Estimating The Macroeconomic Consequences of Transnational Terrorism

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Main Results From Models

- Terrorism Reduces GDP Growth
  - •Average Loss is 50 pct point of GDP growth
  - •Wars & Internal Conflict Cause More Damage
- Terrorism Has Reallocative Effect
- Range of Estimates of 9/11
  - –$60 billion to $125 billion

Empirical Strategy

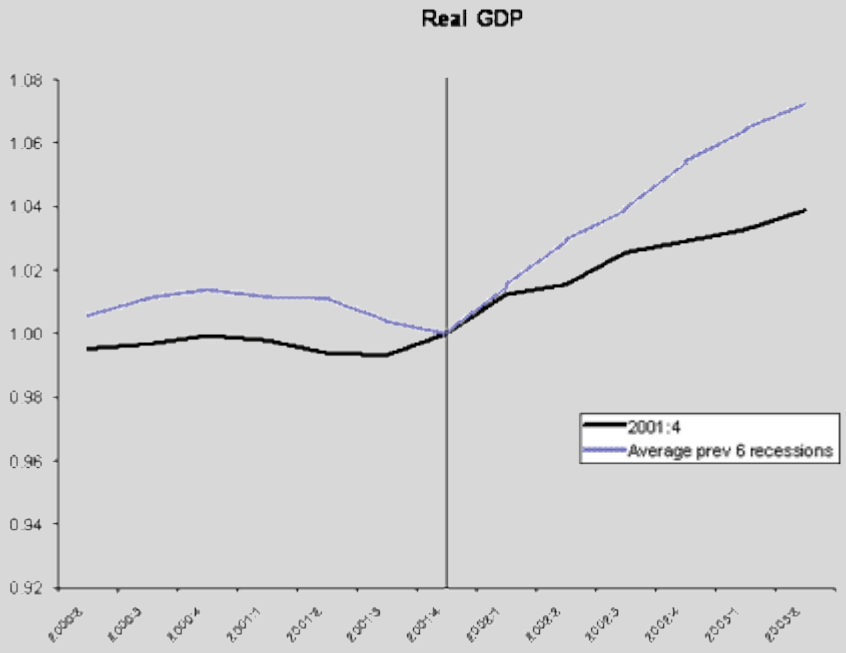
- Estimate Long-term Effect using Cross-section
- Estimate Short-term using Panel Regression
- Robustness Checks
  - –VARs
  - –Quantile Regressions
  - –Welfare Simulation

Challenges in Estimating Consequence of 9/11 using Time Effects only or Why I chose my estimation strategy

- For US: many macroeconomic shocks, few degrees of freedom
  - –Head winds
    - •Dot Com Bubble bursts (Nasdaq peaked in 3/ 2000 at 5,132… by 10/02 Nasdaq slid to 1,108.)
    - •Corporate scandals (Enron's Chief Skilling leaves in August 2001)
    - •Contractionary Federal Reserve Policy (Federal Funds Rate in 12/2000 is 6.25% -- highest since 2/91.)
  - –Tail winds
    - •Expansionary Federal Reserve Policy (Federal Funds Rate falls to 1% through 6/2003 [lowest ever]
    - •Expansionary Fiscal Policy (Bush tax cuts of 2001-3 amt to $188bn, similar in magnitude to Reagan tax cuts)

In other words…

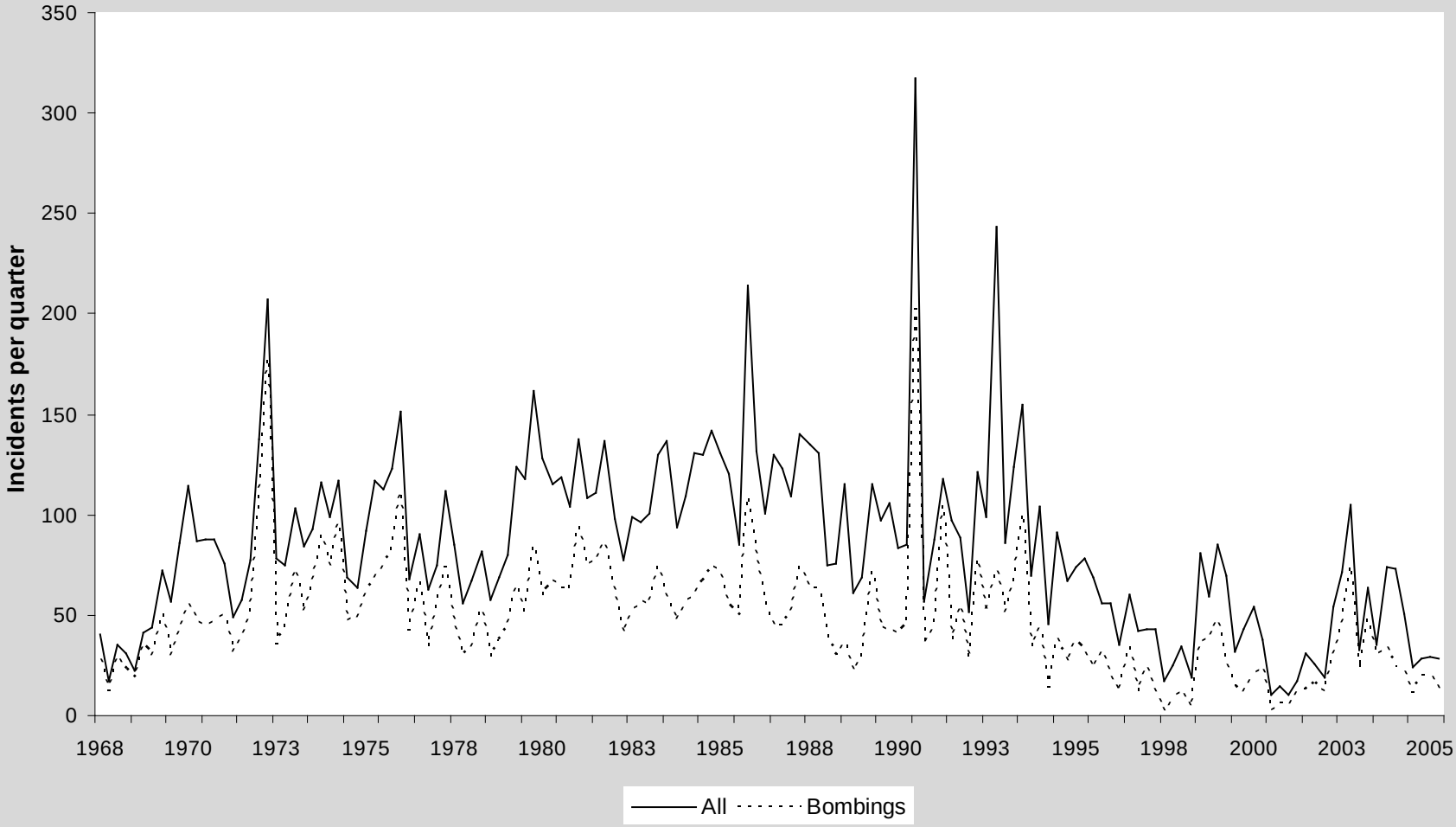
Question from Chart
How much of $300bn
loss is due to 9/11?



Early IMF estimate $75bn
Early Insurance cost est -- Kunreuther et al (2003) $80bn

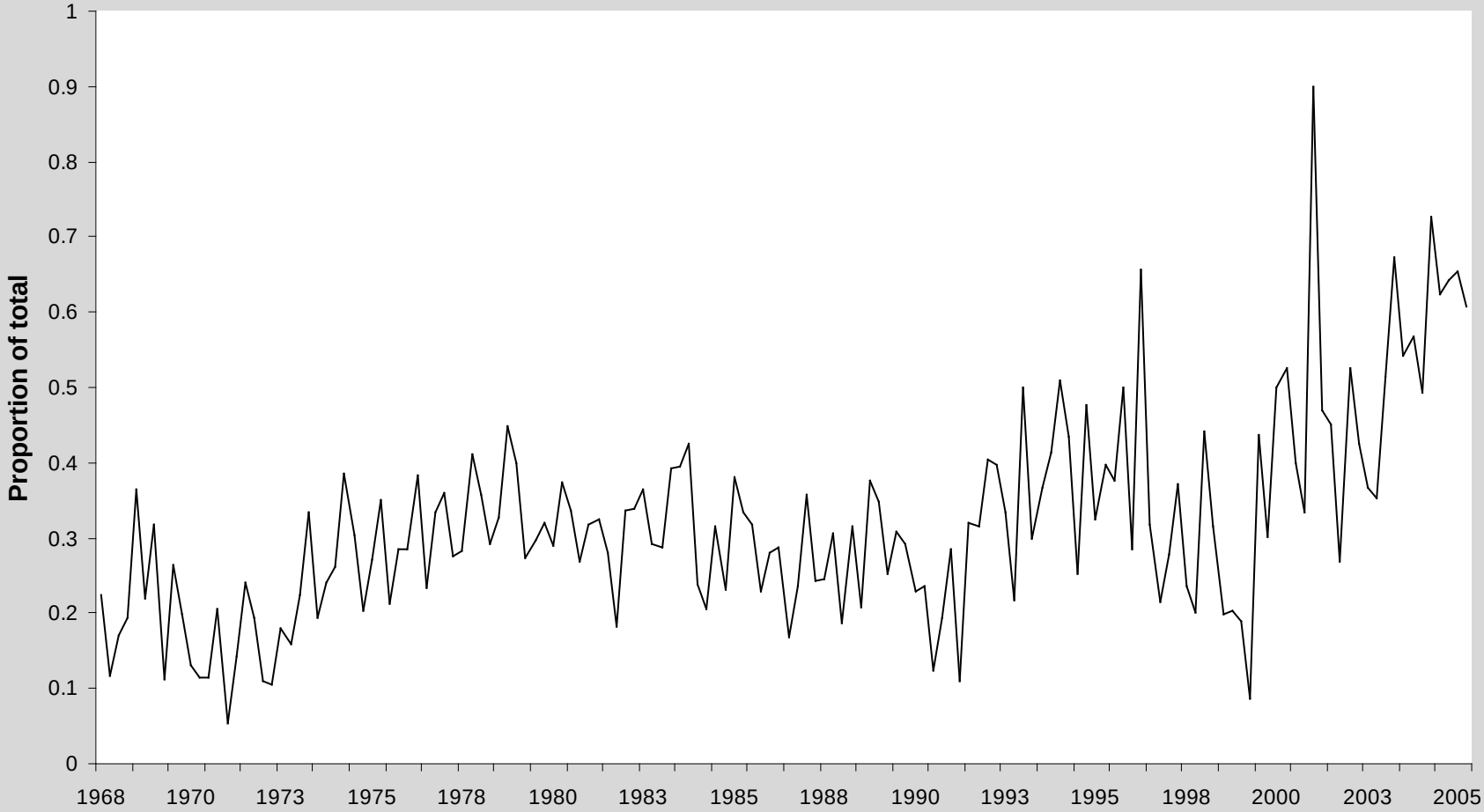
Transnational Terrorism 1968-2005

Figure 2. All Incidents and Bombings



Violent Terrorism is Increasing

Figure 3. Proportion of Casualty Incidents



The Data

- ITERATE -- Terrorism ``the use, or threat of use, of anxiety-inducing, extra-normal violence for political purposes by any individual or group, whether acting for or in opposition to established governmental authority, when such action is intended to influence the attitudes and behavior of a target group wider than the immediate victims and when, through the nationality or foreign ties of its perpetrators, its location, the nature of its institutional or human victims, or the mechanics of its resolution, its ramifications transcend national boundaries.'' (Mickolus et al)
- MIPT data – International & Domestic since 1997
- Internal Conflict (POLITY IV – Gurr, Jaggers, and Moore)
- External Conflict (Brecher, Wilkenfeld and Moser)
- Economic Data (Summers & Heston)

Growth and Terrorism

- Growth Regressions

$$\Delta y_i = \beta_0 + \beta_1 com_i + \beta_2 afr_i + \beta_3 lny_{0i} + \beta_4 ivst_i + \beta_5 T_i + e_i$$

- IV Regressions
- Panel Regressions
- Reallocation Regressions

Table 3: Cross Sectional Regression: Terrorism and Growth

Model	1	2	3	4	5	6	7	8	9	10
Specification	Base	& T	& I	& E	& T,I,E	Base	& T	& I	& E	& T,I,E
Estimation	OLS	OLS	OLS	OLS	OLS	IV	IV	IV	IV	IV
COM	-1.175***	-1.284***	-1.254***	-1.181***	-1.303***	-1.217***	-1.334***	-1.271***	-1.221***	-1.341***
	[0.350]	[0.349]	[0.346]	[0.347]	[0.348]	[0.405]	[0.412]	[0.400]	[0.402]	[0.408]
AFRICA	-1.118***	-1.518***	-1.242***	-1.174***	-1.483***	-0.754	-1.161**	-0.889*	-0.808*	-1.162**
	[0.352]	[0.355]	[0.342]	[0.355]	[0.361]	[0.458]	[0.488]	[0.459]	[0.465]	[0.488]
lny0	-0.506***	-0.464***	-0.615***	-0.530***	-0.550***	-0.910***	-0.881***	-0.944***	-0.919***	-0.897***
	[0.165]	[0.159]	[0.161]	[0.163]	[0.164]	[0.300]	[0.292]	[0.276]	[0.298]	[0.283]
I/Y	1.120***	1.114***	1.035***	1.107***	1.060***	2.484***	2.522***	2.264**	2.439***	2.436***
	[0.303]	[0.277]	[0.281]	[0.295]	[0.271]	[0.877]	[0.833]	[0.877]	[0.880]	[0.885]
T		-1.679***			-1.175*		-1.733***			-1.531*
		[0.528]			[0.687]		[0.640]			[0.834]
I			-0.784***		-0.514*			-0.584*		-0.227
			[0.246]		[0.282]			[0.334]		[0.388]
E				-3.614	-0.225				-2.896	0.244
				[2.978]	[2.621]				[4.044]	[3.841]
Observations	112	112	112	112	112	110	110	110	110	110
R-squared	0.41	0.45	0.44	0.41	0.46	0.23	0.26	0.3	0.25	0.29

Notes: Robust standard errors are presented in square brackets. $*$, $**$ and $***$ represent statistical significance at the .10, .05 and .01 levels, respectively. Models (1) through (10) are different specifications of cross country growth regressions. Models (1) through (5) are the basic OLS model adding separately the different forms of conflict, i.e. terrorism (T), internal conflict (I), home (H) and away (A) wars and their sum, external wars (E). Models (6) through (10) repeat the exercises but estimate the model as IV/GMM with initial investment as a percent of GDP (I/Y) as the instrument. Included in each regression is a dummy for non-oil exporting commodity countries (com), Africa (afr), initial GDP per capita (lny0) and average investment as a percent of GDP (I/Y). The R-squared measure excludes the contribution from the individual fixed effects.

Simple Cost = $55bn
w Conflict Complementarities = $42bn

Table 4: Panel Regression: Terrorism and Growth

Model	1	2	3	4	5	6	7	8	9
Specification	& T	& I	& E	& T,I, E	& T,I, E	& T,I, E	& T,I, E	& T,I, E	& T,I, E
Sample	FULL	FULL	FULL	FULL	NONDEMO	OECD	AFRICA	MIDEAST	ASIA
$lnop_{it-1}$	3.275***	3.114***	3.200***	3.067***	3.117***	0.451	2.644**	5.506***	1.056
	[0.516]	[0.517]	[0.516]	[0.516]	[0.569]	[0.871]	[1.102]	[1.949]	[0.851]
lny_{it-1}	-5.406***	-5.558***	-5.372***	-5.561***	-5.793***	-7.293***	-6.903***	-14.866***	-5.165***
	[0.577]	[0.572]	[0.575]	[0.569]	[0.633]	[1.157]	[1.096]	[2.729]	[1.011]
I/Y_{it-1}	0.120***	0.117***	0.121***	0.116***	0.115***	0.300***	0.071	0.266***	0.269***
	[0.030]	[0.030]	[0.030]	[0.030]	[0.034]	[0.037]	[0.058]	[0.094]	[0.046]
T	-0.553**			-0.418*	-0.482*	-0.123	-1.212*	0.041	-0.487
	[0.222]			[0.221]	[0.285]	[0.188]	[0.706]	[0.736]	[0.370]
I		-1.249***		-1.157***	-1.126***	0.496	-2.047***	1.137	-0.482
		[0.330]		[0.326]	[0.334]	[0.844]	[0.698]	[0.909]	[0.387]
E			-3.832***	-3.588**	-5.000**	0.883	-0.178	-0.43	-5.116**
			[1.478]	[1.451]	[1.963]	[0.673]	[3.790]	[1.624]	[2.336]
Observations	4439	4439	4439	4439	3386	980	1374	290	597
R-squared	0.09	0.09	0.09	0.1	0.1	0.37	0.11	0.37	0.21

Notes: robust standard errors are presented in parentheses. *, ** and * * * represent statistical significance at the .10, .05 and .01 levels, respectively. All specifications include time and individual fixed effects. Models (1) through (9) are different specifications of panel growth regressions. Models (1) through (4) are the basic OLS model adding separately the different forms of conflict, i.e. terrorism (T), internal conflict (I), and external wars (E). Models (6) through (9) repeat the exercises but estimate the model over sub-samples: Non-democracies (NONDEMO), OECD countries, AFRICA, Middle East (MIDEAST) and (ASIA). Included in each regression is ln((exports+imports)/GDP) ($lnop_{it-1}$), lagged GDP per capita (lny_{it-1}) and average investment as a percent of GDP $(I/Y)_{it-1}$.

Reallocative Effect

Table 6: Panel Regression: Terrorism and I/Y and G/Y

Model	1	2	3	4	5	6	7	8
Specification	T	I	E	T I E	T	I	E	T I E
Dep Var	I/Y	I/Y	I/Y	I/Y	G/Y	G/Y	G/Y	G/Y
$lnop_{it-1}$	2.938***	2.878***	2.929***	2.880***	3.196***	3.333***	3.223***	3.346***
	[0.317]	[0.317]	[0.317]	[0.318]	[0.399]	[0.400]	[0.400]	[0.400]
lny_{it-1}	0.531	0.493	0.553*	0.479	-1.923***	-1.808***	-1.951***	-1.798***
	[0.335]	[0.336]	[0.335]	[0.336]	[0.423]	[0.423]	[0.423]	[0.423]
T	-0.414**			-0.372**	0.491**			0.386*
	[0.182]			[0.183]	[0.230]			[0.231]
I		-0.433**		-0.393**		1.017***		0.964***
		[0.175]		[0.176]		[0.220]		[0.222]
E			-0.379	-0.293			1.352*	1.162
			[0.642]	[0.642]			[0.810]	[0.809]
Observations	4553	4553	4553	4553	4553	4553	4553	4553
R-squared	0.11	0.11	0.11	0.11	0.09	0.1	0.09	0.1

Notes: robust standard errors are presented in parentheses. *, ** and *** represent statistical significance at the .10, .05 and .01 levels, respectively. All specifications include time and individual fixed effects. Models (1) through (8) are the basic OLS model adding separately the different forms of conflict, i.e. terrorism (T), internal conflict (I), and external wars (E). Models (1) through (4) estimate the model with I/Y as a dependent variable. Models (5) through (8) estimate the model with G/Y as a dependent variable. Included in each regression is ln((exports+imports)/GDP) ($lnop_{it-1}$) and lagged GDP per capita (lny_{it-1}). The R-squared measure does not include excludes the contribution from the individual fixed effects.

Alternative Approaches: Structural VAR and Terrorism

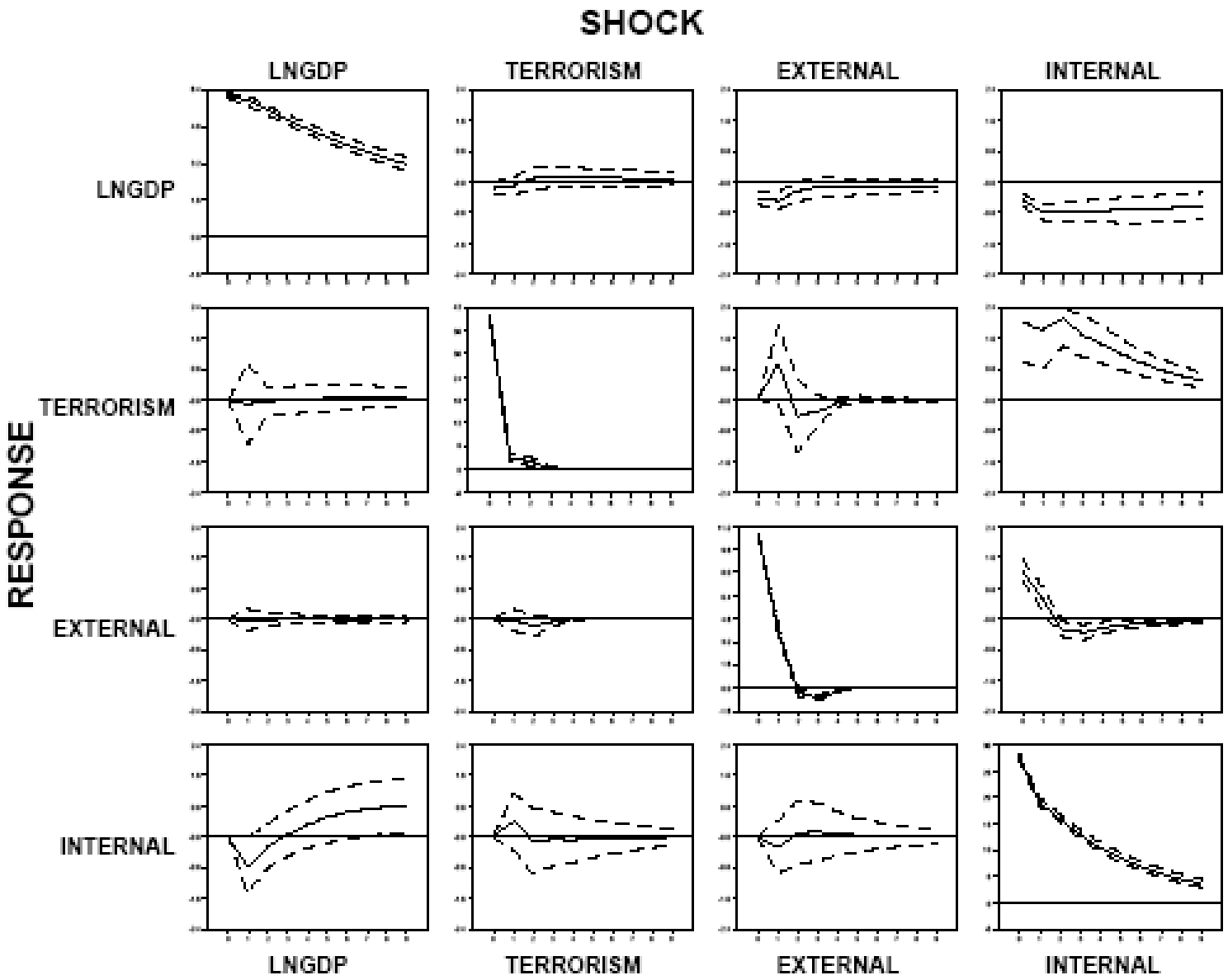
$$e_Y = \alpha_1\varepsilon_T + \alpha_2\varepsilon_E + \alpha_3\varepsilon_I + \varepsilon_Y \quad (1)$$

$$e_T = \alpha_4\varepsilon_I + \varepsilon_T \quad (2)$$

$$e_E = \alpha_5\varepsilon_I + \varepsilon_E \quad (3)$$

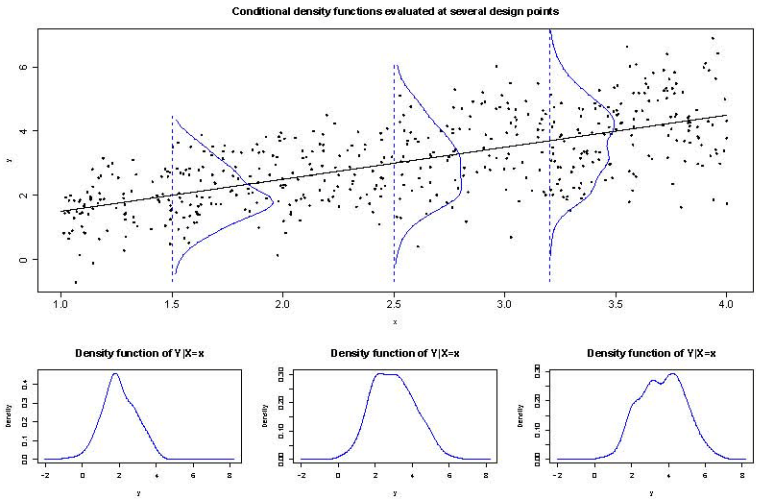
$$e_I = \varepsilon_I \quad (4)$$

Figure 1: Impulse Responses and 90% Error Bands (Full Sample)



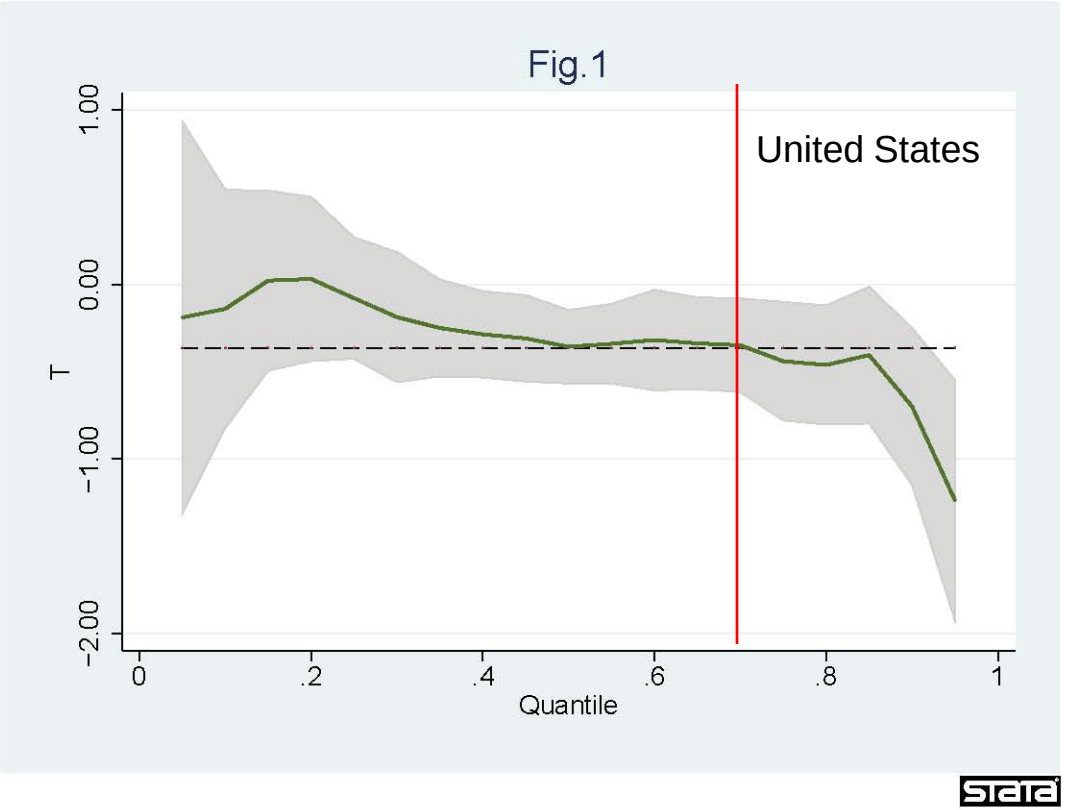
Are All Impacts the Same? Quantile Regression Approach

Conditional Density Function $f_{Y|X}(y|x)$: $y \in R$, $x \in R^d$

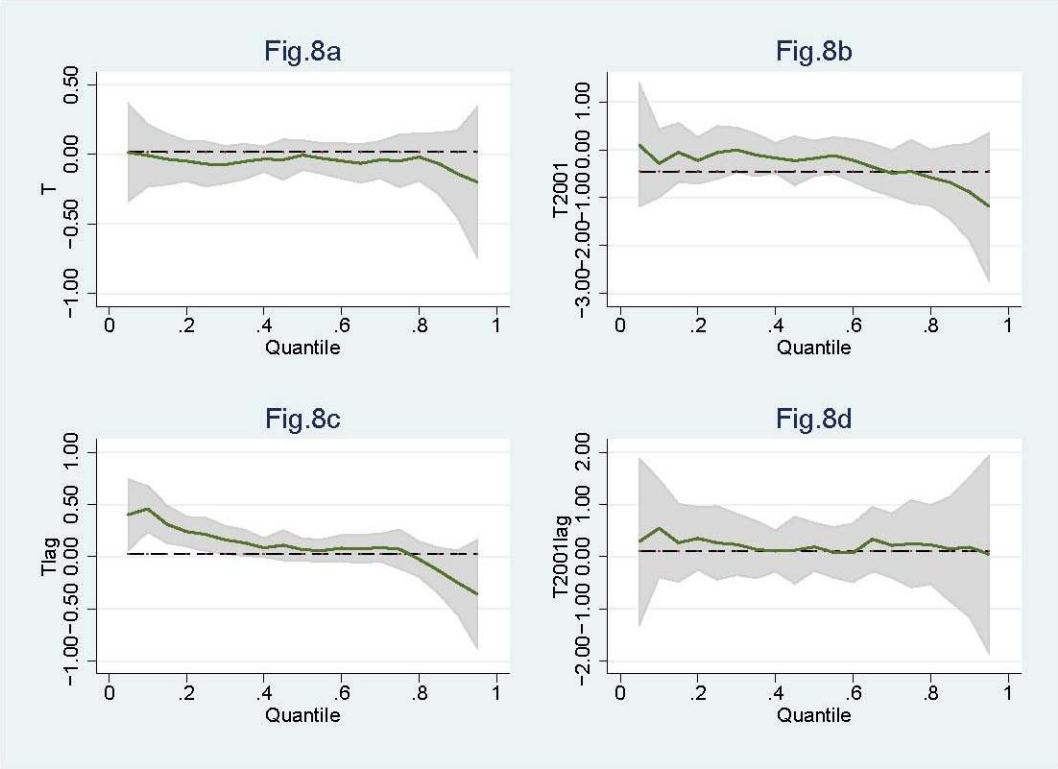


Source: Quillen (2002a, 2002b) and ITERATE

Are All Impacts the Same? Impact of Terrorism on GDP Growth Across Income Distribution



Are All Impacts the Same? Impact of Terrorism on GDP Growth Across Income Distribution – Problems with Overfitting



Simple Quantile Estimate = $36bn in Large Growth year = $70bn

Table 1. Quantile Regressions: Lost GDP Due to Transnational Terrorism Attacks

	OLS	OLS	Q=.5	Q=.1	Q=.75	Q=.9	Q=.95
T_{it}	-.446**	-0.444**	-0.357***	-0.14	-0.440**	-0.698***	-1.236***
	[0.218]	[0.212]	[0.107]	[0.348]	[0.173]	[0.229]	[0.351]
T_{2001}	-.054						
	[0.663]						
T_{it-1}		-0.071					
		[0.212]					
lny_{it-1}	-4.382***	-4.391***	-0.606***	-0.223	-0.862***	-1.184***	-1.235***
	[0.369]	[0.369]	[0.059]	[0.190]	[0.095]	[0.136]	[0.218]
I/Y_{it-1}	0.60***	0.060***	0.081***	0.067**	0.071***	0.072***	0.069***
	[0.017]	[0.017]	[0.006]	[0.026]	[0.010]	[0.014]	[0.023]
SSAFR			-1.469***	-1.617***	-0.689**	-0.301	-0.119
			[0.160]	[0.492]	[0.269]	[0.350]	[0.551]
LAT			-1.187***	-1.301***	-0.974***	-0.673**	-1.184**
			[0.154]	[0.493]	[0.250]	[0.343]	[0.504]
EASIA			-0.037	-1.096*	0.218	0.009	-0.173
			[0.182]	[0.601]	[0.297]	[0.400]	[0.643]
MIDEAST			-1.280***	-4.909***	-1.055***	0.677*	1.929***
			[0.182]	[0.594]	[0.296]	[0.403]	[0.580]
POOR			-1.636***	-2.089***	-2.573***	-3.379***	-3.590***
			[0.162]	[0.516]	[0.255]	[0.341]	[0.539]
RICH			0.242	1.383***	0.027	-0.519	-0.786
			[0.178]	[0.524]	[0.295]	[0.409]	[0.609]
NAMER			0.004	0.052	-0.389	-0.48	-1.055
			[0.404]	[1.317]	[0.654]	[0.831]	[1.262]
OCEANIA			-0.675*	-0.19	-0.954*	-1.18	-1.805**
			[0.360]	[1.134]	[0.559]	[0.720]	[0.868]
Observations	4709	4709	4744	4744	4744	4744	4744

Welfare Effects?

Step 1: Estimate Impact of Terrorism on Consumption Growth [Δlog(c)] and Volatility of Consumption [log|X*|] after controlling for individual (I) and time effects (y), from Lucas [1987]

$$\Delta log(c_{it}) = \alpha_1 + \alpha_2 T_{it} + I_i + y_t + e_{it}, \quad (8)$$

$$log(|X^*_{it}|) = \delta_1 T_{it} + I_i + y_t + u_{it} \quad (10)$$

Lower bound estimates: α_2 = -.174, δ_1 = .145.

Step 2: Use estimates to impute synthetic growth path with no conflict [τ] and average Consumption [μ*] and Volatility of Consumption [σ*] with utility parameters ρ = 2 and θ = .08.

$$\tau_i^* \approx \left[\frac{\Phi_i}{1-\Phi_i}\right] \cdot \left[-(\rho/2)\Delta\sigma_i^2 + (1+\mu_i)^{-1}\Delta\mu_i\right]. \quad (7)$$

$$\Phi_i \equiv (1+\theta)^{-1}(1+\mu_i)^{1-\rho} \exp - \left\{(1-\rho)\rho\sigma_i^2/2\right\} < 1 \quad (3)$$

Step 3: Compare these estimates to growth path with conflict. The result…

A loss of $65 billion.

Are All Impacts the Same? Davis & Weinstein (AER 2002) What if Terrorism involves WMD?

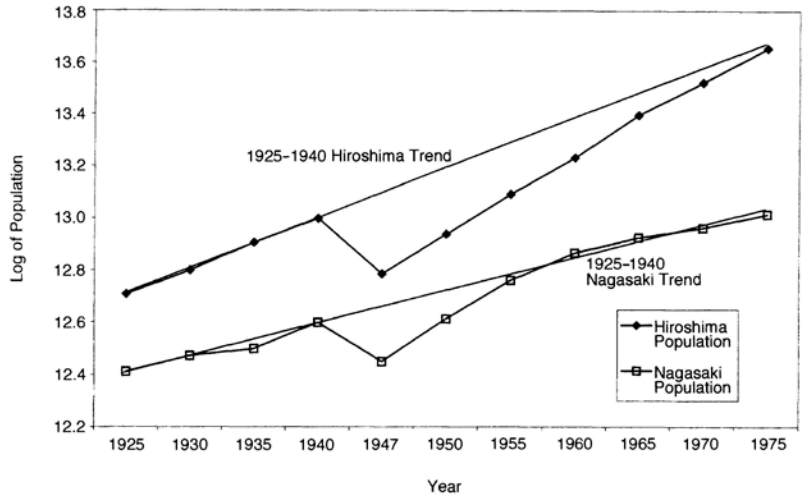


FIGURE 2. POPULATION GROWTH

Summary of Results: Range of Estimates of 9/11

- Simple case -- $60bn
- Controlling for Conflict Complementarities -- $45bn
- Quantile Estimate -- $35bn
- Quantile Estimate in large growth year -- $75bn
- Estimated impact on Welfare -- $70bn
- WMDs?
  - –Estimating Using War Impact -- $400 billion

Conclusion

- Taking the Con out of Conflict Economics
- Terrorism reduces GDP Growth by 40 pct pts
- Range of Estimates of impact of 9/11
  - –$60 billion to $125 billion
  - –Comparable to increase in Homeland Security of $43 billion [Hobijn & Sager (2007)]