Economic Development and Road Traffic Fatalities in Russian Federal Districts, 2004-2011

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Question

What's the relationship of economic development to road traffic fatalities (RTFs) and fatalities per crash (CFR) ?

Methods

1. Sample:

- 73 territory stable districts, 93% Russian population.
- Extreme values of key variables excluded.

2. Measures:

- Number of crashes, injuries, fatalities from traffic police, "gibdd.ru" and "fedstat.ru".
- Gross regional product (GRP) and other socioeconomic data from "*Russia in Figures*" of "gks.ru".

3. Data Analysis: Multivariate FE Models

- $Y_{it} = C + \beta_1 X_{it} + \beta_2 Pop_{it} + m_i + e_{it}$
- Y_{it} count of the RS outcome; X_{it} a set of covariates at the i-th state at time t. Pop_{it} population of that state at time t and m_i is a state-specific error term.
- Models: box-cox & scatter plots
- Hausman test: Fixed-effect

Table 1 Summary data of 73 Russian federal districts, n=584*

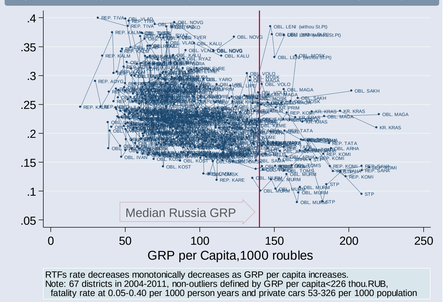
	Mean	SD
Road Safety Variables		
Crash rate, per thou. person years	1.6	0.4
Injury rate, per thou. person years	2.0	0.6
Fatality rate, per thou. person years	0.23	0.08
Fatalities per crash (CFR)	0.15	0.05
Main Socioeconomic Variables		
Population, end of year, thou. persons	154.5	224.6
Gross regional product (GRP) per Capita, thou. RUB	237.5	487.4
Territory, thou. sq. km	1798.2	1688.9
Number of privately owned cars per 1000 population	189.4	48.9
Number of public buses per 100 000 population	49.2	30.8
Length of public motor roads with hard surface, thou. km**	8.0	5.4
Number of physicians of all specialties, thou.	9.0	11.1
Consolidated budget expenditure on healthcare and physical wellness per capita, thou. RUB	3.7	3.0

*All monetary variables are converted to comparable price of 2004;
** Lacking data for Moscow City and St Petersburg City

Results – Fatalities

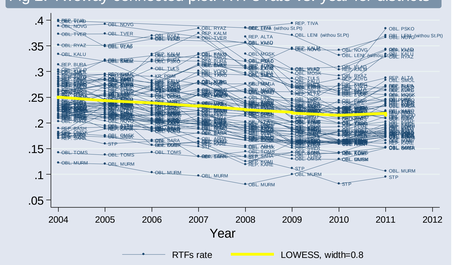
- # of fatalities decreases as GRP increases in basic model;
- Time, # of buses & # of physicians partially explain the negative effect of GRP;
- # of private cars mainly explains the GRP-fatalities association.

Fig 1. Twoway connected plot: RTFs rate vs. GRP per capita



RTFs rate decreases monotonically decreases as GRP per capita increases.
Note: 67 districts in 2004-2011, non-outliers defined by GRP per capita<226 thou.RUB, fatality rate at 0.05-0.40 per 1000 person years and private cars 53-326 per 1000 population

Fig 2. Twoway connected plot: RTFs rate vs. year for districts



The estmated generalfatality rate declines until 2010.
Note: 67 districts, non-outliers defined using GRP per capita<226 thou.RUB, fatality rate at 0.05-0.40 per 1000 person years and privately owned cars 53-326 per 1000 population

Table 2 Multivariate Fixed-effect Models of fatalities and CFR

	Fatalities		*Fatalities per 1000 crashes*	
	Model 1	**Model 2**	**Model 3**	**Model 4**
GRP, bln RUB	-0.405***	0.115	0.010	0.007
Population, thou.	-0.082	0.022	-0.019	-0.003
Territory, thou. sq. km	0.054	-0.070	0.295	0.336
Year 2004, reference	0.000	0.000	0.000	0.000
2005	-2.902	1.762	-9.878***	-10.113***
2006	-20.309***	-13.928**	-21.393***	-21.814***
2007	-7.030	4.336	-25.763***	-26.145***
2008	-30.853***	-7.552	-28.997***	-29.259***
2009	-70.890***	-29.258***	-32.199***	-32.299***
2010	-80.318***	-31.181***	-34.196***	-34.130***
2011	-49.251***	4.712	-29.364***	-28.922***
# of public buses, thou.	-3.703	-24.666***		-3.692
# of physicians, thou.	-22.358***	-6.132		-0.109
Health budget, bln RUB	2.458	1.232		0.187
# of private cars, thou.		-0.657***		-0.007
Constant	791.011***	630.954***	144.558	114.844
R^2 within	0.558	0.703	0.378	0.380
Additive R^2 within	0.558	0.145	0.378	0.002
# of observations	505	505	512	512
# of districts	67	67	66	66
Rho	0.996	0.997	0.990	0.992
Adjusted R^2, OLS	0.982	0.988	0.816	0.815

*Note: *** p<0.01, ** p<0.05 ; Length of road not significant to enter final models*

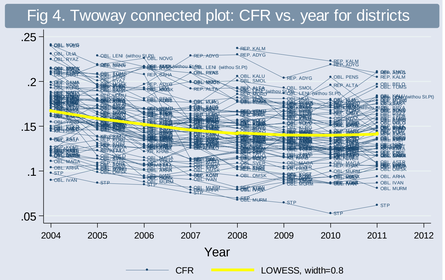
Results-CFR

- CFR decreases as GRP increases in basic model;
- Time explains all the negative effect of GRP;
- Other socioeconomic variables does not explain time trend of CFR.

Fig 3. Twoway connected plot: CFR vs. GRP per capita

CFR decreases as GRP per capita increases duing 2004-2011.
Note: 66 districts in 2004-2011, non-outliers defined by GRP per capita<226 thou. RUB, CFR at 0.04-0.25 and private cars at 53-326 per 1000 population

Fig 4. Twoway connected plot: CFR vs. year for districts



CFR declines over time until 2009-2010.
Note: 66 districts, non-outliers defined by GRP per Capita<226 thou. RUB, CFR at 0.04-0.25, and private cars at 53-326 per 1000 population

Results – Crashes & Injuries

- GRP not relate to traffic crashes or injuries in multivariate models

Discussion-Fatalities

Neither "Kuznets Curve" pattern for fatalities, nor monotonically increasing pattern for crashes/injuries

- Passed the peak?
- Low or slow economic development level?
- Interference of financial crisis?
- Update the framework for sub-country analysis?

Discussion – CFR

Traffic crashes are getting less fatal over time

- More cars: congestion? less severe crashes?
- Better healthcare: somewhat true, support by # of physicians
- More enforcement: lacking data
- Need more investigation with better models

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