2015, Georgia's estimated GDP in 2014 was USD 16.5 billion.

on-going to complete an additional 177 km by 2015 with the support of the World Bank (32 km), the Asian Development Bank (33 km), the European Investment Bank (55 km), and the Japanese International Cooperation Agency (58 km).

4. The objective of this study is to provide an analytical foundation of the economy wide benefits of investment in the East West Highway (EWH), through the assessment of indirect impacts of cumulative investments. Explicitly excluded from the analysis are the direct impacts associated with the civil works, which would have large impacts on real GDP and employment. In order to assess the medium and long term economy-wide benefits of the EWH this study has used a computable general equilibrium (CGE) model, which simulates indirect benefits associated with the completion of the upgraded road corridor. In their most basic form, CGE models characterize a target economy (in this case, Georgia) using detailed consumption and production functions, together with a depiction of the market prices and price distortions (e.g., taxes or regulatory controls), providing a depiction of the economy "as is" in a static framework and then applying a shock. Such a depiction is contained in the Social Accounting Matrix (SAM), a comprehensive, economy-wide data table which represents how the different sectors of the economy interact.

5. Partial equilibrium models usually focus only on one part or sector of the economy, assuming that the impact of that sector on the rest of the economy is either non-existent or small, ignoring interactions with other sectors. A partial equilibrium model also does not take into account the resource constraints of the economy; that to increase production in one sector resources need to be pulled away from other sectors. A partial equilibrium model is most suited for policy analysis when the policy-maker is only interested in sectoral policies, or when the sector under study represents only a small share of total income, or policy changes are likely to change the price in only one market, while prices in other markets will remain constant. In contrast, CGE modeling is an established method for studying economy-wide impacts.

6. A CGE model is a simultaneous equation system that consists of equations representing various economic relationships for different economic agents, such as producers and households. The analytical process includes parameter calibration and policy simulation. Key parameters in the equilibrium model are calibrated through inverse equations based on initial economic information from the SAM. The calibration is conducted under equilibrium given all the information from the SAM representing a real equilibrium economy. Then a new equilibrium is computed through simultaneous equations and by adopting calibrated parameters. Impacts on output variables are calculated after adjusting some of the input variables—in this case transportation costs. Impact changes are measured by the difference between the values of new output variables vis-à-vis original output variables.

Table 1: Overview of EWH Costs, Financing, and Completion by Road Section

Road Section	Length (km)	Cost Estimate (USD million)	Source of Funding	Completion date
Rustavi – Red Bridge	36	110	Project under consideration	
Rustavi – Tbilisi. lot 1, lot 3	11	50	GoG-ADB	Ongoing, 2015
Rustavi – Tbilisi. lot 2	6.4	55	GoG-ADB	2017-2018
Natakhtari – Aghaiani	16	37.5	GoG	2009
Aghaiani – Ruisi	52	240	GoG-World Bank	2013
Ruisi – Agara	19	43	GoG-World Bank	Ongoing, 2015
Agara – Zemo Osiauri	12	55	GoG-World Bank	Ongoing, 2017
Zemo Osiauri – Chumateleti	14	202	GoG-EIB-WB	Current Phase
Chumateleti – Argveta	54	800	Feasibility Study (GoG-WB)	Future Phases (2020)
Zestafoni – Samtredia	57	212	GoG-JICA	Ongoing, 2016
Samtredia – Grigoleti	51	260	GoG-EIB	Ongoing, 2017
Choloki – Kobuleti bypass	33	200	GoG-ADB	Ongoing, 2016
Total	361.4	2,264.5		

Note: The total length of the completed corridor is expected to be less than the length of the sections prior to upgrade.
Sources: Roads Department of Georgia, World Bank.

7. CGE models are commonly used by countries and international financial institutions to simulate policy interventions to determine economy-wide impacts. The model allows for an assessment of the impact of transport investments on intra-country economic and social indicators. A large and growing body of evidence suggests that indirect effects arising from policy changes are not only substantial but may in some cases even outweigh direct benefits. Only a model that consistently specifies economy-wide interactions can fully assess the implications of economic policies or business strategies.[3] The analysis will be confined to impacts at the national level, even though the project can have significant trans-boundary spillover effects benefiting Georgia's trading partners. The construction of a CGE model for Georgia has already been undertaken by ISET Policy Institute, with support from the University of Warwick's Institute for Employment Research, through technical assistance financed by *Deutsche Gesellschaft für Internationale Zusammenarbeit* (GIZ) GmbH.[4] This study involved modifying the existing SAM and CGE model in order to carry out simulations to answer the question of economy wide impacts of the EWH investments,

[3] Norojono O., David Roland-Holst, and Guntur Sugiyarto (2010), Macroeconomic Effects of Road Corridor Investment in Kazakhstan, General Equilibrium Perspective, *Transportation Research Record: Journal of the Transportation Research Board*, No. 2162, Transportation Research Board of the National Academies, Washington, DC, pp. 90-97.
[4] Further information on this project can be found at: http://www2.warwick.ac.uk/fac/soc/ier/research/georgia/ A working paper presenting the CGE model is currently under preparation.

including impacts on real GDP growth, jobs, and trade, as well as impacts on households disaggregated by income. It aims 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 on employment, real GDP growth, trade, and household income?
- Could the EWH help bridge the existing economic divide between rural and urban areas in Georgia?

The study is aims to simulate quantitatively how the EWH as a large-scale infrastructure investment program can bring significant stimulus to foster economic growth and welfare in Georgia.

CGE MODELING APPROACH

8. General equilibrium analysis allows researchers to obtain a comprehensive understanding of transportation infrastructure's impacts given its consideration of interactions between the demand and the supply, in contrast to partial equilibrium analysis. A large and growing body of evidence suggests that indirect effects arising from policy changes are not only substantial but may in some cases even outweigh direct benefits, but these are not captured in standard cost-benefit analysis. There is an extensive literature on the application of equilibrium modeling to the transport sector, including evaluation of impacts of infrastructure, investment, pricing, and other types of transport policies. CGE models are a class of economic models that use actual economic data to estimate how an economy might react to changes in policy, technology or other external factor. There are alternative types of CGE models, single country, multi-country and global models, as well as spatial CGE models, which in turn can be static or dynamic.

9. Many CGE models are comparative static as they model the reactions of the economy at one point in time.[5] For policy analysis, results from such a model are often interpreted as showing the reaction of the economy in some future period to one or a few external shocks or policy changes. That is, the results show the difference (usually reported in percent change form) between two alternative future states—in this case, with and without EWH investments.[6] The process of adjustment to the new equilibrium is not explicitly represented in such a model. By contrast, dynamic CGE models explicitly trace each variable through time—often at annual intervals. These models are more realistic, but more challenging to construct and solve—they require for instance that future changes are predicted for all exogenous variables, not just those affected by a possible

[5] These models are known as comparative static or comparative static CGE models.

[6] In comparative static frameworks temporal aspects are generally not addressed; the model is calibrated to data for a benchmark year generating a benchmark equilibrium. Then, policy analysis is performed by applying the policy or shock in the model and the model then computes a counterfactual equilibrium. The results from the two static equilibria are compared to reveal the impacts of the policy or shock. For an overview of comparative static and dynamic approaches to CGE modeling, see Sundberg, Marcus (2005), Spatial Computable General Equilibrium Modeling- Static and Dynamic Approaches. October 2005, Div. of Transport and Location Analysis, Dept. of Transport and Economics, Royal Institute of Technology, Stockholm, Sweden. Available at:
http://www.diva-portal.org/smash/get/diva2:14187/FULLTEXT01.pdf

policy change. The approach taken under this study was to assess impacts using a comparative static CGE model.

10. A steady-state formulation of an otherwise comparative static model was used instead as a proxy for a dynamic modeling approach. The steady-state model allows adjusting capital stock to a new steady state equilibrium in response to the changes in return on capital.[7] An increase in the rate of return on capital (relative to the cost of investment) due to policy shock results in increasing investments and thereby expansion of the capital stock. This in turn leads to reduction in the return on capital. Investors will continue expanding the stock of capital up until a new equilibrium is reached. Steady-state equilibrium results are considered as upper bound estimates, as they ignore the foregone consumption required to obtain the larger capital stock.

11. In addition to the static-dynamic dimension CGE models can be developed for a single country, region, or as global models. Single-country models tend to be more detailed in terms of sectors and household types, and they are in general used for analyses of country-specific policy issues and proposals.[8] Regional and global models, tend to have less sector detail, and in the case of global models are often designed for analysis of multilateral policies such as free-trade agreements and in the case of regional models, to assess the wider regional impacts of larger international transport infrastructure across countries or regional impacts within a single country. Lastly, while the demand for transport services reflects the location of production and consumption activities, most CGE models do not have a spatial dimension. Spatial CGE models models are specifically designed to account for the spatial dimension of the modeled intervention and have been used extensively when modeling infrastructure.

12. Despite their ability to measure policy effects on the economy, CGE models, as is the case with other classes of models, have limitations. As with any complex quantitative model, the aim is to model the real economy, but the dynamic and complex nature of real economic relationships mean that the models are at best an approximation and only as good as the underlying model specification, data and assumptions. A second limitation is related to the rationale of equilibrium modeling, which is to compare a simulated outcome from a policy variable with the base outcome without the shock. The results are sensitive to exogenous parameters, structure of equations, and the SAM. In practice, this means that the results should be treated with caution and used cautiously. These caveats also apply to other models—the results are only as good as the strength of the structure of equations, data, and underlying assumptions.

13. The modeling approach adopted is that of a static single country CGE model, with impacts confined to the national level, without modeling regional impacts within Georgia or broader trans-

[7] Jensen, Jesper, Thomas Rutherford, and David Tarr (2003). "Economy-wide and Sector Effects of Russia's Accession to the WTO." *Allied Social Science Meetings*, Washington DC.

[8] Lars Bergman (2005), CGE Modeling of Environmental Policy and Resource Management in *Handbook of Environmental Economics: Economywide and International Environmental Issues*, Vol 3, Karl-Göran Mäler and Jeffrey R. Vincent (eds), Elsevier B.V.: The Netherlands.

boundary spillover effects benefiting Georgia's trading partners. The latter point means that the modeling results should be treated as a lower bound, with impacts likely to be considerably larger. The decision to use a single country comparative static CGE model, without regional, spatial or dynamic dimensions was driven by the existence of an already developed country-level comparative static CGE model. The objective of this study was to simulate what indirect impacts, if any, the completed EWH could have on the Georgian economy and households, using the existing CGE model for Georgia, and depending on the outcome of the study, to propose modifications to the model as part of a potential second phase of modeling EWH impacts.

MODEL DESCRIPTION

14. The basic structure of the CGE core module comprises three main blocks of equations determining demand and supply relations, and market clearing conditions. In addition, various regional and national aggregates, such as aggregate employment, aggregate price level, and balance of trade, are defined here. Nested production functions and household demand functions are employed. For production, firms are assumed to use fixed proportion combinations of intermediate inputs and primary factors in the first level while, in the second level, substitution is possible between domestically produced and imported intermediate inputs, on the one hand, and between capital and labor, on the other. The modeling procedure adopted uses a constant elasticity of substitution (CES) specification in the lower levels to combine goods from different sources and primary factors. Given the property of standard CES functions, non-constant returns are ruled out. The model is realized in GAMS MPSGE.[9]

15. Two formulations of the CGE model were developed to assess the impact of the reduction in transportation costs on the economy as a whole, as well as distributional and sectoral effects—comparative static and comparative steady state. Both formulations are built on assumption of full mobility of primary factors– capital and labor. Thus, although the model does not contain an explicit time horizon, its results are typically considered as medium-term (comparative static) or long-term (comparative steady-state). Within the comparative static model, it is assumed that the stock of capital is constant and the return on capital changes in response to the policy shock. The comparative steady-state formulation of the model allows adjusting the capital stock to a new steady state equilibrium in response to the changes in return on capital. As the model is a comparative static as opposed to a dynamic CGE, it does not define a trajectory of movement of the economy to a new equilibrium point. The results of the model should not be considered as a forecast, but as simulations ignoring impact of all other economic shocks affecting the economy of Georgia. Further details on the model can be found in Annex 1.

[9] The General Algebraic Modeling System (GAMS) was the program used for the modeling. GAMS is a high-level modeling system for mathematical programming and optimization. It consists of a language compiler and a stable of integrated high-performance solvers. GAMS is tailored for complex, large scale modeling applications, and allows building large models that can be adapted quickly to new situations. For more information see www.gams.com.

STRUCTURAL PARAMETERS

16. Consumers treat imported and domestically produced goods as imperfect substitutes and producers consider sales on domestic markets or exports as imperfect alternatives, a standard structure knows as an Armington assumption. On the consumption side, the model distinguishes between public, investment and intermediate consumption as well as final household consumption for 5 or 20 categories of households: five household groups represent the structure of Georgian households by level of income, and 20 groups distinguish households by 10 regions of Georgia and two residential characteristics (urban and rural).

17. A SAM is a particular representation of the macroeconomic accounts of a socio-economic system, which captures the transactions and transfers between all economic agents in the system, recording transactions taking place during an accounting period, usually one year.[10] There are three main features of a SAM. First, the accounts are represented as a *square matrix*; where the incomings and outgoings for each account are shown as a corresponding row and column of the matrix. The transactions are shown in the cells, so the matrix displays the interconnections between agents in an explicit way. Second, it is *comprehensive*, in the sense that it portrays all the economic activities of the system (consumption, production, accumulation and distribution), although not necessarily in equivalent detail. Thirdly, the SAM is *flexible*, in that, although it is usually set up in a standard, basic framework there is a large measure of flexibility both in the degree of disaggregation and in the emphasis placed on different parts of the economic system.

18. As it is an accounting framework not only is the SAM square but also the corresponding row and column totals must be equal. A key aspect of a SAM is that households and household groups are at the heart of the framework; only if there exists some detail on the distributional features of the household sector can the framework truly be a 'social' accounting matrix. Also, a SAM typically shows much more detail about the circular flow of income, including transactions between different institutions (including different household groups) and between production activities, and in records the interactions between both these sets of agents via the factor and product markets.

19. The SAM for Georgia developed by ISET Policy Institute has 15 activities and 15 commodities, two factors of production and five or 20 representative household groups, representing the Georgian economy. Production in each activity uses intermediate inputs of goods and services as well as primary factors of production, namely capital and labor, the latter split into self-employment and hired labor. Aggregate output can either be exported or sold domestically. Together with imports from all trade partners, it forms the total aggregate of goods and services available for domestic consumption.

[10] Pyatt G., and J. I. Round (eds), 1985, *Social Accounting Matrices: A Basis for Planning*, The World Bank, Washington, D.C.

20. The impact of the reduction in transportation costs was modeled using the CGE model for Georgia with base year 2013. Comparative static and comparative steady-state versions of the model were specified, with the model applied to two different set of SAMs:

- SAM 15x15x5: 15 activities, 15 commodities, 5 household groups split by income level;
- SAM 15x15x20: 15 activities, 15 commodities, 20 household groups split by 10 regions and 2 types of residence, urban and rural.

21. A counterfactual scenario was developed based on the projected reduction in transportation costs associated with the upgrading of the EWH. Further details can be found in Annex 2.

MODELING OF TRANSPORTATION COSTS

22. The transmission channel that has been modeled is the reduction in transportation costs derived from the cumulative investments in the EWH.[11] While the choice between different modes of transport depends to a significant extent on the amount of time that the user has to spend, time is usually not treated as a scarce factor in CGE models, but in this approach, time savings and reduction in vehicle operating costs (VOC) are the transmission mechanisms that lead to changes in key macroeconomic variables and welfare. The reduction in transportation costs through a reduction in VOC and time savings are the ones normally modeled in cost-benefit analysis of road projects, including the EWH investment projects. This study aims to assess the wider impacts of the reduction in transportation costs in the wider economy.[12]

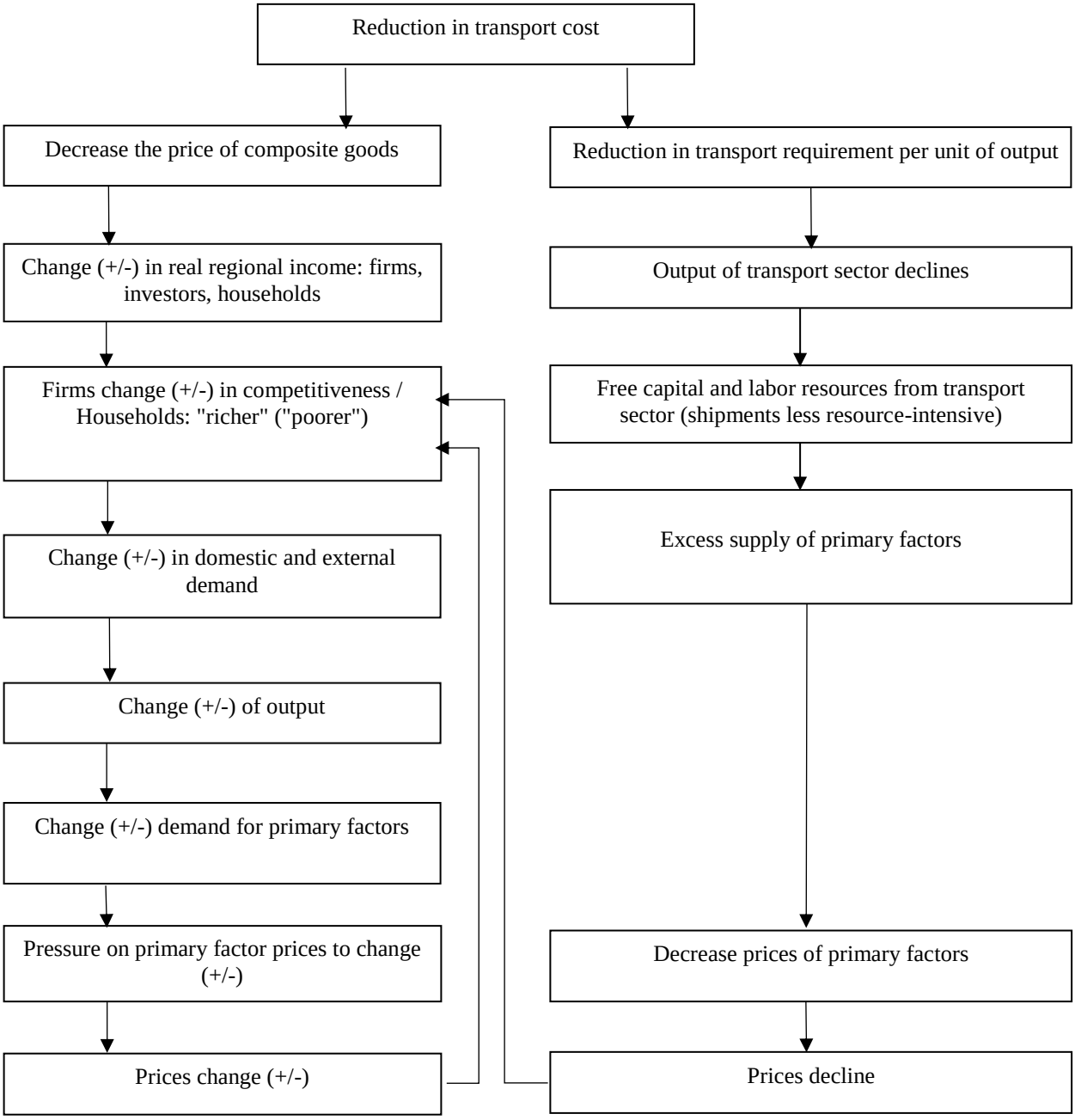
23. Figure 1 provides a schematic representation of the main causal relations underlying the simulation of the reduction in the transportation costs associated with the investments along the EWH. Time savings and VOC related cost reduction enter into the model differently. Time savings are considered as the reduction in the costs of transportation services to users, firms and households. Lower VOC are treated as the reduction in costs of the transport sector per se, that is, the sector can now produce each unit of output more cheaply. The reduction in transportation costs related to time savings implies a reduction in the use of transportation services per unit of output in all sectors, thus causing a direct reduction in the output of the transportation sector (Figure 1). As shipments become less resource-intensive, primary factors are freed, generating excess supply of labor and capital, resulting in a reduction in primary factor price (wages and capital return on capital). This stimulates

[11] The direct impacts of the investments associated with the EWH program have not been modeled given the manner in which the SAM has been developed. Capital enters into the SAM as capital earnings (based on input-output or supply-use tables). This is a standard approach which allows estimating the increase in the capital endowment as a shock on this variable given that the shock is comparable with the size of the variable. However, it is not applicable in this case as the shock (EWH investments) is very large. This would require estimating the annualized increase of capital equivalent to the multi-year EWH construction spending. Also, it would be necessary to model the increase in investments not as an exogenous shock, but as an increase or redirection of public spending and foreign aid to better represent the economic effects of the shock.

[12] Details of the data used for calculating VOC and time savings can be found in Annex 3.

reallocation of primary factors into other sectors demanding additional labor and capital supply as a result of production rising due to the lower cost of transportation.[13]

Figure 1: Reduction in Transport Cost Transmission Mechanism



[13] The model considers the reduction in both final and intermediate consumption of transport services, as well as the transport margin. Thus it captures both freight and passenger transportation. More detailed study of impacts on freight and passenger transportation would require additional data.

Source: ISET Policy Institute.

24. At the same time, the reduction in the VOC results in a decrease in price of transportation services, boosting competitiveness of this sector and increasing demand for its services. It stimulates increase in transportation sector output, acting just oppositely to previously described channel, namely generating excess demand for primary factors of production, resulting in growth of primary factor prices. Cheaper transportation services boost economic activity in other sectors and competition for primary factors further boosts wages and return on capital (or stimulates an increase in the capital stock in the steady state as a response to higher capital returns).

25. Lower transport costs also result in a reduction in the domestic price level and—together with changes in primary factor prices—affect real income of agents in the model, including households and producers (Figure 1). Changes in income generate changes in demand and output, once again affecting prices in the real economy. It is expected that the net effect of these changes will be positive. Freed resources will be used to boost economic production. Downward pressure to domestic prices will make products more affordable to consumers and is expected to boost exports. Higher government revenue collected through taxes is expected to positively affect the welfare of households depending on social transfers, thereby helping to alleviate poverty.

26. In order to calculate the indirect overall economic benefit of EWH using the CGE model, the reduction in transport cost is estimated assuming completion of civil works along the EWH. Transport cost saving consists of two major parts that are considered in the analysis, time saving and VOC saving. For evaluation purposes the EWH is divided into nine sections.[14] Each section has different average traffic—2013 annual daily traffic (AADT) provided by the Roads Department of Georgia—and the transport intensity of the sections varies by vehicle type: cars, microbus, bus and trucks, and trailers. Based on the usage of EWH in terms of vehicle-kilometers, vehicle operating cost (VOC) savings were calculated, comparing VOC before and after the civil works have been completed. An average VOC value of GEL 850.0 (USD 512) before works and GEL 688.6 (USD 414.9) after works was used for all road sections of the EWH, and given the relatively similar condition of the sections prior to the civil works this was considered to be a reasonable assumption, as opposed to section level VOC.[15]

27. Time savings were estimated using data from the World Bank feasibility studies where these were available, and in other sections, design speeds were compared to the current maximum allowed speed of the corresponding section. To calculate total time savings by person, it is necessary to have information on the number of vehicles travelling on the EWH, as well as vehicle occupancy figures. Vehicle occupancy data was available for Chumateleti-Argveta and Samtredia-

[14] The nine road sections are as follows: (i) Tbilisi-Natakhtari (11 km); (ii) Natakhari-Ruisi (66 km); (iii) Ruisi-Chumateleti (45 km); (iv) Chumateleti-Argveta (51 km); (v) Argevta-Samtredia (59 km); (vi) Samtredia-Choloki (70km); (vii) Choloki-Kobuleti (33km); (viii) Tbilisi-Rustavi (21 km); and (ix) Rustavi-Red Bridge (36 km).

[15] The GEL-USD exchange rate used in the modeling exercise was the annual average rate for 2013, with USD1 = GEL 1.66 as per the National Bank of Georgia. The exchange rate as of May 30, 2015 was 2.30, reflecting a 44 percent depreciation in the intervening period.

Choloki sections, and for other sections it was assumed that occupancy was the average of these two sections. [16] By multiplying average occupancy on average number of cars on a given section, for each category of vehicle, it is possible to derive the total number of persons travelling along each section of the EWH. In order to monetize time savings, it was assumed that 75 percent of trips are work related, and the value of time used was GEL 6.35 per hour (USD 3.83 per hour) for car passengers and GEL 4.23 per hour (USD 2.55 per hour) for minibus and bus passengers. The value of non-working time is assumed to be GEL 1.88 per hour (USD 1.33 per hour) for car passengers and GEL 1.25 per hour (USD 0.75 per hour) for minibus and bus passengers. These measures are based on the estimated value calculated by the World Bank in its economic analysis of the East-West Highway Improvement project currently under preparation.

28. Based on the above considerations it was estimated that VOC savings equal GEL 161 million (USD 97 million), while time savings equal GEL 322 million (USD 194 million). The next step was to assess how significant these transport cost savings are for land transportation.[17] According to information from national official statistics, the land transportation sector is equal to GEL 714 million (USD 430 million), including GEL 324 million (USD 195 million or 45 percent of total) for used in intermediate consumption, GEL 68 million (USD 41 million or 10 percent) as transport margin (that is to say, the cost of product delivery—the transportation margin together with trade margin and indirect taxes explain the difference between basic and consumer prices), GEL 306 million (USD 184 million or 43 percent) as households' consumption of transport services, and GEL 17 million (USD10 million or 2 percent) as exported. In other words, transport costs explicitly appear in the SAM as firm's expenditures for transportation of goods and for business travel and as households' costs of private passenger travel.[18]

29. The reduction in VOC is modeled as the reduction in intermediate goods costs for the land transportation sector. For SAM 15x15, GEL 162 million (USD 97 million) cost saving translates into an 11 percent reduction in intermediate goods costs of the transport and communication sector.

30. The reduction in transportation costs associated with monetized time savings is distributed over firms and households, covering costs of product delivery, firms' travel costs and private travel costs. It was assumed that GEL 32 million (USD 19 million) are reduced through transportation margin, and the rest GEL 290 million (USD 174 million) through lowered costs of travels. For SAM 15x15, GEL 322 million (USD 193 million) time-related cost saving translates into a two and a half percent reduction in aggregate transportation margin, a 13 percent reduction in firms' travel costs and an 11 percent reduction in households' travel costs.

[16] Data is taken from feasibility studies for these two sections made by Kocks Consult GmbH in association with BT Designing and Consulting Company in 2009.

[17] As per Geostat, this is classified as other land transportation services; water transport services". This category excludes railway transportation, air transportation, pipelines, cargo handling and storage services, other transport supporting services, post and courier services, travel agency and tour operator services, and telecommunications services.

[18] For a good review of how transport costs could enter the CGE model see Johannes Bröcker (2002), Passenger Flows in CGE Models for Transport Project Evaluation, Institute for Regional Research, Christian-Albrechts-Universität Kiel, May 2002. Paper to be presented to the ERSA Congress 2002, August 2002, Dortmund. Available at: http://www-sre.wu-wien.ac.at/ersa/ersaconfs/ersa02/cd-rom/papers/163.pdf

SIMULATION RESULTS

Macroeconomic, Distributional, and Regional Impacts

31. Table 2 shows how real GDP increases over the medium and long-term, as a result of the EWH investments, presenting macroeconomic simulations results stemming from the reduction of transportation costs. These results clearly indicate the importance of indirect project costs. Real GDP is assessed to increase by 1.5 percent over a medium-term horizon (the comparative static formulation of the model) and 4.2 percent over a long-term horizon (steady-state). Steady-state results should be taken with caution as they represent an upper bound of the potential impact of reduction in transport costs. Real household consumption increases due to lower expenditures on transportation, allowing reallocation of household resources and purchases of other goods, increased income and higher supply due both to the expansion of domestic production and in the long-term, imports, while government consumption also increases but at lower rate.

32. Both exports and imports are expected to expand in the long-run, with exports growing on average faster due to the strong expansion of transportation and manufacturing sectors, accounting together for over two thirds of exports—Annex 4 provides details on the simulation results of the sectoral impact of the EWH. In the medium-term, exports will fall driven primarily by reduced output in manufacturing and other sectors, which in turn is explained by a reallocation of primary factors of production to now relatively more competitive sectors like transportation and mining. In addition, as the price for domestic transport services goes down, domestic supply becomes more competitive compared to imported services, driving down imports, first of all transport sector imports. In the long-run, imports of the transportation sector will also decline, *ceteris paribus*, but total trade will grow amid expansion of other sectors.

Table 2: Indirect Macroeconomic Impact, Cumulative Percentage Change from 2013 Baseline

	Medium-Term (comparative-static)	Long-term (steady-state)
Real GDP	1.5	4.2
Real household consumption	1.5	4.4
Real government consumption	0.7	1.1
Real exports	-0.4	4.7
Real imports	-0.3	1.6
Unemployment	-2.8	-4.4

Sources: World Bank, ISET Policy Institute.

Table 3: Distributional Impacts on Welfare, Cumulative Percentage Change from 2013 Baseline

Quintile	Level of income, GEL	Medium-Term (comparative-static)	Long-term (steady-state)
Household income quintile 1	0-500	1.8	2.6
Household income quintile 2	500-1000	2.1	3.2
Household income quintile 3	1000-1500	2.3	3.8
Household income quintile 4	1500-3000	2.5	4.0
Household income quintile 5	more than 3000	2.8	4.4

Source: World Bank, ISET Policy Institute.

33. In the comparative static formulation of the model, the first two quintiles with the lowest income—the bottom 40 percent with annual income up to GEL 1000 (USD 602)—gain relatively less than other household groups (

34.

35. Table **3**). In the comparative steady-state formulation of the model, this effect is reinforced, most likely because households with higher levels of income tend to own more capital, the stock of which increases in the steady-state formulation of the model. The reduction in unemployment in the long-term arises from the expansion of the capital stock, allowing use of unemployed labor. There are several transmission mechanisms allowing households to gain income in case of transport cost reduction. First, the expansion of production results in higher demand for primary factors and thus household income. Secondly, wages increases for both the self-employed and hired labor and unemployment declines. Higher households' income results also increase households' consumption (Table 2).

36. Regional welfare-increasing effect of construction of the EWH was estimated (Table 4). On average, rural households gain more than urban households, in line with a priori expectations, as rural households' income is more affected by transportation costs as they need to purchase and deliver goods on longer distances both for consumption and for sale.

Table 4: Regional Household Welfare Impact Change, Cumulative Percentage Cumulative from 2013 Baseline

	Urban		Rural	
	Medium-Term (comparative-static)	Long-term (steady-state)	Medium-Term (comparative-static)	Long-term (steady-state)
Kakheti	2.00	4.28	2.15	4.07
Tbilisi	2.43	5.48	3.42	5.75
Shida Kartli	1.91	4.74	2.31	4.77
Kvemo_Kartli	2.27	4.66	2.26	4.81
Samtskhe	1.84	4.45	2.29	4.62
Adjara	2.13	5.22	2.57	5.23
Guria	1.71	3.56	2.27	4.58

	Urban		Rural	
	Medium-Term (comparative-static)	Long-term (steady-state)	Medium-Term (comparative-static)	Long-term (steady-state)
Samegrelo	1.99	4.40	2.31	5.06
Imereti	2.21	4.92	2.44	4.63
Mtskheta	3.33	5.90	2.47	4.59
Urban	2.14	4.72	N/A	N/A
Rural	N/A	N/A	2.38	4.79

Note: Welfare as proxied by household consumption.
Sources: World Bank, ISET Policy Institute.

SENSITIVITY ANALYSIS

37. Sensitivity analysis of the simulated indirect impacts of the reduction in transportation costs associated with the EWH reveal that results are robust to changes in elasticity parameters of the model. The model results are the most sensitive to changes in elasticity of substitution between leisure and consumption/saving bundles (Tables 5 and 6). The reduction of elasticity by 0.25 points results in a drop in real GDP and households' consumption both in the static and steady-state formulation of the model, as people become less interested in sacrificing their leisure. The logic is as follows: the reduction in transportation costs stimulates economic activity that means more demand for labor and thus pressure for unemployed to be employed. If people value leisure so that leisure and work are poor substitutes, impact of reduced costs on the economy would be less positive. The opposite is also true. If work and leisure are better substitutes, the increased opportunities in case of cheaper transportation stimulate employment and thus economic growth, especially in the long-run when the capital stock is also adjustable. So, a 0.25 point increase in this elasticity parameter boosts real GDP and households' consumption.

38. Another elasticity parameter affecting real GDP and households' consumption patterns is the elasticity of substitution between primary factors of production: a higher elasticity allows more variability in technology and thus boosts production, real GDP, as well as consumption. Armington elasticity related to substitution between exports and domestic supply and between domestic supply and imports affects mainly trade patterns, producing minor impact on other macroeconomic variables.[19]

[19] An Armington elasticity represents the elasticity of substitution between products of different countries, and is based on the assumption that products traded internationally are differentiated by country of origin. The Armington assumption has become a standard assumption of international CGE models, generating smaller and more realistic responses of trade to price changes than implied by models with homogeneous products.

Table 5: Sensitivity Analysis of Indirect Macroeconomic Impact, Cumulative Percentage Change from 2013 Baseline, Medium-Term (comparative-static)

	Baseline	Elasticity of transformation between domestic supply and exports, baseline value is equal to 1		Elasticity of substitution between leisure and consumption/saving bundle, baseline value is equal to 0.5		Elasticity of substitution between domestic supply and imports, baseline value is equal to 1		Elasticity of substitution between primary factors of production, baseline value is equal to 1	
		0	2	0.25	0.75	0	2	0	2
Real GDP	1.50	1.5	1.5	0.9	1.8	1.5	1.5	1.3	1.6
Real household consumption	1.47	1.5	1.5	0.9	1.8	1.5	1.5	1.2	1.6
Real government consumption	0.7	0.7	0.7	0.0	0.7	0.7	0.7	0.6	0.8
Real exports	-0.4	-0.4	-0.5	-1.0	-0.1	-0.2	-0.5	-0.7	-0.3
Real imports	-0.3	-0.3	-0.4	-0.8	-0.1	-0.2	-0.4	-0.5	-0.2

Sources: World Bank, ISET Policy Institute.

Table 6: Sensitivity Analysis of Indirect Macroeconomic Impact, Cumulative Percentage Change from 2013 Baseline, Long-Term (steady-state)

	Baseline	Elasticity of transformation between domestic supply and exports, baseline value is equal to 1		Elasticity of substitution between leisure and consumption/saving bundle, baseline value is equal to 0.5		Elasticity of substitution between domestic supply and imports, baseline value is equal to 1		Elasticity of substitution between primary factors of production, baseline value is equal to 1	
		0	2	0.25	0.75	0	2	0	2
Real GDP	4.2	4.1	4.3	1.9	6.5	4.1	4.3	3.8	4.6
Real household consumption	4.4	4.4	4.5	1.8	7.1	4.4	4.5	4.3	4.5
Real government consumption	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Real exports	4.7	3.1	6.3	2.1	7.3	3.9	5.5	4.3	5.1
Real imports	1.6	2.1	1.2	-0.9	4.1	2.5	0.7	1.1	2.1

Note: Results based on 15 x 15 SAM.
Sources: World Bank, ISET Policy Institute.

CONCLUSIONS

39. This study has presented results from a single country general equilibrium assessment of the indirect impacts of the reduction in transportation costs arising from the EWH investment program in Georgia. This approach is well-suited to estimate the extensive indirect effects of the project. Estimations of different components of the project's indirect effects are important in order to have a comprehensive impact evaluation. While only the indirect impacts of reduced transportation costs has been modeled, other indirect effects can be modeled, which would lead to much larger indirect impacts. In particular, trans-boundary spillover will support higher economic growth in neighboring

countries, reflecting the impact of improved infrastructure in an international corridor for enhanced regional integration.

40. This assessment was carried out with the construction of the CGE model for Georgia based on the existing model code, already developed by ISET Policy Institute. For this study, the existing code was revised and elaborated. In particular, (a) the steady-state formulation was added allowing variability of the level of capital stock and thus approximating the results of the model with a dynamic formulation; and (b) the model code was developed for two different SAM matrices: 15x15 matrix with 20 households representing Georgian regions, and 15x15 matrix with five household categories split by income levels. The counterfactual scenario was run to assess the reduction of transportation costs following completion of the EWH investment program, using official statistics, as well as data provided by the Roads Department of Georgia, and the World Bank team working on the East West Highway projects.

41. It was estimated that monetized time saving and vehicle operational cost saving associated with the EWH project amounted to an estimated GEL 483 million (USD 291 million). This amount is higher than the transport margin of road transportation, and thus the counterfactuals were run assuming a reduction in both the transportation margin and in travel costs. The simulations show positive economy wide effects of the reduction in transportation costs associated with the EWH investments. Real GDP is estimated to increase by 1.5 percent in the comparative static formulation of the model and by 4.2 percent in the steady state formulation. Total output, exports and imports are expected to grow. The works on the EWH and associated fall in transportation cost will positively affect all types of households, contributing to a reduction in absolute poverty. The reduction in transportation costs will be more beneficial for the rural population, as the former are much more reliant on transportation and thus much more sensitive to price changes.

42. CGE models are not without their detractors and have been subject to a number of criticisms. One criticism is that they are inaccessible to non-economists and expensive and difficult to change and some economists argue that the indirect economic relationships that CGE analyses seek to represent can be captured in simpler and more transparent models. The complexity of the model structure and underlying assumptions means that model results are less accessible to a wider audience than other econometric modeling approaches. Like all models, CGE models are limited by the data used, both in term of the quality of the data and the availability of the data.[20] A CGE model needs quantities and prices of all goods, services, factors of production, and any other variables for the initial state of the economy; as well as elasticities describing how they respond to a change. These elasticities are used to calculate the remaining parameters, check the model design, and for comparing with the post-change results. Elasticities are usually parameters in a CGE model; the results of the model are the changes in prices and quantities and their effects on macro variables

[20] This discussion on data limitation is taken from King, Anita (2002), Economy-Wide Impacts of Industry Policy, New Zealand Treasury Working Paper 12/05, Available at: http://www.treasury.govt.nz/publications/research-policy/wp/2012/12-05/twp12-05.pdf

such as GDP. Data limitations are the main constraint on the number of sectors and the level of detail of a CGE model can attain.

43. Comparative static CGE models have some particular limitations. Firstly, these class of models do not specify the transition required to move from the initial equilibrium to the final one, and may fail to capture some of the costs and benefits associated with the transition, and therefore can overstate or understate the benefits from the policy change or shock being modeled. Secondly, comparative static CGE models are used as scenario-based tool. They are designed to perform policy experiments to help understand the potential economic results of a particular policy change or shock. They are not designed for forecasting, where many changes occur simultaneously.

44. With these caveats in mind, there are several possible extensions to the model to capture indirect effects. First, the international spillovers related to the construction of the EWH could be modeled to assess the impact on neighboring countries. This could be done both in a single-country framework and in multi-county formulation of the model. Second, the regional disaggregation of the model could be developed to assess the spatial effects of infrastructure development within Georgia. However, this extension faces significant data requirements as regional input-output matrices would need to be developed. Lastly, a dynamic model could be constructed to capture the trajectory of annual changes to key economic parameters as a result of constructing the EWH, including assessing the direct impacts of the investments themselves, as well as the impact of the VOC reduction and value of time on freight, an important consideration for trade impacts.

ANNEX 1: CGE MODEL

In their most basic form, CGE models characterize a target economy (in this case, Georgia) using detailed consumption and production functions, together with a depiction of the market prices and price distortions (e.g., taxes or regulatory controls). This provides a depiction of the economy "as is" in a static framework, or using a "business as usual" projection, in a dynamic framework. Such depiction is contained in the SAM, a comprehensive, economy-wide data table which represents how the different sectors of the economy interact.

The basic SAM in Georgia has 15 activities and 15 commodities, 2 types of factors of production and 20 representative households groups. The project relies on the CGE model already developed by the ISET. The model was developed following Mathiesen (1985)[21] and Rutherford (1995; 1999)[22] and setting 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.

Households exchange labor effort for wages, and labor 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.

In the initial formulation of the model, firms produce a single good using a multi-level, differentiable, constant return to scale production function that combines factor inputs[23] (Figure A1.1) with intermediate goods. The capital and labor bundle assume a Cobb-Douglas function, while the combination of capital and labor is combined with intermediate inputs using the Leontief function. Similar to Hosoe et al. (2010)[24] and Rutherford et al. (2002), a constant elasticity of transformation (CET) function has been used to split production into export and domestic consumption. Then, domestic consumption and imports are aggregated to form the Armington final good (Armington 1969).[25]

[21] 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.

[22] 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. Rutherford, Thomas F. (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.

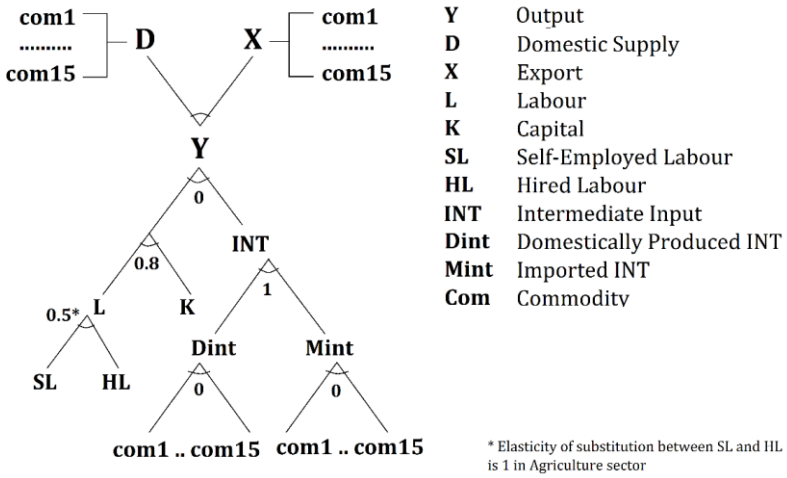
[23] Elasticity of substitution between self-employed and hired labor is assumed to be 0.5, with the exception of the agricultural sector where we assume that self-employed and hired types of labor are perfect substitutes.

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

[25] 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.

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 environment in which the country cannot affect world prices. Export and import prices quoted in foreign currency are exogenously given.

Figure A1.1: Production Functions

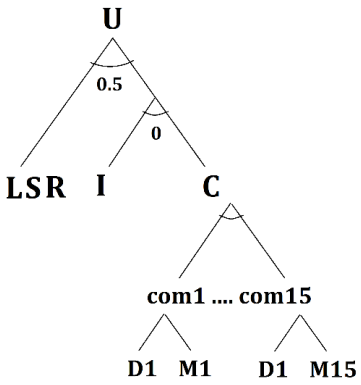


Source: ISET Policy Institute.

Households maximize a multi-level utility function (Figure A1.2) taking into account their disposable income. Households derive utility from leisure time, saving and consumption of commodity bundles, including imported or domestically produced products. A Cobb-Douglas function of consumption of goods is used, 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 A1.2: Utility functions



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

In the framework of this paper, the model was modified, with the following changes introduced in the code:

- The steady-state formulation was added allowing variability of the level of capital stock and thus approximating the results of the model to dynamic formulation;
- Model code was realized for two different SAM matrixes: 15x15 matrix with 20 households representing Georgian regions, 15x15 matrix with 5 households split by the level of their income.
- A counterfactual scenario was run to assess the reduction of transportation costs. The magnitude of reduction was assessed by the project team based on available information from open sources and provided by the World Bank team (Annex 3).

The model was realized in GAMS/MPGSE.

ANNEX 2: SOCIAL ACCOUNTING MATRIX

Overview of Social Accounting Matrix

This annex documents the construction of a Social Accounting Matrix for Georgia for the year 2013. The SAM is based on Supply-Use tables, national accounts, government budget, balance of payments and integrated household survey data. In our analysis we use two types of SAMs. Both SAMs for Georgia provide information about 15 activities and 15 commodities of the economy and they contain 3 types of production factors. The difference between the two matrices is that the first SAM consists of 20 representative household groups by regions and rural-urban areas, whereas the second SAM splits households by 5 income level.

The SAM is a comprehensive, economy-wide data table which represents how the different sectors of the economy interact. A SAM is a square matrix in which each row and column is called an "account" and SAM shows incomes and expenditures of each account. Each cell in the matrix represents, by convention, a flow of funds from a column account to a row account. For each account total revenues equal total expenditure, this means that an account's row and column totals must be equal, only in this case is the SAM balanced. The information needed to build a SAM comes from a variety of sources and placing these data within the SAM framework inevitably reveals inconsistencies between the incomes and expenditures of each account. A number of statistical estimation techniques exist to "balance" these small inconsistencies.

Each cell in the SAM shows the payment from the account of its column (expenditures) to the account of its row (incomes). For example in the aggregated SAM of 2013 (Table A2.1), different economic activities (economic sectors), grouped in Activity (A) column, use different commodities purchased at factor markets as intermediate inputs worth GEL 17,216 million (USD 10,371 million; cell C-A[26]) and these are used to produce goods and services with value added of GEL 23,335 million (USD 14,047 million; cell F-A), consisting of labor and capital value added. These goods and services are then sold through commodity markets to households, government, investors (gross capital formation) and foreigners (export).[27] The overall revenue received by the commodity market (row C) was GEL 65,563 million (USD 39,496 million), of which foreign exports total GEL 11,998 million (USD 7,228 million; cell C-R). In 2013, Households' expenditure on commodities was GEL 19,193 million (USD 11,562 million; cell C-H), final government consumption expenditure equaled GEL 4,479 million (USD 2,698 million; cell C-G), and gross capital formation was GEL 6,653 million (USD 4,008 million; cell C-S).

On the other hand, the commodity account consists of following expenditures: GEL 40,551 million USD 24, 428 million; cell A-C) for activities, GEL 6,024 million (USD 3,629 million; cell TTM-C) is transaction costs, GEL 3,512 million (USD 2,116 million; cell T-C) is taxes less subsidies and imports constituted GEL 15,475 million (USD 9,322 million; cell R-C). Data about activities and

[26] In the notation used, the row name is followed by the column name.
[27] Households in this context means households and non-profit organizations serving households (NPISH).

commodities accounts come from 2013 GeoStat supply-use tables of 2013. Total output was measured in basic prices, in order to transform it into market prices, trade and transportation margins were added (cells TTM-C and C-TTM). Table A2.2 explains briefly the meaning of each cell.

To check the correctness of the SAM, the GDP of Georgia for 2013 was calculated using three different approaches:

- *Production approach*. GDP = Total output (cell A-C) – Intermediate Inputs (cell C-A) + Net Taxes (cell T-C) = GEL 26,847 million (USD 16,173 million).
- *Expenditure approach*. GDP = Household consumption (cell C-H) + Government consumption (cell C-G) + Gross capital formation (cell C-S) +exports (cell C-R) - imports (cell R-C) = GEL 26,847 million.
- *Income approach*. GDP= Employment Income + Other income from self-employment + Total profit from companies (cell F-A) + Net Taxes (cell T-C) = GEL 26,847 million.

In the model, household and government purchases of commodities provide the income that producers need to continue the production process. In addition, inter-institutional transfers, such as taxes and savings, ensure that the circular flow of incomes is closed. Overall, consolidated budget revenue was GEL 7,434 million (USD 4,478 million) or the sum of the row or column of Government account), out of which (a) GEL 239 million (USD 144 million; cell G-R) was grants; (b) GEL 6,659 million (USD 4,011 million) was revenue from taxes; and (c) the rest (GEL 536 million; USD 323 million) was other income including income from property, dividends received from government owned companies' profits, among others. This value was assigned to Government's factor income from capital (cell G-F). Part of the money on tax account comes from commodities which includes value added tax of GEL 2,848 million (USD 1,716 million), excise tax of GEL 722 million (USD 435 million), import tax of GEL 89 million (USD 54 million) and subsidies GEL 147 million (USD 89 million) which enters in the SAM with negative sign. Thus, overall we have GEL 3,512 million (USD 2,116 million) of net taxes (cell T-C) from commodities. The rest of the revenue comes from households (including income tax, profit tax, property tax and other taxes, having in mind the wide definition of households), which is GEL 3,147 million (USD 1,896 million; cell T-H).

Table A2.1: Macro SAM for Georgia (GEL million), 2013

	A	C	TTM	F	H	G	T	S	R	
A		40,551								40,551
C	17,216		6,024		19,193	4,479		6,653	11,998	65,563
TTM		6,024								
F	23,335									23,335
H				22,292	1,260	2,244			2,461	26,997
G				536			6,659		239	7,434
T		3,512			3,147					6,659
S					4,398	711			1,543	6,653
R		15,475		507	259					16,241
	40,551	65,563	6,024	23,335	26,997	7,434	6,659	6,653	16,241	

Note: A is activities (economic sectors), C is commodities, TTM is Trade and Transport Margins, F is factors of production (Capital, Labor), H is households, G-is government, T is taxes, S is saving-investment, and are R is rest of the world.
Source: ISET Policy Institute.

Table A2.2: SAM description

	A	C	TTM	F	H	G	T	S	R
A		Total Output							
C	Intermediate demand		Transaction costs		Household consumption	Government consumption		Gross Capital Formation	Exports
TTM		Transaction costs							
F	Factor Value Added								
H				Factor Income to households	Inter-household transfers	Transfers to households			Foreign remittances received
G				Factor Income to Government			Government revenue from taxes		Grants received by Government
T		Net Taxes			Taxes paid by households				
S					Households savings	Net Operating Balance			Current Account (Foreign savings)
R		Imports		FDI Value Added	Foreign remittances paid				

Source: ISET Policy Institute.

Household income consists of inter household transfers of GEL 1,260 million (USD 759 million; cell H-H), which was derived from integrated household survey data[28], social transfer payments from the government (cell H-G) and remittances (cell H-R). Value added to households was assigned as they are owners of factors (cell H-F), excluding FDI value added (cell R-F) and capital value added of government (cell G-F).

According to the consolidated budget of 2013, social assistance amounted to GEL 2,295 million (USD 1,378 million), which includes pensions, social aid, social rehabilitation, childcare, healthcare programs and other transfers. Part of which is already reflected in government expenditure on goods and services (cell C-G). Thus, a lower value of GEL 2,244 million (USD 1,347 million) is used as government transfers to households. As for the remittances, official data comes from the National Bank of Georgia, according to which remittance inflows in 2013 were USD 1,477 million and outflows USD 155 million—equivalent to GEL 2,461 million and GEL 259 million respectively.[29]

Other government expenditures (column G) include spending on goods and services, as mentioned above, and savings, which is net operating balance of GEL 711 million (USD 428 million) or the difference between consolidated revenues and expenditures (cell S-G). Overall, Government expenditure (sum of column G), including savings, is GEL 6,441 million (USD 3,880 million), which equals total Government income (row G).

The current account deficit is depicted in the cell S-R in 2013, according to official data, the current account was negative USD 926 million, which is about GEL 1,543 million.[30]

Household savings-investment, for which official data does not exist, is straightforward to obtain. Official data on net operating balance (cell S-G) and current account deficit (cell S-R) were used. In addition, the value of gross capital formation of GEL 6,653 million (USD 4,008 million) is also known (cell S-total). Therefore, the household saving-investment comes out to be GEL 4,398 million (USD 2,640 million) this is a "plug in" number which balances the SAM.

The rest of the world also receives income from FDI value added GEL 507 million (cell R-F), which simply includes dividends received by foreigners and part of profit which is not reinvested. In other words, this is estimated outflow of capital value added of FDI in 2013. The value for this cell is plug-in number, while all other values for R account are official data from different sources. In the less disaggregates SAM, there are 15 economic activities and 15 commodities as described in Table A2.3.

It is important to note that in the initial SAM the rule that one activity produces one commodity did not hold, several activities producing more than a single commodity. The SAM was rebalanced the SAM to enforce this rule. The rebalancing was applied to both SAMs.

[28] GeoStat: http://geostat.ge/index.php?action=meurneoba&mpid=1&lang=eng
[29] Calculated by using average annual exchange rate of 1.6659 in 2013
[30] Source: GeoStat, 2013

Table A2.3: Economic Activities of the SAM 15x15

1	Agriculture, hunting and forestry
2	Fishing and fish farming
3	Mining and quarrying
4	Manufacturing
5	Electricity, gas and water supply
6	Construction
7	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods
8	Hotels and restaurants
9	Transport and communication
10	Financial intermediation
11	Real estate, renting and business activities
12	Public administration
13	Education
14	Health and social work
15	Other community, social and personal service activities, services of domestic staff employed by households

Source: ISET Policy Institute.

Household Income and Expenditure

To desegregate household expenditure (cell C-H) by sectors, the Integrated Household Survey (IHS) data of 2013 produced by GeoStat was used. Data is disaggregated at the level of ten regions: Kakheti, Tbilisi, Shida Kartli, Kvemo Kartli, Samtskhe Javakheti, Adjara, Guria, Samegrelo Zemo Svaneti, Imereti Kvemo Svaneti Racha Lechkhumi, Mtskheta Mtianeti. In turn, each region has been disaggregated into rural and urban areas, which means that there are in total 20 household categories.

The SAM uses a variable showing income in foreign currency to calculate the percentage distribution of remittances across regions, and within rural and urban areas in each region. To disaggregate transfers from the government to households (cell H-G), proxy variables from household survey data are used, which aggregate pensions and aid paid by government to households. Labor factor income is fully allocated to households, but capital factor income was allocated between households, government and the rest of the world.

For disaggregating factor income (cell H-F) labor value added among rural and urban areas of each region was derived from monetary income of households from self-employed and hired employment. Approximately the same weights are then used to calculate capital value added for each group of households. Taxes are split into value added tax (VAT), import tax, excise tax, subsidies, and other taxes. The redistribution of these taxes among sectors we obtained from GeoStat. Overall, there were GEL 2,847.8 million (USD 1,716 million) VAT, GEL 722.3 million (USD 435 million) of excise tax, GEL 89.4 million (USD 54 million) of import tax and GEL 147 million (USD 86 million) of subsidies.[31] The rest of taxes paid by households (GEL 3,147 million; USD 1,896 million) was redistributed based on income from hired employment for different household groups.

[31] Redistribution of subsidies by sector was given in a supply table.

Money sent abroad (cell R-H) we disaggregated proportionally to population size in rural and urban areas for each regions.

Transfers from households to other households (cell H-H) were disaggregated by using the variable which captures income from relatives. First, for each group of households, the total amount of money they get from other households was calculated in order to derive the total for row account (incomes). Second, population shares were used to redistribute these amounts across column household accounts, in order to estimate amount transferred from each type of household to another.

Finally, trade and transport margins for each commodity were disaggregated proportionally according to values of import, export and domestic use.

Structure of Consumption

Transport and communication sector services have different importance for other sectors of the economy (TableA2.4). For example, for sector 11 "Real estate, renting and business activities" transportation services (business travels) and communication services constitute 19.8 percent of sectors' expenditures on goods and services for intermediate consumption. For mining and quarrying, the share is 11.5 percent, while for agriculture – only 4.2 percent.

Table A2.4: Structure of Intermediate Consumption of Sectors, % of total sector intermediate consumption

		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1	Agriculture, hunting and forestry	49.3	5.3	11.6	21.4	0.2	0.5	0.7	1.9	0.1	0.5	0.5	11.6	8.7	4.3	1.7
2	Fishing and fish farming	0.1	1.4	0.1	0.8	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.6	0.7	0.1	0.0
3	Mining and quarrying	1.6	0.2	4.8	7.7	23.1	0.4	0.3	0.1	0.5	0.1	0.3	1.7	0.2	0.7	0.1
4	Manufacturing	39.5	67.9	50.2	52.3	7.4	62.4	33.4	44.1	52.4	17.8	23.5	59.5	52.9	57.3	24.1
5	Electricity, gas and water supply	1.4	2.7	6.9	6.2	14.7	0.7	5.5	8.0	2.3	3.4	7.0	2.2	7.4	5.9	7.1
6	Construction	0.6	4.5	0.7	1.7	2.7	26.4	2.4	3.5	2.8	1.6	1.4	0.0	1.8	5.6	3.8
7	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	0.4	0.7	2.0	0.6	2.5	0.9	5.2	0.3	5.4	3.7	2.1	2.2	0.5	0.6	4.0
8	Hotels and restaurants	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.5	7.5	1.7	0.5	0.6	4.7	1.1	4.6
9	Transport and communication	4.2	0.3	11.5	3.0	11.3	1.4	9.1	12.4	18.9	6.1	19.8	4.8	1.4	11.5	7.4
10	Financial intermediation	0.6	12.0	3.5	2.5	16.4	2.6	7.0	18.9	3.4	0.5	15.2	0.0	0.5	0.7	1.8
11	Real estate, renting and business activities	1.3	4.9	8.6	3.5	7.6	4.3	34.8	5.3	5.8	57.3	21.7	4.1	20.1	8.4	41.8
12	Public administration	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	Education	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.8	0.2	2.5	5.3	0.1	0.3	1.0	0.5
14	Health and social work	0.9	0.0	0.0	0.0	0.0	0.0	0.1	3.4	0.2	0.4	0.3	6.8	0.0	1.7	0.2
15	Other community, social and personal service activities, services of domestic staff employed by households	0.1	0.0	0.1	0.2	13.8	0.1	1.2	0.3	0.7	4.4	2.3	5.7	0.8	1.2	2.9

Source: ISET Policy Institute.

Manufacturing products account for the largest share of final consumption for all categories of households. Transport and communication expenses are higher for high income households (HH5), while the low-income households spend the larger share of their income on agriculture products.

Table A2.5: Structure of Final Consumption of Households (Income Groups), % of total household final consumption

		HH1	HH2	HH3	HH4	HH5
	Level of income, GEL	0-500	500-1000	1000-1500	1500-3000	more than 3000
1	Agriculture, hunting and forestry	16.4	12.4	9.6	7.3	4.1
2	Fishing and fish farming	0.0	0.0	0.0	0.0	0.0
3	Mining and quarrying	2.8	1.5	1.8	1.5	2.7
4	Manufacturing	48.1	55.6	53.6	52.8	38.2
5	Electricity, gas and water supply	4.1	3.5	3.0	2.3	1.5
6	Construction	0.7	0.4	0.5	0.4	0.7
7	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	1.6	0.8	1.1	0.9	1.6
8	Hotels and restaurants	3.9	2.0	2.5	2.1	3.8
9	Transport and communication	3.6	5.4	6.7	8.2	10.8
10	Financial intermediation	4.1	2.1	2.7	2.2	4.0
11	Real estate, renting and business activities	1.0	1.6	2.9	7.6	17.1
12	Public administration	0.0	0.0	0.0	0.0	0.0
13	Education	1.1	2.9	4.4	3.9	2.9
14	Health and social work	7.5	6.3	5.7	4.9	7.4
15	Other community, social and personal service activities, services of domestic staff employed by households	4.9	5.5	5.6	5.8	5.3

Source: ISET Policy Institute.

In regional breakdown, transportation services account for the largest share of consumption of households living in rural Tbilisi (Table A2.6).

Table A2.6: Structure of Final Consumption of Households (Regional Groups), % of total household final consumption

	Kakheti_U	**Kakheti_R**	**Tbilisi_U**	**Tbilisi_R**	**Shida_Kartli_U**	**Shida_Kartli_R**	**Kvemo_Kartli_U**	**Kvemo_Kartli_R**	**Samtskhe_U**	**Samtskhe_R**	**Adjara_U**	**Adjara_R**	**Guria_U**	**Guria_R**	**Samegrelo_U**	**Samegrelo_R**	**Imereti_U**	**Imereti_R**	**Mtskheta_U**	**Mtskheta_R**
1	13.5	13.1	8.0	15.5	7.8	10.6	9.3	13.3	9.9	10.3	8.4	15.3	16.0	15.8	10.1	9.4	9.4	12.4	7.4	14.8
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	2.6	2.6	1.6	3.0	1.5	2.1	1.8	2.6	1.9	2.0	1.6	3.0	3.1	3.1	2.0	1.8	1.8	2.4	1.4	2.9
4	48.5	57.5	44.4	12.7	58.4	64.9	44.3	58.7	62.9	60.4	42.0	39.3	59.8	57.2	66.0	66.4	55.0	57.2	49.4	39.6
5	3.6	3.4	3.3	6.4	2.2	2.2	2.8	3.5	2.8	2.9	3.9	2.5	3.1	2.4	2.2	1.6	2.1	2.5	3.1	4.0
6	0.4	0.2	0.7	0.7	0.5	0.2	0.7	0.2	0.4	0.3	0.6	0.6	0.1	0.2	0.2	0.2	0.4	0.2	0.4	0.3
7	1.0	0.5	1.6	1.6	1.1	0.4	1.6	0.5	0.9	0.6	1.5	1.3	0.3	0.4	0.5	0.5	1.0	0.5	1.0	0.7
8	2.5	1.2	3.8	4.0	2.7	0.9	3.8	1.1	2.1	1.5	3.6	3.2	0.7	1.0	1.3	1.1	2.5	1.2	2.4	1.6
9	4.7	7.2	7.4	22.1	3.0	6.8	6.8	5.8	2.3	6.9	4.7	8.2	2.8	6.8	4.7	6.1	6.5	8.5	15.2	9.6
10	2.7	1.2	4.0	4.2	2.9	1.0	4.0	1.2	2.3	1.6	3.8	3.4	0.8	1.1	1.3	1.2	2.6	1.3	2.5	1.7
11	5.2	2.4	7.7	8.1	5.6	1.8	7.7	2.2	4.4	3.1	7.3	6.5	1.5	2.1	2.6	2.3	5.1	2.4	4.8	3.2
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	3.0	1.4	4.5	4.8	3.3	1.1	4.5	1.3	2.6	1.8	4.3	3.8	0.9	1.2	1.5	1.3	3.0	1.4	2.8	1.9
14	5.8	2.7	8.7	9.1	6.3	2.1	8.6	2.5	4.9	3.5	8.2	7.3	1.7	2.3	2.9	2.5	5.7	2.7	5.4	3.6
15	6.3	6.6	4.5	7.7	4.5	6.0	4.2	7.0	2.7	4.9	10.0	5.7	9.3	6.3	4.5	5.6	4.8	7.2	4.3	16.2

Source: ISET Policy Institute.

Land transportation

Land transportation accounts quite a low share of entire transportation and communication sector that is considered in SAM 15x15. Total use of land transportation is GEL 646 million (USD 388 million), that is 13

percent of the transportation and communication sector.[32] Sector's output is used primarily in intermediate and final consumption. Slightly more than a quarter of supply of land transportation services in Georgia is imports, and the rest is produced domestically (Table 2.8).

Table A2.7: Land Transportation: Uses, 2013 (at current prices, GEL million)

		Intermediate consumption	Final consumption expenditure (Gov + HH)	Exports	Gross capital formation	Use, Total
1	Agriculture, hunting and forestry	2,145	1,920	1,003	695	5,763
2	Fishing and fish farming	57	4	2	1	65
3	Mining and quarrying	614	370	481	49	1,515
4	Manufacturing	7,950	9,786	6,090	2,945	26,771
5	Electricity, gas and water supply	829	559	55	0	1,444
6	Construction	900	91	64	2,920	3,976
7	Wholesale and retail trade	316	213	92	0	620
8	Hotels and restaurants	198	511	494	0	1,203
9	Transport and communication (including land transportation)	1,185	1,335	2,277	0	4,797
	Land Transportation Services	323	306	17	0	646
10	Financial intermediation	727	541	92	0	1,359
11	Real estate, renting and business activities	1,870	1,050	230	42	3,192
12	Public administration	0	3,122	203	0	3,326
13	Education	86	1,441	77	0	1,604
14	Health and social work	111	1,658	20	0	1,790
15	Other community, social and personal service activities	228	1,070	817	0	2,115

Source: ISET Policy Institute.

Table A2.8: Land Transportation: Resources, 2013 (GEL million)

		Output	Trade and transport margins	Net Taxes	Imports	Resources, Total
1	Agriculture, hunting and forestry	3,732	1,468	-26	588	5,763
2	Fishing and fish farming	20	9	3	33	65
3	Mining and quarrying	355	211	98	851	1,515
4	Manufacturing	8,702	4,335	2,374	11,359	26,771
5	Electricity, gas and water supply	1,134	0	260	50	1,444
6	Construction	3,732	0	230	14	3,976
7	Wholesale and retail trade	5,228	-4,795	182	5	620
8	Hotels and restaurants	1,167	0	36	0	1,203
9	Transport and communication (including land transportation)	3,994	-1,229	140	1,892	4,797
	Land Transportation Services	531	-68	0	183	646
10	Financial intermediation	1,131	0	0	228	1,359
11	Real estate, renting and business activities	2,955	0	79	159	3,192
12	Public administration	3,172	0	-3	157	3,326
13	Education	1,462	0	27	116	1,604
14	Health and social work	1,745	0	41	3	1,790
15	Other community, social and personal service activities	2,022	0	73	20	2,115

Source: ISET Policy Institute.

[32] The transport and communication sector comprises railway, land, water, and air transport, as well as telecommunications, post and courier services, and travel agency and tour operator services.

ANNEX 3: TRANSPORT COST DATA[33]

Table A3.1: Vehicle Fleet Basic Characteristics and Economic Unit Costs

	Car 4X4	Van	Minibus	Bus	2 Axles Truck	3 Axles Truck	4+ Axles Truck
Economic Unit Costs							
New Vehicle Cost (USD/vehicle)	20,454	22,727	22,727	65,909	29,545	38,636	100,000
New Tire Cost (USD/tire)	55	273	91	341	182	273	364
Fuel Cost (USD/liter)	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Lubricant Cost (USD/liter)	6.18	6.18	6.18	6.18	6.18	6.18	6.18
Maintenance Labor Cost (USD/hour)	0.72	1.64	1.64	1.64	2.10	2.10	3.00
Crew Cost (USD/hour)	0.00	2.55	2.55	2.55	2.55	2.55	2.55
Overhead (USD/year)	640	640	640	640	1280	1280	1280
Interest Rate (%)	12	12	12	12	12	12	12
Passenger Working Time (USD/hour)	3.83	3.83	2.55	2.55	0.00	0.00	0.00
Passenger Non Working Time (USD/hour)	1.13	1.13	0.75	0.75	0.00	0.00	0.00
Cargo Time (USD/hour)	0.00	0.00	0.00	0.00	2.68	2.68	2.68
Basic Characteristics							
Kilometers Driven per Year (km)	23000	23000	30000	70000	40000	86000	86000
Hours Driven per Year (hr)	550	550	750	1600	1000	2000	2000
Service Life (years)	10	10	8	7	12	14	14
Percent Private Use (%)	100	0	0	0	0	0	0
Number of Passengers (#)	2.35	0.00	15.00	40.00	0.00	0.00	0.00
Work Related Passenger-Trips (%)	75	100	75	75	100	100	100
Gross Vehicle Weight (tons)	1.20	1.50	2.20	10.00	2.00	7.50	28.00
Equivalent Standard Axels (ESA)	0.02	0.14	0.02	1.51	0.84	2.50	3.50

Table A3.2: Unit Road User Costs (USD per vehicle-km)

		Car 4X4	Van	Minibus	Bus	2 Axles Truck	3 Axles Truck	4+ Axles Truck
Without Project	Vehicle Operating Costs	0.24	0.33	0.30	0.46	0.34	0.54	1.05
	Travel Time Costs	0.15	0.00	0.65	1.76	0.06	0.06	0.06
	Road User Costs	0.39	0.33	0.96	2.22	0.40	0.60	1.11
With Project	Vehicle Operating Costs	0.21	0.28	0.27	0.40	0.33	0.50	0.93
	Travel Time Costs	0.10	0.00	0.42	1.19	0.04	0.03	0.04
	Road User Costs	0.31	0.28	0.70	1.58	0.36	0.53	0.97
Savings with the Project	Vehicle Operating Costs	0.02	0.04	0.03	0.06	0.02	0.04	0.12
	Travel Time Costs	0.06	0.00	0.23	0.57	0.02	0.02	0.02
	Road User Costs	0.08	0.04	0.26	0.64	0.04	0.06	0.14

Note: Assumes a roughness of 4 IRI and a speed of 50 km/hour without project, and a roughness of 2 with project and a speed of 80 km/hr.

[33] This data was based on existing Feasibility Studies and analysis made by Rodrigo Archondo-Callao. The underlying assumptions are in line with the transportation costs used by the World Bank in the economic analysis of its East West Highway projects.

Table A3.3: Traffic With and Without EWH Project

Section	Length Without Project (km)	Traffic (vehicles per day) Cars	Microbus	Bus and Truck	Trailer and > 3 axis	Total
Tbilisi-Natakhtari	11.0	24201	2175	1992	1154	29522
Natakhtari-Ruisi	66.0	11390	3172	1520	1105	17187
Ruisi-Chumateleti	45.0	7671	2245	683	651	11251
Chumateleti-Argveta	51.0	9084	852	757	944	11637
Argveta-Samtredia	59.0	9888	1895	842	1375	13999
Samtredia-Choloki	70.0	3433	947	329	397	5107
Choloki-Kobuleti BP	33.0	11341	1360	569	1050	14320
Tbilisi-Rustavi	21.0	13129	2843	957	546	17475
Rustavi-Red Bridge	36.0	3649	98	255	312	4314
Total	392.0					
Section	Length With Project[34] (km)	Traffic (vehicles per day) Cars	Microbus	Bus and Truck	Trailer and > 3 axis	Total
Tbilisi-Natakhtari	9.9	24201	2175	1992	1154	29522
Natakhtari-Ruisi	59.4	11390	3172	1520	1105	17187
Ruisi-Chumateleti	40.5	7671	2245	683	651	11251
Chumateleti-Argveta	45.9	9084	852	757	944	11637
Argveta-Samtredia	53.1	9888	1895	842	1375	13999
Samtredia-Choloki	63	3433	947	329	397	5107
Choloki-Kobuleti BP	29.7	11341	1360	569	1050	14320
Tbilisi-Rustavi	18.9	13129	2843	957	546	17475
Rustavi-Red Bridge	32.4	3649	98	255	312	4314
Total	352.8					

Table A3.4: Unit Vehicle Operating Costs With and Without Project

Unit VOC Costs (USD/km)	Cars	Microbus	Bus and Truck	Trailer and > 3 axis
Unit VOC without project	0.15	0.65	0.91	0.06
Unit VOC with project	0.10	0.42	0.61	0.04

[34] Length with project assumes 10 percent reduction in length of each road section.

Table A3.5: Total VOC without Project

Section	Length Without Project (km)	Total VOC Without the Project (USD million)				
		Cars	Microbus	Bus and Truck	Trailer and > 3 axis	Total
Tbilisi-Natakhtari	11.0	23.0	2.7	3.2	3.7	32.6
Natakhtari-Ruisi	66.0	65.0	23.3	14.7	21.2	124.2
Ruisi-Chumateleti	45.0	29.9	11.2	4.5	8.5	54.1
Chumateleti-Argveta	51.0	40.1	4.8	5.6	14.0	64.5
Argveta-Samtredia	59.0	50.5	12.4	7.3	23.6	93.7
Samtredia-Choloki	70.0	20.8	7.4	3.4	8.1	39.6
Choloki-Kobuleti BP	33.0	32.4	5.0	2.7	10.1	50.2
Tbilisi-Rustavi	21.0	23.9	6.6	2.9	3.3	36.8
Rustavi-Red Bridge	36.0	11.4	0.4	1.3	3.3	16.4
Total	392.0					512.0

Table A3.6: Total VOC with Project

Section	Length Without Project (km)	Total VOC With the Project (USD million)				
		Cars	Microbus	Bus and Truck	Trailer and > 3 axis	Total
Tbilisi-Natakhtari	9.9	18.7	2.1	2.6	3.0	26.4
Natakhtari-Ruisi	59.4	52.7	18.8	11.9	17.1	100.6
Ruisi-Chumateleti	40.5	24.2	9.1	3.7	6.9	43.8
Chumateleti-Argveta	45.9	32.5	3.9	4.6	11.3	52.3
Argveta-Samtredia	53.1	40.9	10.0	5.9	19.1	75.9
Samtredia-Choloki	63.0	16.9	6.0	2.7	6.5	32.1
Choloki-Kobuleti BP	29.7	26.3	4.0	2.2	8.1	40.7
Tbilisi-Rustavi	18.9	19.3	5.4	2.4	2.7	29.8
Rustavi-Red Bridge	32.4	9.2	0.3	1.1	2.6	13.3
Total	352.8					414.8

VOC Savings (USD Million)	97.2
VOC Savings (GEL Million)	161.7

Table A3.7: Unit Time Costs without the Project

Unit Transport Costs	Unit TC Without the Project (USD/veh-km)			
	Cars	Microbus	Bus and Truck	Trailer and > 3 axis
Unit TC without the EWH Project	0.15	0.65	0.91	0.06
Unit TC with the EWH Project	0.10	0.42	0.61	0.04

Table A3.8: Total Transportation Costs without the Project

Section	Length Without Project (km)	Total TC Without the Project (USD million)				
		Cars	Microbus	Bus and Truck	Trailer and > 3 axis	Total
Tbilisi-Natakhtari	11.0	14.9	5.7	7.3	0.3	28.1
Natakhtari-Ruisi	66.0	42.0	50.0	33.3	1.5	126.8
Ruisi-Chumateleti	45.0	19.3	24.1	10.2	0.6	54.2
Chumateleti-Argveta	51.0	25.9	10.4	12.8	1.0	50.1
Argveta-Samtredia	59.0	32.6	26.7	16.5	1.6	77.4
Samtredia-Choloki	70.0	13.4	15.8	7.6	0.6	37.5
Choloki-Kobuleti BP	33.0	20.9	10.7	6.2	0.7	38.6
Tbilisi-Rustavi	21.0	15.4	14.3	6.7	0.2	36.6
Rustavi-Red Bridge	36.0	7.3	0.8	3.0	0.2	11.5
Total	392.0					460.6

Table A3.9: Total Time Costs with the EWH Project

Section	Length Without Project (km)	Total TC With the Project (USD million)				
		Cars	Microbus	Bus and Truck	Trailer and > 3 axis	Total
Tbilisi-Natakhtari	9.9	8.4	3.3	4.4	0.1	16.2
Natakhtari-Ruisi	59.4	23.6	29.1	20.2	0.8	73.7
Ruisi-Chumateleti	40.5	10.8	14.1	6.2	0.3	31.4
Chumateleti-Argveta	45.9	14.6	6.0	7.8	0.6	28.9
Argveta-Samtredia	53.1	18.3	15.6	10.0	0.9	44.8
Samtredia-Choloki	63.0	7.6	9.2	4.6	0.3	21.7
Choloki-Kobuleti BP	29.7	11.8	6.2	3.8	0.4	22.2
Tbilisi-Rustavi	18.9	8.7	8.3	4.0	0.1	21.1
Rustavi-Red Bridge	32.4	4.1	0.5	1.8	0.1	6.6
Total	352.8					266.8

TC Savings (USD Million)	193.8
TC Savings (GEL Million)	322.3

VOC+TC savings (USD Million)	**291**
VOC+TC savings (USD Million)	**484**

ANNEX 4: SECTORAL IMPACT

Table A4.1: Sectoral Impact, Percentage Cumulative Change from 2013 Baseline

		Medium-Term (static)	Long-term (steady-state)
1	Agriculture, hunting and forestry	0.20	3.33
2	Fishing and fish farming	-2.01	2.71
3	Mining and quarrying	4.14	2.57
4	Manufacturing	-1.61	4.58
5	Electricity, gas and water supply	0.47	4.31
6	Construction	0.73	1.60
7	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	0.31	3.70
8	Hotels and restaurants	0.26	4.05
9	Transport and communication	0.19	6.25
10	Financial intermediation	0.42	3.89
11	Real estate, renting and business activities	0.88	4.23
12	Public administration	-0.16	-0.12
13	Education	0.81	2.18
14	Health and social work	1.61	3.68
15	Other community, social and personal service activities, services of domestic staff employed by households	1.42	4.87

Sources: World Bank, ISET Policy Institute.

Table A4.2: Export, Percentage Cumulative Change from 2013 Baseline

		Medium-Term (comparative-static)	Long-term (steady-state)
1	Agriculture, hunting and forestry	-0.74	2.10
2	Fishing and fish farming	-3.33	1.21
3	Mining and quarrying	3.80	2.73
4	Manufacturing	-2.22	4.84
5	Electricity, gas and water supply	-0.23	4.26
6	Construction	-0.22	1.24
7	Wholesale and retail trade; repair of motor vehicles, motorcycles, personal and household goods	-1.01	3.26
8	Hotels and restaurants	0.30	4.99
9	Transport and communication	3.32	10.79
10	Financial intermediation	-0.53	2.98
11	Real estate, renting and business activities	0.31	5.07
12	Public administration	-1.51	-1.13
13	Education	-0.75	0.71
14	Health and social work	0.37	3.47
15	Other community, social and personal service activities, services of domestic staff	0.63	5.09

		Medium-Term (comparative-static)	Long-term (steady-state)
	employed by households		

Sources: World Bank, ISET Policy Institute.

Table A4.3: Imports, Percentage Cumulative Change from 2013 Baseline

		Medium-Term (comparative-static)	Long-term (steady-state)
1	Agriculture, hunting and forestry	1.79	5.41
2	Fishing and fish farming	-0.34	4.60
3	Mining and quarrying	0.44	4.32
4	Manufacturing	1.18	3.41
5	Electricity, gas and water supply	1.24	4.38
6	Construction	1.71	1.98
7	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	1.70	4.16
8	Hotels and restaurants	0.00	0.39
9	Transport and communication	-11.02	-9.94
10	Financial intermediation	1.56	4.98
11	Real estate, renting and business activities	1.55	3.24
12	Public administration	1.38	1.03
13	Education	2.58	3.84
14	Health and social work	2.89	3.90
15	Other community, social and personal service activities, services of domestic staff employed by households	3.31	4.37

Sources: World Bank, ISET Policy Institute.