The Cost-Effectiveness of the Army's Medium and Heavy Tactical Wheeled Vehicles in Iraq

Chris Rohlfs
Syracuse University

Ryan Sullivan
Naval Postgraduate School

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Question and Motivation

Large-scale U.S. Army policies in Iraq

- Replacing light with medium tactical wheeled vehicles
- Late 2005 through early 2008

- Replacing medium with heavy tactical wheeled vehicles
- Late 2007 through 2008
- ~$35 billion spent on heavy TWV procurement

Did these major policies reduce U.S. Army fatalities?

Were they cost-effective?

Data

For Official Use Only (FOUO) data from multiple Army and Defense Department sources

- Vehicle counts and mileages
    - ~20% sample of U.S. Army battalions in Iraq
    - Some measurement error in unit-level totals
- Vehicle costs
- Casualties linked to unit & location
- Unit & troop characteristics

Preview of Findings

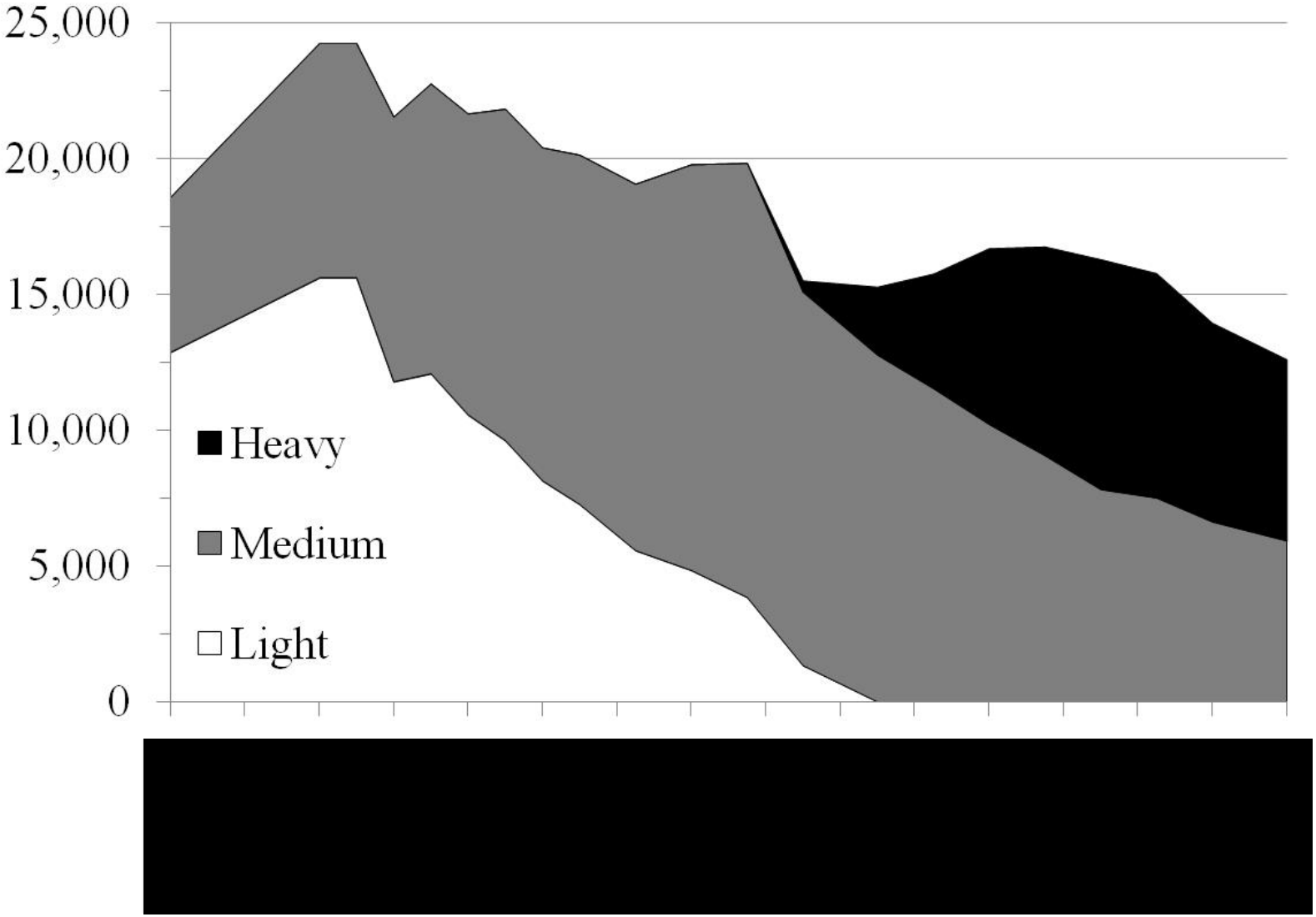
Medium TWV phase-in

- $1 million to $25 million cost per life saved for infantry,
    - Preferred estimates on the lower end
- Slightly higher cost for “other” unit types
- Not cost effective for armored & cavalry or admin & support

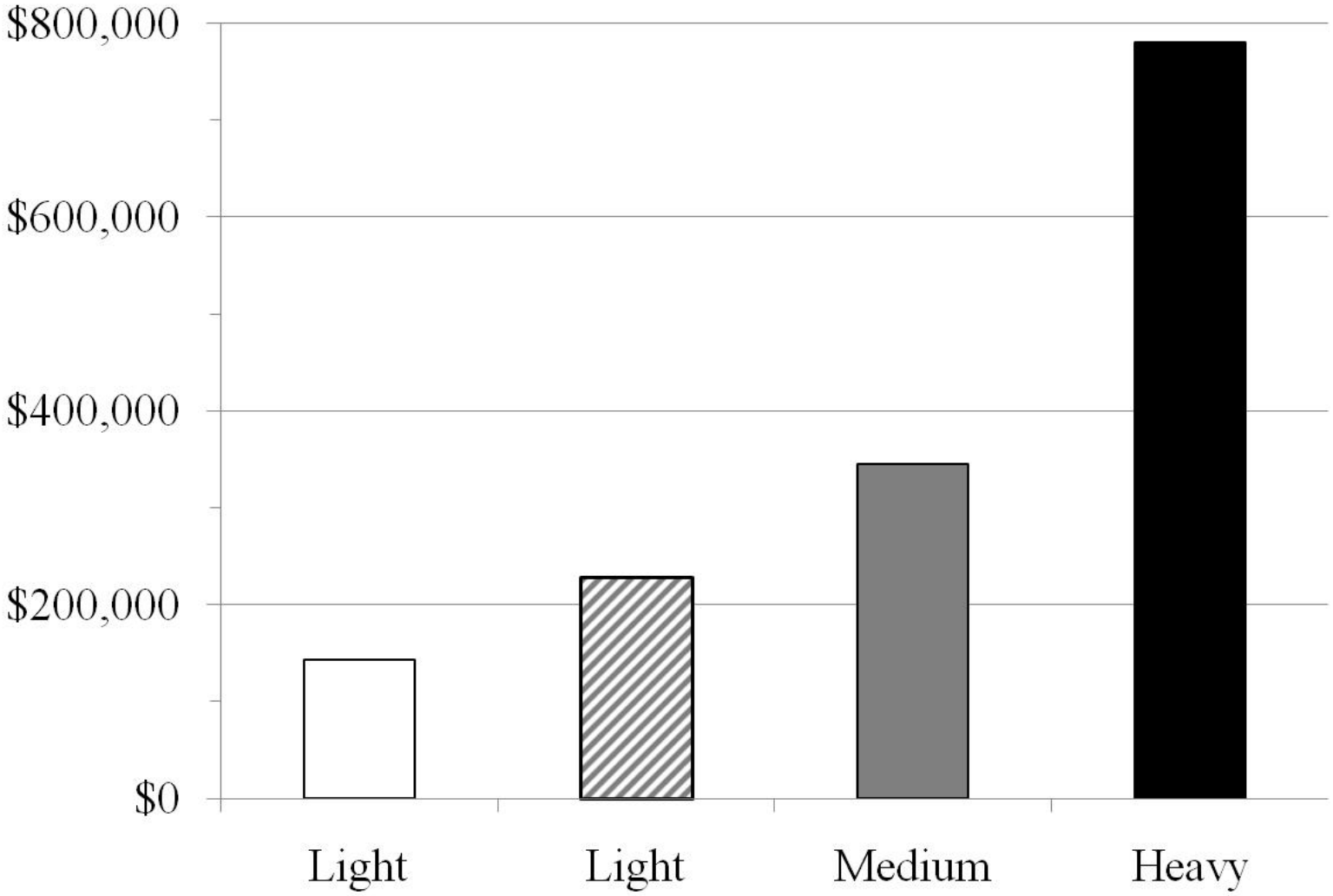
Heavy TWV phase-in

- Provided little benefit above medium TWVs
- Not cost effective for any unit type

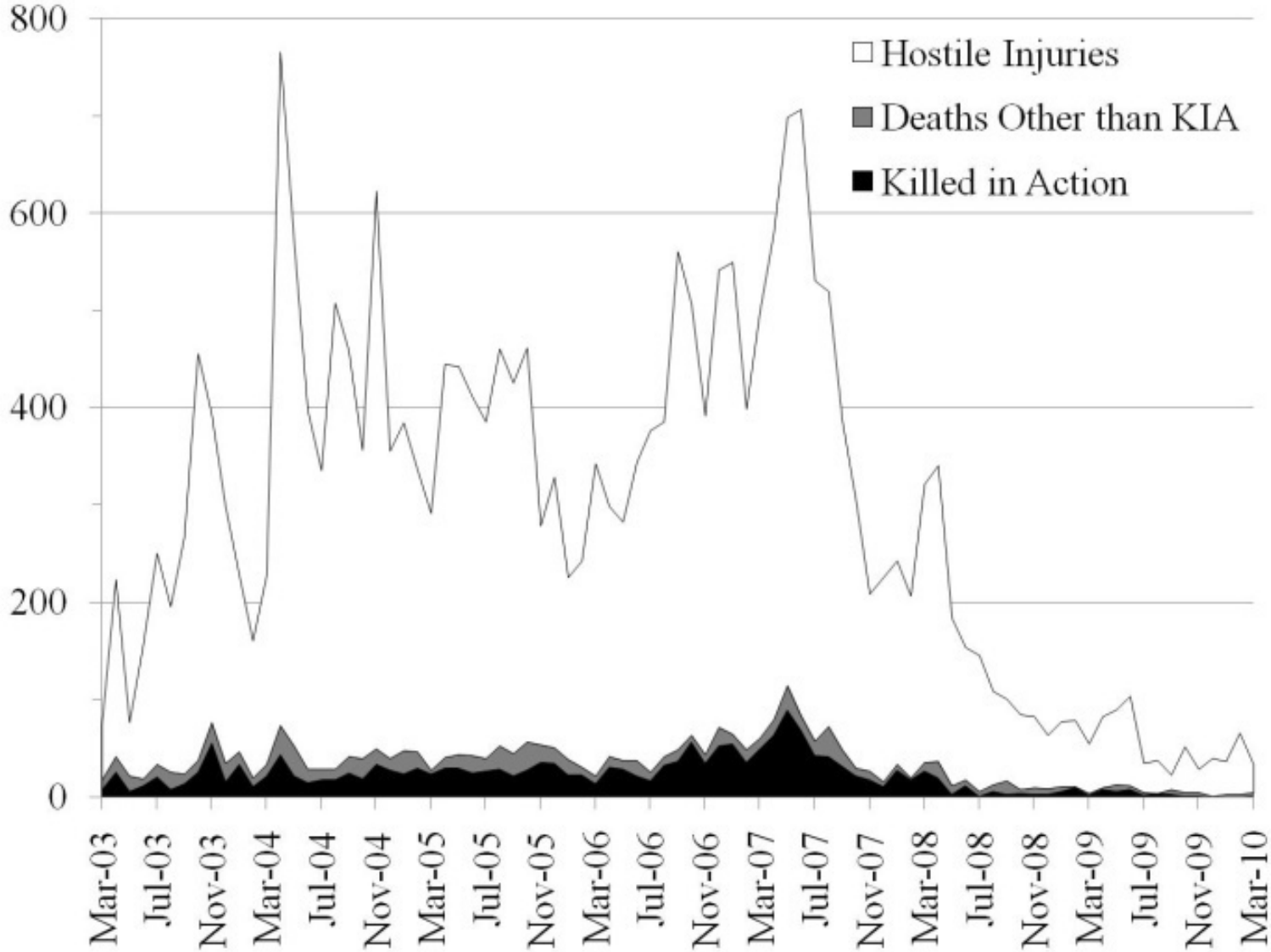
U.S. Army TWVs in Iraq



Panel C: Estimated Average Cost by Vehicle Type



Panel E: Army-wide Casualties in Iraq



Estimation Equations

$$fatalities_{it} = \sum_{j=1}^{3} \alpha_{cj}^{f} * q_{jit} + \boldsymbol{\beta}_{\mathbf{c}}^{\mathbf{f}\prime}\mathbf{x}_{\mathbf{it}} + \varepsilon_{it}^{f},$$

$$fatalities_{it} = \left(\alpha_{c2}^{f} - \alpha_{c1}^{f}\right) * q_{2it} + \left(\alpha_{c3}^{f} - \alpha_{c1}^{f}\right) * q_{3it}$$

$$+\alpha_{c1}^{f} * \sum_{j=1}^{3} q_{jit} + \boldsymbol{\beta}_{\mathbf{c}}^{\mathbf{f}\prime}\mathbf{x}_{\mathbf{it}} + \varepsilon_{it}^{f}.$$

Plus corresponding equations for costs, injuries, miles driven

Parameters of interest:

$-(\alpha_{c2}^{e} - \alpha_{c1}^{e})/\left(\alpha_{c2}^{f} - \alpha_{c1}^{f}\right)$ and $-(\alpha_{c3}^{e} - \alpha_{c2}^{e})/\left(\alpha_{c3}^{f} - \alpha_{c2}^{f}\right)$

Table 1: Pooled OLS and Fixed Effects Estimates of Effects of TWV Type on Deaths

Unit-by-Month Data, Dependent Variable is Unit-Level Deaths that Month							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Infantry Units, N = 815, Clusters = 355							
Heavy/100	-0.123	-0.046	-0.067	-0.067	-0.094	-0.306	-0.275
	(0.035)**	(0.032)	(0.040)*	(0.054)	(0.070)	(0.216)	(0.233)
Medium/100	-0.075	-0.044	-0.045	-0.067	-0.084	-0.357	-0.427
	(0.035)**	(0.039)	(0.042)	(0.064)	(0.064)	(0.223)	(0.227)*
Total TWVs/100	0.093	0.050	0.054	0.063	0.057	0.240	0.308
	(0.033)**	(0.034)	(0.038)	(0.053)	(0.067)	(0.205)	(0.219)
R^2	0.026	0.084	0.217	0.367	0.173	0.462	0.549
Panel B: Armored and Cavalry Units, N = 1213, Clusters = 518							
Heavy/100	-0.061	0.050	0.047	0.034	0.032	0.107	0.308
	(0.033)*	(0.039)	(0.043)	(0.054)	(0.072)	(0.100)	(0.153)**
Medium/100	-0.026	0.012	0.011	-0.008	-0.016	0.059	0.214
	(0.028)	(0.028)	(0.032)	(0.044)	(0.050)	(0.065)	(0.111)*
Total TWVs/100	0.051	-0.011	-0.007	0.012	0.023	-0.034	-0.185
	(0.022)**	(0.024)	(0.028)	(0.040)	(0.050)	(0.066)	(0.110)*
R^2	0.015	0.072	0.140	0.293	0.137	0.355	0.412
Panel C: Administrative and Support Units, N = 961, Clusters = 404							
Heavy/100	-0.023	-0.011	-0.014	0.000	0.026	0.050	0.084
	(0.009)**	(0.010)	(0.009)*	(0.011)	(0.089)	(0.074)	(0.097)
Medium/100	0.012	0.002	-0.001	0.004	0.115	0.058	0.085
	(0.011)	(0.013)	(0.014)	(0.019)	(0.090)	(0.063)	(0.097)
Total TWVs/100	0.000	-0.011	-0.008	-0.002	-0.084	-0.068	-0.086
	(0.002)	(0.005)*	(0.005)*	(0.005)	(0.093)	(0.073)	(0.097)*
R^2	0.001	0.038	0.169	0.499	0.149	0.648	0.689
Panel D: Other Units, N = 684, Clusters = 301							
Heavy/100	-0.056	-0.012	-0.020	-0.073	-0.155	-0.272	-0.313
	(0.034)	(0.033)	(0.035)	(0.071)	(0.117)	(0.219)	(0.449)
Medium/100	-0.033	-0.019	-0.019	-0.075	-0.148	-0.194	-0.278
	(0.036)	(0.031)	(0.031)	(0.070)	(0.114)	(0.234)	(0.561)
Total TWVs/100	0.034	0.015	0.016	0.076	0.160	0.308	0.364
	(0.033)	(0.028)	(0.031)	(0.069)	(0.118)	(0.212)	(0.423)
R^2	0.011	0.065	0.366	0.605	0.216	0.690	0.761
Controls Include . . .							
Other Vehicles		Yes	Yes	Yes	Yes	Yes	Yes
Unit Characteristics		Yes	Yes	Yes	Yes	Yes	Yes
Quadratic in Month		Yes			Yes		
Year x Month FEs			Yes				
Province FEs			Yes				
Province x Year x Month FEs				Yes		Yes	Yes
Unit FEs					Yes	Yes	Yes
Unit-Specific Trends							Yes

Table 2: Estimated Cost per Life Saved through Vehicle Substitutions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Costs Presented in Millions of 2010 Dollars						
	Panel A: Infantry Units, N = 815, Clusters = 355						
Heavy in place of Medium	$15.80 (5.374)**	$423.7 (3,793)	$49.70 (38.65)	-$53,067 (6.3.E+07)	$97.80 (326.1)	-$21.83 (32.05)	-$7.827 (4.103)*
Medium in place of Light	$16.18 (7.507)**	$24.58 (21.14)	$21.85 (19.20)	$13.35 (9.321)	$9.119 (6.496)	$1.131 (0.549)**	$1.755 (0.603)**
	Panel B: Armored and Cavalry Units, N = 1213, Clusters = 518						
Heavy in place of Medium	$40.35 (31.15)	-$31.92 (28.56)	-$33.48 (32.72)	-$28.25 (23.74)	-$24.43 (29.74)	-$23.44 (33.28)	-$12.51 (11.14)
Medium in place of Light	$15.61 (16.46)	-$35.88 (80.37)	-$40.69 (111.3)	$55.37 (243.2)	$35.36 (106.0)	-$8.905 (7.836)	-$2.515 (1.108)**
	Panel C: Administrative and Support Units, N = 961, Clusters = 404						
Heavy in place of Medium	$0.343 (10.87)	$10.78 (30.13)	$18.22 (36.74)	$69.18 (381.2)	$10.68 (10.31)	$125.4 (371.0)	$1,595 (69,441)
Medium in place of Light	-$103.1 (98.17)	$465.6 (2,423)	$842.7 (8,959)	-$256.2 (961.3)	-$4.779 (3.430)	-$9.662 (7.236)	$4.838 (3.462)
	Panel D: Other Units, N = 684, Clusters = 301						
Heavy in place of Medium	$19.96 (11.82)*	-$57.58 (75.65)	$1,506 (72,628)	-$398.0 (2,036)	$115.3 (256.7)	$18.46 (8.472)**	$48.01 (109.9)
Medium in place of Light	$41.23 (44.10)	$71.98 (116.1)	$72.55 (103.1)	$19.09 (11.73)	$10.13 (8.669)	$4.117 (3.193)	$2.396 (2.259)
Controls Include . . .							
Other Vehicles		Yes	Yes	Yes	Yes	Yes	Yes
Unit Characteristics		Yes	Yes	Yes	Yes	Yes	Yes
Quadratic in Month		Yes			Yes		
Year x Month FEs			Yes				
Province FEs			Yes				
Province x Year x Month FEs				Yes		Yes	Yes
Unit FEs					Yes	Yes	Yes
Unit-Specific Trends							Yes