

# The adaptability of Armenian economic sectors to freight market fluctuations

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**Key words:** Freight Tariffs, Economic Growth, Armenia, adaptability, ARIMA

## Հայաստանի տնտեսական ճյուղերի հարմարվողականությունը բեռնափոխադրումների շուկայի տատանումներին

Մխիթարյան Հ. Ա.

Հայաստանի Ամերիկյան Համալսարանի գործարարություն ֆակուլտետի ուսանող (Երևան, Հայաստան)

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**Ամփոփում՝** հետազոտության հիմնական նպատակն է գնահատել Հայաստանի տնտեսության տարբեր ճյուղերի հարմարվողականությունը բեռնափոխադրումների սակագների փոփոխությանը վերջին 20 տարիների ընթացքում: Հետազոտությունն իրականացնելու համար պաշտոնական վիճակագրությունը ստացվել է ՀՀ կենտրոնական բանկից և վիճակագրական կոմիտեից: Մշակված մոդելների գործակիցները գնահատելու համար օգտագործվել է ինքնահեռացման ինտեգրված շարժվող միջին տեխնիկան (ARIMA): Չնայած այն հանգամանքին, որ ոչ մի ապացույց չի հաջողվել հայտնաբերել հարմարվողականության վարկածի հաստատման համար, ուսումնասիրության արդյունքները կարող են օգտակար լինել բեռնափոխադրումների շուկայում գների տատանումների ընթացքում համապատասխան մարմինների հետագա քաղաքականության նկատառումներին:

**Հանգուցաբառեր՝** բեռնափոխադրումների սակագներ, տնտեսական աճ, հարմարվողականություն, Հայաստան, ARIMA

## Адаптивность секторов экономики Армении к колебаниям на рынке грузовых перевозок

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**Аннотация.** Основная цель исследования - оценить адаптируемость различных секторов экономики Армении к изменениям грузовых тарифов за последние 20 лет. Для проведения исследования официальная статистика была получена из Центрального банка Армении и Статистического комитета. Для оценки коэффициентов разработанных моделей использовалась методика авторегрессионного интегрированного скользящего среднего. Несмотря на то, что ни одна из оценок не смогла выявить никаких доказательств предполагаемой адаптации, результаты исследования могут быть полезны для дальнейших политических соображений соответствующими органами во время колебаний цен на рынке грузовых перевозок.

**Ключевые слова:** грузовые тарифы, экономический рост, Армения, адаптивность, ARIMA.

### Introduction

The price instabilities are rampant in developing countries. One of the many causes for fluctuations in market prices for goods and services is the level of interdependence and intricacy of modern economies. The most patent proof for it is the rapid development of trade openness globally for the past 50 years. On the one hand, the increased financial integration and globalization possess benefits for smoothening the economy through channels such as, borrowing, efficient investments and risk diversification. While, another consequence of the phenomenon is the increased vulnerability to external shocks of global economy and short-term fluctuations [1]. Developing countries are particularly impaired by the latter for their

inefficiency to recover from the recessions compared to developed countries.

As a consequence, for the increase in trade openness countries became more dependent on imports and exports. Walter Isard proposed a theory and later the famous gravity model of trade, aimed to explain the trade between two countries on the basis of distance and scales of the economies [2; 3]. The approach, does not however consider the various trade barriers and economic costs, except for the distance, to account for the amount of trade in the economy. The short-term changes in those barriers, such as fluctuations in freight markets, alterations in legislations or import tariffs, can cause increase/decrease in the amount and costs of exports and imports leading to sequential impacts on the

gross domestic output of the country. As a result, the gravity model is flawed for short-term analysis.

These instabilities are particularly patent for the Armenian economy. The ongoing military conflict and partial blockade for the past 30 years, and absence of direct access to sea routes, left Armenian economy virtually deprived of stable means of transportations (e.g., railways, shipping). This resulted in higher dependence on the road and air transportation. The latter have historically had higher inconsistency in prices (fluctuations in oil prices, weather conditions, etc.). Further, A key crossing (Upper Lars) on the major route connecting Armenia to its main trade partner Russia is occasionally blocked as a result of unfavorable weather conditions, amplifying the inconsistency in freight market.

In this paper, the impact of changes in freight tariffs on the gross output of different market sectors in Armenia is to be analyzed. The aforementioned settings are likely to have detrimental effects on the Armenian economy. Nevertheless, hypothetically the economies have a common feature of adapting to analogous incidents that are periodic in nature. Therefore, the main objective of the study is to evaluate the marginal effect of the percentage change in tariffs on economic growth, and determine whether such effects (if any) have historically diminished in scale.

### **Literature Review**

Despite the importance and the growing interest of the transportation costs in the trade theory, the scientific literature and empirical analysis on the topic remains modest. In the paper “*Globalization and the Inequality of Nations*” Krugman gives importance’s to the transportation costs in the division of poor and rich countries in the world, suggesting that decreasing costs lead to stronger integration in financial markets and thus higher income [4, p. 862].

Steven Radelet, in the paper “*Shipping Costs, Manufactured Exports, and Economic Growth*” analyzing the historical data sample from 1965 to 1990 for 64 developing countries found that in contemporary economy the shipping costs are not a significant barrier for the trade [5, p. 11]. Further, the trend for shipping costs shows downward trend, implying that in the future the freight costs would cease being an issue for countries. Nevertheless, the findings suggest that geographic isolation and increased costs of transportation make country less competitive and making it hard to promote exports [5, p. 10]. As a result, firms pay lower wages and realize lower returns on investments.

In a comparably recent paper, David Hummels analyzes the factors behind the increase in international trade. His main findings imply unprecedented

decrease in transportation costs to be the main cause. He labels as driver of second era globalization, attributing the phenomenon to technological advancements in air transportation. Hummels predicts third era to be triggered by the “unfolding of cross-border trade” [6, pp. 151-152].

Overall, despite the rise of articles focusing on the international trade barriers, the literature is scarce on explaining the link between economic growth and freight costs. The paper is aimed to contribute to filling the gap in the literature and evaluate the degree of impact in Armenia with unstable freight costs. I hope that this research can further serve as a valuable basis for deeper analysis on case of other countries.

### **Methodology**

#### *Model building*

The research was inspired and based on a recently published paper on the adaptability of the Ukrainian economy to the fluctuations in prices of energy carriers [7]. However, a similar approach is inapplicable in Armenia, because of the scarcity of micro-level data for minimal required period of time. Instead, a macro level approach is adopted for the evaluation of adaptability. The basic purpose of the study is to estimate the level of dependence of different sectors of economy measured by their total value-added quarterly output on the unit change in the index of freight tariffs (statistical committee of RA), while controlling for third factors and external shocks. Based on the latter, a comparison was to be made between different periods to detect whether the effect (hypothesized to be negative) diminished or not. If yes, it would likely indicate that the given sector managed to become less dependent (more adaptable) on such fluctuations, for instance by increasing its productivity, or decreased its reliance on supply from imported materials.

The population model 1 to be estimated has the following form:

$$\begin{aligned} 1) \ln(\text{Value\_added})_t &= \beta_0 + \beta_1 \ln(\text{Value\_added})_{t-1} \\ &+ \beta_2 \text{freight\_tariffs}_t \\ &+ \beta_3 \text{price\_sector}_t \\ &+ \beta_4 \ln(\text{REER})_t + \varepsilon_t \end{aligned}$$

$\text{Value\_added}_t$  – represents the real output (*rgdp*) of the sector (or total) based on 2005 constant prices acquired from statistical committee. Natural log of the variable is used to estimate the percentage change of the variable in time  $t$ .

$\text{Rgdp\_rus}_t$  - represents the Russian GDP in time  $t$ , adjusted to 2005 constant prices. Given the high correlation between Armenian and Russian economies the variable is intended to control for external shocks in the model.

$\text{Freight Tariffs}_t$  – main explanatory variable represents the percentage change in freight tariffs for given period  $t$ . retrieved from CBA.

$Prices\_sector_t$  – the variable represents the price index of corresponding sector of the economy. retrieved from CBA.

$REER_t$  – represents real effective exchange rate constant 2005 at time  $t$ , retrieved from CBA.

$Sector\_price$  – represent the price index for the given sector. Retrieved statistical committee of Armenia.

The variables  $REER$  and  $Sector\_price$  are intended to control for internal shocks of the economy for the given period  $t$ . The former is used for estimating the coefficients for the model with total GDP, while the latter is used in estimation of given  $sector$  model.

Based on this model, the data needs to be split into four periods of 5 years, a significant positive difference between coefficients of  $freight\_tariffs$  would indicate positive signs of adaptation. The patent drawback of this model is the fact that 5-year period (20 observations) is absurdly small for estimating a model with 6 explanatory variables and a constant, thus the results would hardly be robust.

A more practical approach is adopted for the second population model below:

$$\begin{aligned}
 & 2) \ln(Value\_added)_t \\
 & = \beta_0 + \beta_1 \ln(Value\_added)_{t-1} \\
 & + \beta_2 \ln(rgdp\_rus)_t + \beta_3 freight\_tariffs_t \\
 & + \beta_4 price_{sector}_t + \beta_5 \ln(REER)_t \\
 & + \beta_6 freight\_tariffs * period + \varepsilon_t
 \end{aligned}$$

$period$  – is a dummy variable taking value 1 if the  $t$  is between 2015-2020. Consequently, a significant positive coefficient for the interaction term added in the second model, would imply that the industry is less affected by the freight tariffs in the recently compared to the earlier periods. Suppose both  $\beta_2$  is negative and  $\beta_5$  is positive, and they are both significant. In this case a unit change in the index of freight tariffs will lead to  $\beta_2$  decrease in the value added of the given sector for the years before 2015, and  $\beta_2 + \beta_5$  decrease for the years from 2015-2020. Based on the earlier assumption the absolute value of the change for the latter would less than that of the former.

Note: In model 2 the variable denoting percentage in  $REER$  prices was abandoned, as the risk of overfitting would have been substantiate given, otherwise, the ratio of the number of observations to number of variables.

Data

Table 1. Variable Summary Table

Variables	(syntax)	Data Source
Real GDP of Armenia (sector)	(rgdp_arm)	Statistical Committee of Armenia
Real GDP of Russia	(rgdp_rus)	International Financial Statistics
Transportation Costs	(freight_tariffs)	Central Bank of Armenia
Consumer Price Index Armenia	(cpi_arm)	Central Bank of Armenia
Consumer Price Index Russia	(cpi_rus)	Central Bank of Russia
REER	(reer)	Central Bank of Armenia
CPI (sector)	(Sector_price)	Central Bank of Armenia

Data Modification

The collected dataset from 2000 to 2020 inclusive (period chosen based on availability), contained some missing observations (e.g., transportation costs from 2002-2004, output per sector 2020). Instead of dropping the rows for given years, a decision was made to estimate the values

based moving average growth rates of same 3 quarters of previous 3 years. Additionally, as the dataset was quarterly X12 procedure was applied to smoothen the series and eliminate the seasonal component. after the modifications were made the dataset contained 7 variables and 80 observations.

Table 2. Correlation Table

	$\ln(real\_AM\_GDP)$	$\ln(real\_man)(t)$	$\ln(real\_agr)(t)$	$\ln(real\_cons)(t)$	$\ln(real\_ser)(t)$
Freight_tariffs(t) (%)	-0.2929	-0.1702	-0.2779	-0.1885	-0.2854
Freight_tariffs(t-1) (%)	-0.2508	-0.0779	-0.3178	-0.17	-0.3335

Analysis

In this section short description of the procedure of the analysis and main findings are provided. All the regression outputs provided in the paper are estimated using The Autoregressive Integrated Moving Average (ARIMA) modelling approach. ARIMA was preferred to regular regression and

ARDL models, as the it proved to be more efficient in accurate prediction. The estimation was conducted using statistical software STATA 17.0.

To achieve the objectives of the paper listed below:

- Estimate the degree of impact of freight cost changes on economic growth

• Test the hypothesis of economic adaptability

Value added of economic sectors – manufacturing, agriculture, construction and services, as well as the total GDP output were considered. For each sector two models were

constructed based on population models developed in the methodology section. All the variables, except for *REER*, utilized in the models showed no signs of existence unit root in the Dickey Fuller and Philips Perron tests. As for *REER* the first difference of the variable was taken a proxy variable for *REER*.

**Table 3. ARIMA summary for percentage change in Real GDP**

Variables	Coefficients	P-Value	Coefficients	P-Value
$\ln(\text{real\_AM\_GDP})$				
<i>Freight_tariffs(t)</i> (%)	-0.016	0.77	-0.009	0.87
<i>Freight_tariffs(t-1)</i> (%)	-0.202	0	-0.197	0
$\ln(\text{real\_RF\_GDP})$	1.381	0	1.426	0
$\ln(\text{dif\_reer}(t))$	0.012	0.87	0.004	0.96
$\ln(\text{dif\_reer}(t-1))$	0.001	0.99	-0.001	0.99
<i>Freight_tariffs*Period</i>			0.013	0.25
Constant	-13.043	0.36	-19.278	0.2
ARMA				
$\ln(\text{real\_AM\_GDP})(t-1)$	-1.024	0	-1.016	0
$\ln(\text{real\_AM\_GDP})(t-2)$	-0.742	0	-0.737	0
Moving Average (t-1)	1.224	0	1.221	0
Moving Average (t-2)	1	0	1	0
Log-Likelihood		406.1		404.5
	AIC	SIC	AIC	SIC
	426.1	449.6	426.5	452.3

The choice of the lags for the dependent variable and moving average was chosen based on Akaike-Bayesian criterion. In the examples of total GDP, manufacturing, agriculture and services the most optimal choice with lowest Akaike and Bayesian scores were 2 previous lags for both the dependent variable lags and Moving Average (MA) variables. While for the *construction* model the it was lag 1 for MA.

In the **table 4** regression output explaining the percentage change in Real GDP is provided. The variable names with respective coefficients and P-values are summarized in separate columns. It can be concluded from the model that percentage change in freight tariffs for the current period has no statistically significant effect on the dependent variable. Nevertheless, a strong 0.2 negative effect is triggered for a percent increase in the tariffs of previous term. This is an expected result as many contracts in business world are signed in advance, therefore the economy takes time to react to the changes. Further, the table reveals that real GDP is strongly dependent on its previous lags as well as proxy variable representing Russian economy, while *REER* has no very high p-value, it was left in the model to control for shocks.

The second model including the interaction term of freight tariffs and recent period, however

revealed no sign of adaptability based on the adopted methodology. The statement is true for all the other models. Rest of the tables (i.e., manufacturing; services and construction models) are provided in the appendix section (PAGE 9-11).

### Conclusion

The research succeeded in identifying the most and least dependent sectors of economy on the freight tariffs, as well as assess the scale of changes triggered by one percent change in the transportation costs. The impact on total GDP, manufacturing, agriculture, construction and services are 0.2%, 0.37%, insignificant, 0.25% and 0.49% respectively. Making the services sector the most affected by the fluctuations. Interestingly, manufacturing sector revealed no sign of interdependence on those fluctuations on short term, yet a positive correlation of 0.3 percent is present for a for fluctuations occurred 12-15 months ago. A possible explanation for this is that in unstable times people tend to switch to manufacturing (assuming it is steadier sector), thus increasing its output. The time lag of more than a year is reasonable, given the time that people need to adapt to new circumstances. **In the scope of this study no sign of adaptability was found.**

Table 4. ARIMA summary for percentage change in manufacturing sector

	Coefficients	P-Value	Coefficients	P-Value
$\ln(\text{real\_man})(t)$				
<i>Freight_tarrifs(t)</i> (%)	-0.018	0.86	-0.048	0.68
<i>Freight_tariffs(t-5)</i> (%)	0.368	0	0.402	0
$\ln(\text{real\_RF\_GDP})$	0.364	0.1	0.381	0.09
<i>cpi_manufacturing(t)</i>	-0.108	0.3	-0.069	0.54
<i>cpi_manufacturing(t-1)</i>	0.252	0.01	0.226	0.06
<i>Freight_tariffs*Period</i>			0.036	0.15
Constant	15.723	0.55	11.486	0.69
ARMA				
$\ln(\text{real\_man})(t-1)$	1.106	0	1.048	0
$\ln(\text{real\_man})(t-2)$	-0.784	0	-0.77	0
Moving Average (t-1)	-0.806	0	-0.8	0
Moving Average (t-2)	1	0	1	0
Log-Likelihood		466.3		454.9
	AIC	SIC	AIC	SIC
	486.3	509.7	476.9	502.6

Table 5. ARIMA summary for percentage change in agricultural sector

	Coefficients	P-Value	Coefficients	P-Value
$\ln(\text{real\_agr})(t)$				
<i>Freight_tarrifs(t)</i> (%)	-0.084	0.62	-0.189	0.31
<i>Freight_tariffs(t-5)</i> (%)	-0.25	0.1	-0.394	0.06
$\ln(\text{real\_RF\_GDP})$	0.263	0.5	-0.415	0
<i>cpi_agr(t)</i>	-0.211	0.03	-0.266	0
<i>Freight_tariffs*Period</i>			-0.1	0
Constant	133.593	0	138.147	0
ARMA				
$\ln(\text{real\_agr})(t-1)$	0.516	0.66	1.65	0
$\ln(\text{real\_agr})(t-2)$	0.338	0.57	-0.807	0
Moving Average (t-1)	-0.652	0.47	-1.997	1
Moving Average (t-2)	-0.666	0.56	1	1
Log-Likelihood		538.8		511.5
	AIC	SIC	AIC	SIC
	556.8	577.9	529.5	550.6

Table 6. ARIMA summary for percentage change in construction sector

	Coefficients	P-Value	Coefficients	P-Value
$\ln(\text{real\_cons})(t)$				
<i>Freight_tarrifs(t)</i> (%)	0.167	0.53	0.17	0.53
<i>Freight_tariffs(t-1)</i> (%)	-0.056	0.79	-0.057	0.79
$\ln(\text{real\_RF\_GDP})$	3.796	0	3.727	0
<i>cpi_cons(t)</i>	0.729	0	0.724	0
<i>cpi_cons(t-1)</i>	-0.187	0.54	-0.207	0.52

<i>Freight_tariffs*Period</i>			-0.026	0.75
Constant	-353.114	0	-343.03	0
ARMA				
<i>ln(real_cons)(t-1)</i>	0.457	0.71	0.422	0.75
<i>ln(real_cons)(t-2)</i>	0.038	0.96	0.069	0.93
Moving Average (t-1)	0.191	0.88	0.23	0.86
Log-Likelihood	577.33		577.16135	
	AIC	SIC	AIC	SIC
	595.3	616.4	597.2	620.6

**Table 7. ARIMA summary for percentage change in services sector**

	Services Value added		Services Value added	
	Coefficients	P-Value	Coefficients	P-Value
<i>ln(real_ser)(t)</i>				
<i>Freight_tarrifs(t) (%)</i>	-0.162	0	-0.164	0
<i>Freight_tariffs(t-1) (%)</i>	-0.328	0	-0.327	0
<i>ln(real_RF_GDP)</i>	0.872	0	0.887	0
<i>cpi_services(t)</i>	-0.033	0.41	-0.037	0.45
<i>cpi_services(t-1)</i>	0.067	0.15	0.067	0.15
<i>Freight_tariffs*Period</i>			0.004	0.88
Constant	69.577	0.01	67.998	0.03
ARMA				
<i>ln(real_ser)(t-1)</i>	1.106	0	0.642	0
<i>ln(real_ser)(t-2)</i>	-0.784	0	-0.619	0
Moving Average (t-1)	-0.806	0	-0.137	0.3
Moving Average (t-2)	1	0	1	0
Log-Likelihood	402.0		401.9	
	AIC	SIC	AIC	SIC
	422.0	445.4	423.9	449.7

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