

# **“MEASURING IMPACTS AND FINANCING INFRASTRUCTURE IN KAZAKHSTAN”**

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# Structure of Presentation

- I. INFRASTRUCTURE PROJECT IN KAZAKHSTAN
- II. THE DIFFERENCE-IN-DIFFERENCE (DID) APPROACH
- III. DATA FOR EMPIRICAL ANALYSIS
- IV. ECONOMETRIC MODEL WITH DID APPROACH
- V. EMPIRICAL RESULTS
- VI. CONCLUSION

# Research project of Evaluation of the effect of Investment in Infrastructure in Kazakhstan

- In this research of impact of investment in Infrastructure in Kazakhstan we consider the Project of construction of the railway Horgos - Zhetygen, which located in Almatiskaya oblast in East region of Kazakhstan on the border with China.



# Infrastructure project of railway construction Horgos - Zhetygen in Kazakhstan



- ▶ Construction of the new railway line “Zhetygen-Korgas” is strategic importance because its opens the second railway transition between Kazakhstan and China.
- ▶ During the implementation of this project, a 293 km-long main railway was built. Also construction of 28 bridges and 2 overpasses on the Zhetygen-Korgas section are completed, service and technical buildings were constructed.

# Infrastructure project of railway construction Horgos - Zhetygen in Kazakhstan



- ▶ “Khorgos” ICBC consists of the two parts: Kazakhstan part – located in the territory of Panfilovskiy raiyon of Almatinskaya oblast, and China part – located in the territory of the Ili-Kazakh Autonomous Prefecture of Xinjiang–Uyghur Autonomous Region.
- ▶ The distance from the Kazakhstan part of “Khorgos” to the regional center of Almatinskaya oblast, is 321 km, and the distance to the largest city of the Republic of Kazakhstan – city of Almaty is 361 km. In this regards, we consider these two regions such as treatment region by Difference in Difference approach in this research.
- ▶ During the implementation of this project in Kazakhstan were constructed Railway station building and administrative building at the border station Altynkol; engineering networks and their facilities were built. Also many infrastructure objects such as, the houses for railway workers and public servicemen, objects as a school, kindergarten, clinic and other facilities were constructed. After the railway is launched, was created more than 2,000 jobs.

## II. THE DIFFERENCE-IN-DIFFERENCE (DiD) APPROACH

# THE DIFFERENCE-IN-DIFFERENCE (DiD) METHOD

- ▶ The Difference-in-Difference (DiD) method enables us to see the effect of a particular infrastructure project by computing difference over time (before and after intervention) and across different regions.
- ▶ The DiD approach will help us to measure difference between “actual” outcome and the alternative outcome. For this purpose, we will divide data into control and treated groups on the basis of geography and time. The result should reflect difference between pre-intervention and post-intervention data. After observing the changes in both groups over time, DID coefficient can be calculated, that will serve as a measure of impact.

# Pre-intervention and post-intervention periods

Period	Pre-construction	Operation phase 1	Operation phase 2
Years	2000-2009	2010-2014	2015-2017



# Treatment and control group by regions

Treatment region	Traversed regions	Control regions
Almatinskaya Almaty	Severo-Kazakhstanskaya Kostanaiskaya Akmolinskaya Pavlodarskaya Astana city Karagandinskaya Vostochno-Kazakhstanskaya Zhambylskaya Yuzhno-Kazakhstanskaya	Aktubinskaya Atyrauskaya Zapadno-Kazakhstanskaya Mangistauskaya Kyzylordinskaya

# III. DATA FOR EMPIRICAL ANALYSIS

# Region of Kazakhstan

Regions	Number
Akmolinskaya	1
Aktubinskaya	2
Almatinskaya	3
Atyrauskaya	4
Zapadno-Kazakhstanskaya	5
Zhambylskaya	6
Karagandinskaya	7
Kostanaiskaya	8
Kyzylordinskaya	9
Mangistauskaya	10
Yuzhno-Kazakhstanskaya	11
Pavlodarskaya	12
Severo-Kazakhstanskaya	13
Vostochno-Kazakhstanskaya	14
Astana city	15
Almaty city	16

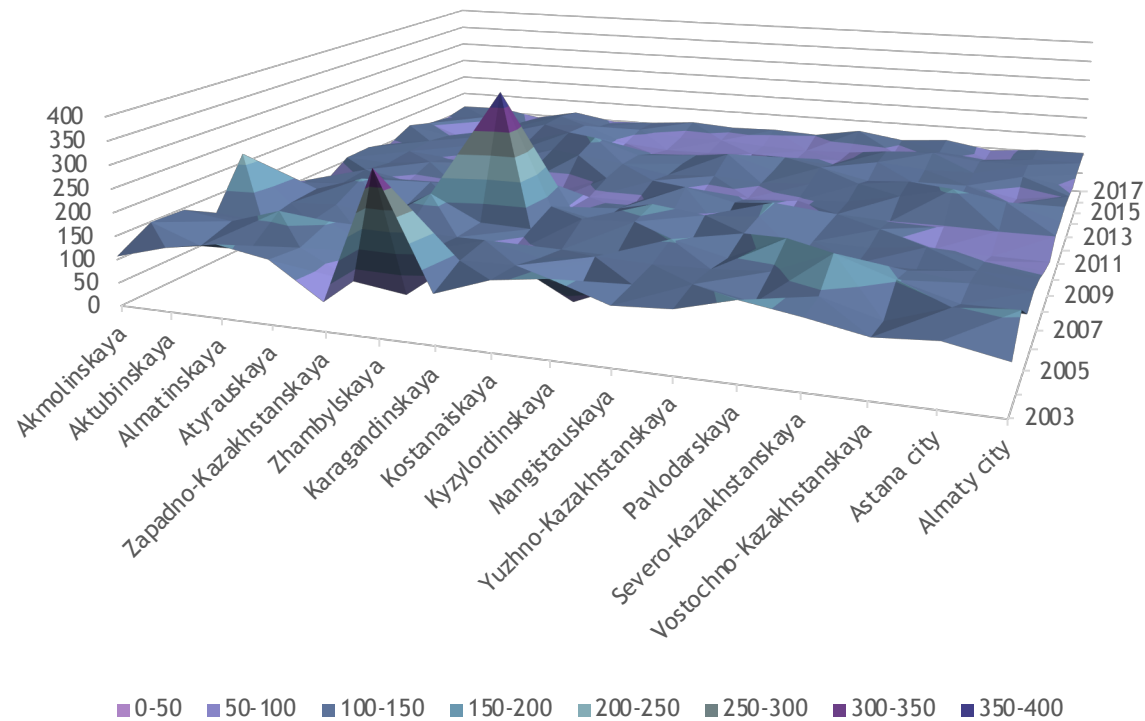
Kazakhstan is divided into 14 regions (oblasti) and two the largest city Almaty, and the capital city Astana.

# Panel data set of macroeconomic variables for all regions of Kazakhstan

- ▶ We compiled a **panel data set of encompassing all regions of Kazakhstan.**
- ▶ We consider the **impact of implementing of infrastructure in Macroeconomic level**, in which we consider the influence of the Project on macroeconomic indicators by regions, such as:
  - **Gross Regional Product by region in total,**
  - **Gross rate of index real volume of relevant industries, such as**
    - Real growth rate of the Transport industry by region (%)
    - Real growth rate of the Trade sector by region (%)
    - Real growth rate of the Construction industry by region (%)
    - Real growth rate of Investment in fixed capital by region (%)

# Investment in fixed capital by region of Kazakhstan

Indices of physical volume of investments in fixed capital by regions,  
in % to previous year



# Descriptive statistics for dependent macroeconomic variables in DiD model

	GRP_GR_TOT	GRP_GR_TRD	GRP_GR_TRN	GRP_GR_CNS
Mean	6.390809	8.368015	7.670588	20.57353
Median	5.500000	7.050000	6.300000	10.65000
Maximum	25.40000	134.3000	88.20000	324.6000
Minimum	-7.100000	-52.60000	-54.60000	-41.90000
Std. Dev.	6.103204	14.89617	12.84060	45.97655
Skewness	0.578245	2.570177	1.605236	3.596669
Kurtosis	3.284303	23.44524	16.12480	21.40386
Jarque-Bera	16.07401	5036.884	2069.100	4425.055
Probability	0.000323	0.000000	0.000000	0.000000
Sum	1738.300	2276.100	2086.400	5596.000
Sum Sq. Dev.	10094.51	60133.77	44682.78	572851.4
Observations	272	272	272	272

where:

GRP\_GR\_TOT - Real growth rate of the Gross Regional Product by region (%)

GRP\_GR\_CNS - Real growth rate of the Construction industry by region (%)

GRP\_GR\_TRD - Real growth rate of the Trade sector by region (%)

GRP\_GR\_TRN - Real growth rate of the Transport industry by region (%)

# Descriptive statistics for independent variables in DiD model

	RTRD_GR	WTRD_NR	INV_FX_GR	TRN_CARGO_TN_GR	CSTR_RH_TSQM_GR
Mean	11.95163	25.06894	20.29653	5.812635	19.66425
Median	9.350000	19.10195	9.400000	5.966923	9.899512
Maximum	61.40000	283.1103	283.0000	45.72714	347.5410
Minimum	-16.00000	-61.86458	-46.70000	-56.03306	-70.44335
Std. Dev.	12.82508	36.04747	42.29591	10.36569	44.40713
Skewness	1.066865	2.936008	3.292948	-0.708243	3.857823
Kurtosis	4.709969	19.68806	18.41852	10.11606	25.45237
Jarque-Bera	89.72154	3547.017	3373.257	592.2531	6387.921
Probability	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	3442.070	6818.752	5845.400	1569.411	5348.677
Sum Sq. Dev.	47206.50	352142.9	513427.0	28903.38	534410.2
Observations	288	272	288	270	272

where:

INV\_FX\_GR – Growth rate of Investments in fixed capital by region (%)

TRN\_CARGO\_TN\_GR - Growth rate of cargo transportation in Transport industry by region (%)

WTRD\_NR - Growth rate of Wholesale trade of the Trade sector by region (%)

RTRD\_GR - Growth rate of Retail trade of the Trade sector by region (%)

CSTR\_RH\_TSQM\_GR - Growth rate of total area of residential buildings put into operation of the Construction industry by region (%)

## IV. Econometric model with DiD approach



# Econometric models with DiD method

- We specify two estimating equations associated with the two affected regional types (treatment and traversed). Difference-in-difference coefficients for each regional type represent deviations in growth rates from those regions not included in the affected groups.
- We then estimate each of the two equations separately for each of the four growth indicators (GRP total and value added for each of Transport industry, Construction and Trade sector) for a total of 8 regressions.

- Our two estimating equations by region are given as follows:

- $$\frac{Y_{it} - Y_{it-1}}{Y_{it-1}} = a_i + \varphi_i + X'_{it} * \beta + \delta_3 * Dtreatment * D_{10-14} + \delta_4 * Dtreatment * D_{15-17} + \varepsilon_{it}$$

- $$\frac{Y_{it} - Y_{it-1}}{Y_{it-1}} = a_i + \varphi_i + X'_{it} * \beta + \delta_3 * Dtraversed * D_{10-14} + \delta_4 * Dtraversed * D_{15-17} + \varepsilon_{it}$$

- Where  $\frac{Y_{it} - Y_{it-1}}{Y_{it-1}}$  is the growth rate of economic performance indicators (GRP and value added for Transport, Construction and Trade sector);

- $Dtreatment$  and  $Dtraversed$  - are binary variables indicating whether or not the observation belongs to the respective geographical types;

- $D_{10-14}$  and  $D_{15-17}$  - are binary variables indicating whether or not the observation belongs to the respective time periods;

# Econometric models with DiD method

- ▶ **Dependent variables:** (real growth rate to previous year in percent)
- ▶ GRP\_GR\_TOT - Real growth rate of the Gross Regional Product by region (%)
- ▶ GRP\_GR\_CNS - Real growth rate of the Construction industry by region (%)
- ▶ GRP\_GR\_TRD - Real growth rate of the Trade sector by region (%)
- ▶ GRP\_GR\_TRN - Real growth rate of the Transport industry by region (%)
- ▶ **Independent variables:** (included in X')
- ▶ INV\_FX\_GR – Growth rate of Investments in fixed capital by region (%)
- ▶ TRN\_CARGO\_TN\_GR - Growth rate of cargo transportation in Transport industry by region (%)
- ▶ WTRD\_NR - Growth rate of Wholesale trade of the Trade sector by region (%)
- ▶ RTRD\_GR - Growth rate of Retail trade of the Trade sector by region (%)
- ▶ CSTR\_RH\_TSQM\_GR - Growth rate of total area of residential buildings put into operation of the Construction industry by region (%)

# V. Empirical results

# Evaluation of impact to the Gross Regional Product in total on treatment region

Dependent Variable: GRP_GR_TOT					
Method: Panel EGLS (Cross-section random effects)					
Date: 11/29/18 Time: 20:35					
Sample (adjusted): 2001 2017					
Periods included: 17					
Cross-sections included: 16					
Total panel (unbalanced) observations: 270					
Swamy and Arora estimator of component variances					
Variable	Coefficient	Std. Error	t-Statistic	Prob.	
RTRD_GR	0.069585	0.026689	2.607299	0.0096	
WTRD_NR	0.039923	0.009208	4.335788	0.0000	
INV_FX_GR	0.043628	0.009378	4.652141	0.0000	
TRN_CARGO_TN_GR	0.072631	0.032016	2.268582	0.0241	
CSTR_RH_TSQM_GR	0.017548	0.007635	2.298369	0.0223	
DP10_14*DTREATMENT	3.417291	1.714347	1.993348	0.0473	
DP15_17*DTREATMENT	-1.098719	2.402863	-0.457254	0.6479	
C	2.971474	0.522285	5.689376	0.0000	
Effects Specification				S.D.	Rho
Cross-section random				0.000000	0.0000
Idiosyncratic random				5.266106	1.0000
Weighted Statistics					
R-squared	0.245366	Mean dependent var	6.424815		
Adjusted R-squared	0.225204	S.D. dependent var	6.110009		
S.E. of regression	5.378183	Sum squared resid	7578.310		
F-statistic	12.16973	Durbin-Watson stat	1.740644		
Prob(F-statistic)	0.000000				
Unweighted Statistics					
R-squared	0.245366	Mean dependent var	6.424815		
Sum squared resid	7578.310	Durbin-Watson stat	1.740644		

# Evaluation of impact to the Trade sector on treatment region

Dependent Variable: GRP_GR_TRD				
Method: Panel EGLS (Cross-section random effects)				
Date: 11/29/18 Time: 20:40				
Sample (adjusted): 2001 2017				
Periods included: 17				
Cross-sections included: 16				
Total panel (unbalanced) observations: 270				
Swamy and Arora estimator of component variances				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
RTRD_GR	0.129340	0.053361	2.423879	0.0160
WTRD_NR	0.286078	0.018410	15.53937	0.0000
INV_FX_GR	-0.012461	0.018750	-0.664565	0.5069
TRN_CARGO_TN_GR	0.039247	0.064012	0.613126	0.5403
CSTR_RH_TSQM_GR	-0.018138	0.015265	-1.188220	0.2358
DP10_14*DTREATMENT	6.973330	3.427625	2.034449	0.0429
DP15_17*DTREATMENT	0.189046	4.804228	0.039350	0.9686
C	-0.179811	1.044244	-0.172193	0.8634
Effects Specification			S.D.	Rho
Cross-section random			0.000000	0.0000
Idiosyncratic random			10.52893	1.0000
Weighted Statistics				
R-squared	0.519836	Mean dependent var	8.425185	
Adjusted R-squared	0.507008	S.D. dependent var	14.93651	
S.E. of regression	10.48743	Sum squared resid	28816.39	
F-statistic	40.52106	Durbin-Watson stat	1.993373	
Prob(F-statistic)	0.000000			
Unweighted Statistics				
R-squared	0.519836	Mean dependent var	8.425185	
Sum squared resid	28816.39	Durbin-Watson stat	1.993373	

# Evaluation of impact to the Transport sector on treatment region

Dependent Variable: GRP_GR_TRN				
Method: Panel EGLS (Cross-section random effects)				
Date: 11/29/18 Time: 20:42				
Sample (adjusted): 2001 2017				
Periods included: 17				
Cross-sections included: 16				
Total panel (unbalanced) observations: 270				
Swamy and Arora estimator of component variances				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
RTRD_GR	0.091916	0.062903	1.461237	0.1451
WTRD_NR	0.074841	0.021669	3.453764	0.0006
INV_FX_GR	-0.033467	0.022143	-1.511411	0.1319
TRN_CARGO_TN_GR	-0.178799	0.075340	-2.373219	0.0184
CSTR_RH_TSQM_GR	0.018651	0.017947	1.039230	0.2997
DP10_14*DTREATMENT	2.777676	4.113305	0.675291	0.5001
DP15_17*DTREATMENT	-0.315184	5.704914	-0.055248	0.9560
C	5.874095	1.267541	4.634244	0.0000
Effects Specification			S.D.	Rho
Cross-section random			1.232373	0.0098
Idiosyncratic random			12.36673	0.9902
Weighted Statistics				
R-squared	0.082942	Mean dependent var	7.093065	
Adjusted R-squared	0.058440	S.D. dependent var	12.81841	
S.E. of regression	12.43908	Sum squared resid	40539.43	
F-statistic	3.385171	Durbin-Watson stat	1.933625	
Prob(F-statistic)	0.001775			
Unweighted Statistics				
R-squared	0.082782	Mean dependent var	7.666296	
Sum squared resid	40983.12	Durbin-Watson stat	1.912691	

# Evaluation of impact to the Construction industry on treatment region

Dependent Variable: GRP_GR_CNS				
Method: Panel EGLS (Cross-section random effects)				
Date: 11/29/18 Time: 20:44				
Sample (adjusted): 2001 2017				
Periods included: 17				
Cross-sections included: 16				
Total panel (unbalanced) observations: 270				
Swamy and Arora estimator of component variances				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
RTRD_GR	0.060665	0.182804	0.331858	0.7403
WTRD_NR	-0.031755	0.063069	-0.503503	0.6150
INV_FX_GR	0.798376	0.064235	12.42899	0.0000
TRN_CARGO_TN_GR	0.168857	0.219292	0.770008	0.4420
CSTR_RH_TSQM_GR	0.050501	0.052296	0.965676	0.3351
DP10_14*DTREATMENT	-5.018352	11.74238	-0.427371	0.6695
DP15_17*DTREATMENT	-6.790335	16.45835	-0.412577	0.6803
C	5.129163	3.577376	1.433778	0.1528
Effects Specification			S.D.	Rho
Cross-section random			0.000000	0.0000
Idiosyncratic random			36.07006	1.0000
Weighted Statistics				
R-squared	0.415669	Mean dependent var	20.72000	
Adjusted R-squared	0.400057	S.D. dependent var	46.11540	
S.E. of regression	35.71915	Sum squared resid	334274.6	
F-statistic	26.62511	Durbin-Watson stat	1.653727	
Prob(F-statistic)	0.000000			
Unweighted Statistics				
R-squared	0.415669	Mean dependent var	20.72000	
Sum squared resid	334274.6	Durbin-Watson stat	1.653727	

# Evaluation of impact to the Gross Regional Product in total on traversed region

Dependent Variable: GRP\_GR\_TOT  
Method: Panel EGLS (Cross-section random effects)  
Date: 11/30/18 Time: 08:36  
Sample (adjusted): 2001 2017  
Periods included: 17  
Cross-sections included: 16  
Total panel (unbalanced) observations: 270  
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RTRD_GR	0.067065	0.027955	2.399016	0.0171
WTRD_NR	0.034630	0.009386	3.689583	0.0003
INV_FX_GR	0.040063	0.009575	4.184116	0.0000
TRN_CARGO_TN_GR	0.080265	0.033331	2.408123	0.0167
CSTR_RH_TSQM_GR	0.016449	0.007684	2.140680	0.0332
DP10_14*DTRAVERSED	-1.187433	0.973396	-1.219887	0.2236
DP15_17*DTRAVERSED	-2.399865	1.168560	-2.053695	0.0410
C	3.717604	0.622979	5.967461	0.0000

## Effects Specification

	S.D.	Rho
Cross-section random	0.801687	0.0226
Idiosyncratic random	5.267983	0.9774

## Weighted Statistics

R-squared	0.250380	Mean dependent var	5.448090
Adjusted R-squared	0.230352	S.D. dependent var	6.034866
S.E. of regression	5.293987	Sum squared resid	7342.889
F-statistic	12.50148	Durbin-Watson stat	1.765221
Prob(F-statistic)	0.000000		

## Unweighted Statistics

R-squared	0.250062	Mean dependent var	6.424815
Sum squared resid	7531.151	Durbin-Watson stat	1.721095



# Evaluation of impact to the Trade sector on traversed region

Dependent Variable: GRP\_GR\_TRD  
Method: Panel EGLS (Cross-section random effects)  
Date: 11/30/18 Time: 08:34  
Sample (adjusted): 2001 2017  
Periods included: 17  
Cross-sections included: 16  
Total panel (unbalanced) observations: 270  
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RTRD_GR	0.107378	0.055654	1.929394	0.0548
WTRD_NR	0.281412	0.018761	14.99977	0.0000
INV_FX_GR	-0.018107	0.019005	-0.952754	0.3416
TRN_CARGO_TN_GR	0.037901	0.066549	0.569520	0.5695
CSTR_RH_TSQM_GR	-0.018085	0.015364	-1.177098	0.2402
DP10_14*DTRAVERSED	0.615870	1.904736	0.323336	0.7467
DP15_17*DTRAVERSED	-3.686509	2.306224	-1.598504	0.1111
C	0.825399	1.185369	0.696323	0.4868

Effects Specification		S.D.	Rho
Cross-section random		0.727870	0.0047
Idiosyncratic random		10.55411	0.9953

Weighted Statistics			
R-squared	0.517709	Mean dependent var	8.106069
Adjusted R-squared	0.504824	S.D. dependent var	14.91217
S.E. of regression	10.49350	Sum squared resid	28849.73
F-statistic	40.17729	Durbin-Watson stat	1.988917
Prob(F-statistic)	0.000000		

Unweighted Statistics			
R-squared	0.517511	Mean dependent var	8.425185
Sum squared resid	28955.98	Durbin-Watson stat	1.981619

# Evaluation of impact to the Transport sector on traversed region

Dependent Variable: GRP\_GR\_TRN  
Method: Panel EGLS (Cross-section random effects)  
Date: 11/30/18 Time: 08:37  
Sample (adjusted): 2001 2017  
Periods included: 17  
Cross-sections included: 16  
Total panel (unbalanced) observations: 270  
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RTRD_GR	0.077238	0.065336	1.182170	0.2382
WTRD_NR	0.075371	0.021963	3.431748	0.0007
INV_FX_GR	-0.033642	0.022358	-1.504737	0.1336
TRN_CARGO_TN_GR	-0.198792	0.077968	-2.549654	0.0114
CSTR_RH_TSQM_GR	0.020164	0.017982	1.121365	0.2632
DP10_14*DTRAVERSED	2.129296	2.262878	0.940968	0.3476
DP15_17*DTRAVERSED	-0.848697	2.723638	-0.311604	0.7556
C	5.945797	1.433854	4.146725	0.0000

Effects Specification		S.D.	Rho
Cross-section random		1.592691	0.0164
Idiosyncratic random		12.33550	0.9836

Weighted Statistics			
R-squared	0.085375	Mean dependent var	6.770053
Adjusted R-squared	0.060938	S.D. dependent var	12.78143
S.E. of regression	12.38707	Sum squared resid	40201.18
F-statistic	3.493722	Durbin-Watson stat	1.950121
Prob(F-statistic)	0.001338		

Unweighted Statistics			
R-squared	0.084132	Mean dependent var	7.666296
Sum squared resid	40922.81	Durbin-Watson stat	1.915733

# Evaluation of impact to the Construction industry on traversed region

Dependent Variable: GRP\_GR\_CNS  
Method: Panel EGLS (Cross-section random effects)  
Date: 11/30/18 Time: 08:38  
Sample (adjusted): 2001 2017  
Periods included: 17  
Cross-sections included: 16  
Total panel (unbalanced) observations: 270  
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RTRD_GR	0.083162	0.189334	0.439237	0.6609
WTRD_NR	-0.041112	0.063916	-0.643220	0.5206
INV_FX_GR	0.793427	0.064589	12.28419	0.0000
TRN_CARGO_TN_GR	0.212522	0.226633	0.937737	0.3492
CSTR_RH_TSQM_GR	0.045932	0.052351	0.877389	0.3811
DP10_14*DTRAVERSED	-6.439043	6.442903	-0.999401	0.3185
DP15_17*DTRAVERSED	-3.665191	7.823893	-0.468461	0.6398
C	6.156522	3.981786	1.546171	0.1233

Effects Specification		S.D.	Rho
Cross-section random		0.000000	0.0000
Idiosyncratic random		35.98541	1.0000

Weighted Statistics			
R-squared	0.417438	Mean dependent var	20.72000
Adjusted R-squared	0.401874	S.D. dependent var	46.11540
S.E. of regression	35.66501	Sum squared resid	333262.2
F-statistic	26.81970	Durbin-Watson stat	1.655795
Prob(F-statistic)	0.000000		

Unweighted Statistics			
R-squared	0.417438	Mean dependent var	20.72000
Sum squared resid	333262.2	Durbin-Watson stat	1.655795

# VI. CONCLUSION

# Conclusion

- ▶ “Khorgos” is very significant infrastructure projects, which develop cross border trade, economic, scientific, technical and cultural cooperation between Kazakhstan and China as well as to improve transit potential of both countries.
- ▶ Taking into account strategic location of the project area, it is possible to say that establishment of “Khorgos” International Cross-Border Cooperation Center is the break-through project in infrastructure sector of economy, which boosted development infrastructure in the area and transit potential of the country in the system of International logistics business.

*Thank you very much!*

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