Boston College
Econometric Methods
Death Penalty Deterrence

Econometrics & Death Penalty Deterrence

Take aways:

- Not being able to reject the null hypothesis of no deterrence effect means that the data/analysis is not able to reject that hypothesis at any acceptable statistical significance level.
- That means that such an effect has not been conclusively (incontrovertibly?) established. It does not mean that there is no effect.
- However, if study after study are unable to reject the null hypothesis, then at some point you begin to wonder a bit.
- But what if study after study after study find negative coefficients, even though none are statistically significant? Then you might wonder some more.

Uses and Abuses of Empirical Evidence in the Death Penalty Debate[1]
John J. Donohue and Justin Wolfers[2]

To start: Two juicy quotes from Donohue and Wolfers

1. Joanna Shepherd, an author of several studies finding a deterrent effect, has recently argued before Congress that recent research has created a "strong consensus among economists that capital punishment deters crime," going so far as to claim that "[t]he studies are unanimous."[3] *Upon further probing from the committee chairman about "the findings of anti-death penalty advocates that are 180 degrees from your conclusions," id. at 24, Shepherd responded:*

> *There may be people on the other side that rely on older papers and studies that use outdated statistical techniques or older data, but all of the modern economic studies in the past decade have found a deterrent effect. So I am not sure what the other people are relying on.*

2. Sunstein and Vermeule argue that

> *"a significant body of recent evidence [shows] that capital punishment may well have a deterrent effect, possibly a quite powerful one" and that "[a] wave of sophisticated multiple regression studies have exploited a newly available form of data, so-called 'panel data,' that uses all information from a set of units (states or counties) and follows that data over an extended period of time."*

So let's start the empirical analysis with some figures from D&W:

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[1] 58 Stanford Law Review 791 (2006)
[2] For a terrific compilation of resources go to: http://bpp.wharton.upenn.edu/jwolfers/DeathPenalty.shtml
[3] Terrorist Penalties Enhancement Act of 2003: Hearing on H.R. 2934 Before the Subcomm. on Crime, Terrorism, and Homeland Security of the H. Comm. on the Judiciary, 108th Cong. 10-11 (2004), available at http://judiciary.house.gov/media/pdfs/printers/108th/93224.pdf

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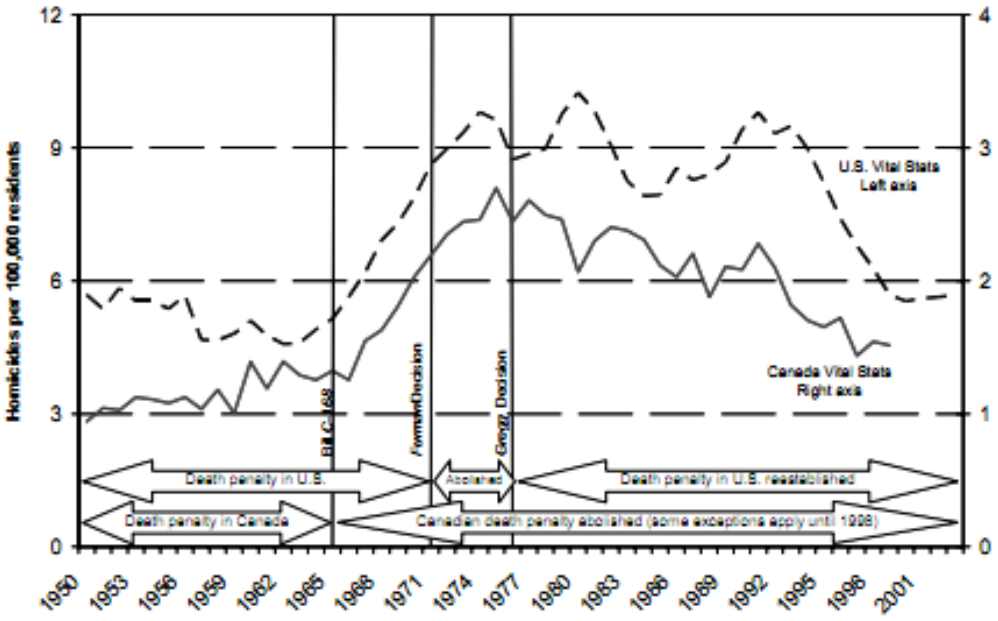
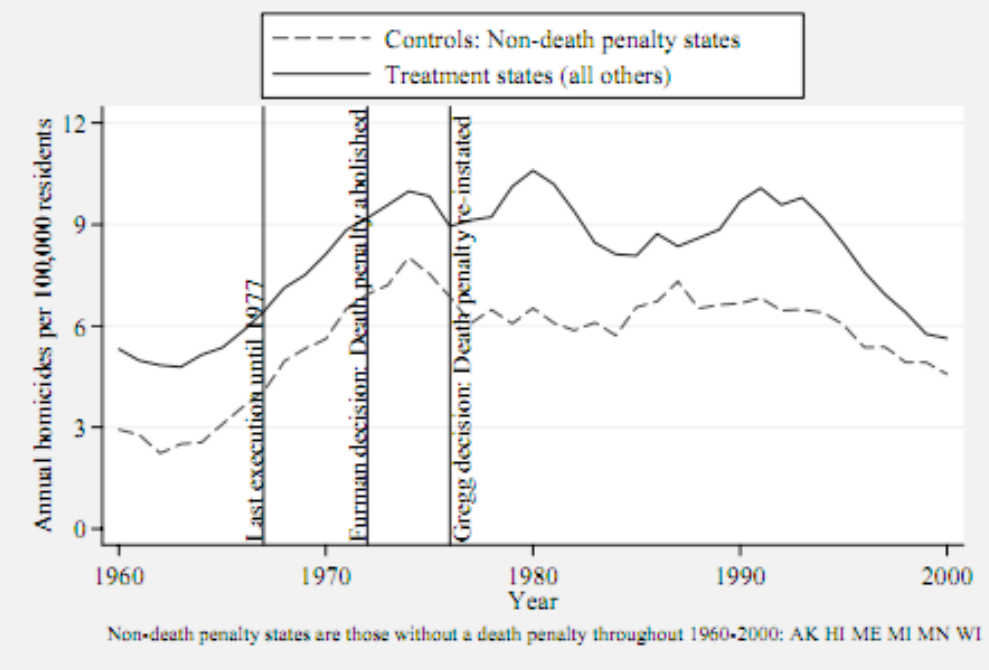
Figure 2. Homicide Rates and the Death Penalty in the United States and Canada



Notice the similarities in the pattern of homicide rates over time, even though the US and Canadian death penalty laws differ significantly.

Figure 3. Homicide Rates in the United States



Again: Similar patterns over time in death penalty and non-death-penalty states.

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And a paper to look at:

Hashem Dezhbakhsh & Joanna M. Shepherd: The Deterrent Effect of Capital Punishment: Evidence from a "Judicial Experiment"[4]

Data:

- Annual state level data, 1960-2000 (panel dataset… state/year) [sample_ds=1]

Dependent Variable:

- Annual homicides (per 100,000 residents) [pc_mur]

RHS Variables:

- ***Favorite coefficient***: Death Penalty dummy (active death penalty law) [legal]
- Per capita real income [rpc_inc]
- Unemployment rate [ur]
- Police employment [ipolice]
- %pop non-white [nonwhite]
- %pop aged 15-19 [age15to19]
- %pop aged 20-24 [age20to24]

Fixed effects (dummies):

- State
- Decade

Estimation:

- Weight by state population [popul]
- Panel data methods… but we'll pretty much just use OLS

Donohue & Wolfers robustness tests:

- Replication (coefficients and standard errors)
- Add year fixed effects
- De juro v de facto death penalty laws (any executions in past decade?)

Results:

[4] Am. Law & Econ. Ass'n Working Paper No. 18, 2004: http://law.bepress.com/cgi/viewcontent.cgi?article=1017&context=alea

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Start with no weighting and no state or decade effects

```
. reg pc_mur legal rpc_inc ur ipolice nonwhite age15to19 age20to24 if sample_ds==1
```

Source	SS	df	MS		
Model	18119.5849	7	2588.51212	Number of obs	= 2009
Residual	11202.5342	2001	5.59846785	F(7, 2001)	= 462.36
				Prob > F	= 0.0000
Total	29322.119	2008	14.6026489	R-squared	= 0.6179
				Adj R-squared	= 0.6166
				Root MSE	= 2.3661

pc_mur	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
legal	.1207065	.124588	0.97	0.333	-.1236294	.3650423
rpc_inc	-.0175036	.002774	-6.31	0.000	-.0229438	-.0120634
ur	.1637506	.0279443	5.86	0.000	.1089477	.2185535
ipolice	.000412	.0000408	10.09	0.000	.0003319	.0004921
nonwhite	26.02953	.6185301	42.08	0.000	24.8165	27.24256
age15to19	-.3294123	9.859352	-0.03	0.973	-19.66508	19.00626
age20to24	89.7912	7.856899	11.43	0.000	74.38264	105.1998
_cons	-3.203597	.79637	-4.02	0.000	-4.765398	-1.641796

Weight by population

```
. reg pc_mur legal rpc_inc ur ipolice nonwhite age15to19 age20to24  [w=popul] if sample_ds==1
(analytic weights assumed)
(sum of wgt is   9.2562e+06)
```

Source	SS	df	MS		
Model	13872.6143	7	1981.80205	Number of obs	= 2009
Residual	12205.3703	2001	6.09963532	F(7, 2001)	= 324.91
				Prob > F	= 0.0000
Total	26077.9846	2008	12.9870441	R-squared	= 0.5320
				Adj R-squared	= 0.5303
				Root MSE	= 2.4697

pc_mur	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
legal	-.7308648	.1398317	-5.23	0.000	-1.005096	-.4566339
rpc_inc	-.0352761	.0031644	-11.15	0.000	-.0414818	-.0290703
ur	.0950243	.0300316	3.16	0.002	.0361278	.1539208
ipolice	.0002333	.0000286	8.15	0.000	.0001771	.0002894
nonwhite	23.97303	.7242909	33.10	0.000	22.55259	25.39348
age15to19	-72.01421	12.30448	-5.85	0.000	-96.14514	-47.88328
age20to24	181.6098	10.26554	17.69	0.000	161.4775	201.742
_cons	-.2300067	.89901	-0.26	0.798	-1.9931	1.533087

…add state and decade effects

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```
. reg pc_mur legal rpc_inc ur ipolice nonwhite age15to19 age20to24 _Ist* _Ide* [w=popul] if sample_ds==1
(analytic weights assumed)
(sum of wgt is   9.2562e+06)
note: _Ist_8 omitted because of collinearity
note: _Ist_12 omitted because of collinearity
note: _Idecade_ds_1940 omitted because of collinearity
note: _Idecade_ds_1950 omitted because of collinearity
note: _Idecade_ds_1960 omitted because of collinearity
```

Source	SS	df	MS
Model	20780.4256	59	352.210604
Residual	5297.55899	1949	2.71809081
Total	26077.9846	2008	12.9870441

Number of obs	2009
F(59, 1949)	129.58
Prob > F	0.0000
R-squared	0.7969
Adj R-squared	0.7907
Root MSE	1.6487

pc_mur	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
legal	-.9549002	.1378439	-6.93	0.000	-1.225237	-.6845632
rpc_inc	-.0348004	.0049336	-7.05	0.000	-.0444761	-.0251246
ur	-.1365854	.0290056	-4.71	0.000	-.1934707	-.0797001
ipolice	.0001449	.000073	1.98	0.047	1.69e-06	.0002881
nonwhite	.1329647	1.617937	0.08	0.935	-3.040104	3.306033
age15to19	-27.20694	12.92045	-2.11	0.035	-52.54629	-1.86758
age20to24	159.225	12.13043	13.13	0.000	135.435	183.015
_Ist_2	2.879526	.9576623	3.01	0.003	1.001376	4.757676
_Ist_3	1.012833	1.003523	1.01	0.313	-.9552586	2.980924

… add year effects

```
. reg pc_mur legal rpc_inc ur ipolice nonwhite age15to19 age20to24 _Ist* _Ide* _Iye* [w=popul] if sample_ds==1
(analytic weights assumed)
(sum of wgt is   9.2562e+06)
```

Source	SS	df	MS
Model	21940.8602	95	230.956423
Residual	4137.1244	1913	2.1626369
Total	26077.9846	2008	12.9870441

Number of obs	2009
F(95, 1913)	106.79
Prob > F	0.0000
R-squared	0.8414
Adj R-squared	0.8335
Root MSE	1.4706

pc_mur	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
legal	-.4724342	.1594548	-2.96	0.003	-.7851578	-.1597106
rpc_inc	-.0025453	.0064984	-0.39	0.695	-.01529	.0101995
ur	-.2292825	.0345841	-6.63	0.000	-.297109	-.161456
ipolice	-.0001523	.0000682	-2.23	0.026	-.0002861	-.0000185
nonwhite	10.81947	1.651789	6.55	0.000	7.579977	14.05897
age15to19	62.09126	18.22073	3.41	0.001	26.35669	97.82584
age20to24	75.12214	14.29399	5.26	0.000	47.08869	103.1556
_Istname_2	2.131986	.9163161	2.33	0.020	.3349019	3.929069
_Istname_3	.9446499	.9704431	0.97	0.330	-.9585878	2.847888

zap bingo! … but look at that statistical significance… so bring on the panel techniques

```
. xi: reg pc_mur legal rpc_inc ur ipolice nonwhite age15to19 age20to24 i.st i.year i.decade_ds [w=pop
> ul] if sample_ds==1, cluster(st)
i.st              _Ist_1-51           (_Ist_1 for st==AK omitted)
i.year            _Iyear_1930-2004    (naturally coded; _Iyear_1930 omitted)
i.decade_ds       _Idecade_ds_1930-2000(naturally coded; _Idecade_ds_1930 omitted)
```

(Std. Err. adjusted for 49 clusters in st)

pc_mur	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
legal	-.4724342	.7357463	-0.64	0.524	-1.951751	1.006883
rpc_inc	-.0025453	.0146042	-0.17	0.862	-.0319089	.0268184
ur	-.2292825	.0667896	-3.43	0.001	-.363572	-.0949931
ipolice	-.0001523	.0001854	-0.82	0.415	-.000525	.0002205
nonwhite	10.81947	4.665156	2.32	0.025	1.439548	20.1994
age15to19	62.09126	52.36709	1.19	0.242	-43.19984	167.3824
age20to24	75.12214	31.46479	2.39	0.021	11.85795	138.3863
_Ist_2	2.131986	.9661636	2.21	0.032	.1893833	4.074588
_Ist_3	.9446499	1.09457	0.86	0.392	-1.25613	3.14543

oops! … and some states are more active in enforcing their death penalty laws

Linear regression

Number of obs	= 2009
F(47, 48)	= .
Prob > F	= .
R-squared	= 0.8414
Root MSE	= 1.4706

(Std. Err. adjusted for 49 clusters in st)

pc_mur	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
active	-.5691727	.6320035	-0.90	0.372	-1.839901	.7015555
passive	-.452028	.7734454	-0.58	0.562	-2.007144	1.103088
rpc_inc	-.0034003	.0161784	-0.21	0.834	-.0359292	.0291286
ur	-.2274706	.0658794	-3.45	0.001	-.35993	-.0950112
ipolice	-.0001457	.0001961	-0.74	0.461	-.0005401	.0002486
nonwhite	10.67453	4.673653	2.28	0.027	1.277525	20.07154
age15to19	63.54067	50.36247	1.26	0.213	-37.71985	164.8012
age20to24	74.7368	30.96726	2.41	0.020	12.47295	137.0006
_Ist_2	2.130419	.9549222	2.23	0.030	.2104191	4.050419

So here's D&W's summary table:

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Table 2: Panel Data Estimates of the Effects of Death Penalty Laws on Murder Rates: 1960-2000

Dependent Variable: ***Annual Homicides Per 100,000 Residents***				
	Dezhbakhsh and Shepherd (1)	Our Replication (2)	Controlling for Year Fixed Effects (3)	De Facto Versus De Jure Laws (4)
Death Penalty Law	-0.87*** (.21)	-0.95 (.57)	-0.47 (.74)	
Active Death Penalty Law (≥ *1 Execution in Previous Decade*)				-0.57 (.63)
Inactive Death Penalty Law (*No Executions in Previous Decade*)				-0.45 (.77)
State Fixed Effects	Yes	Yes	Yes	Yes
Decade Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	No	No	Yes	Yes
Adjusted R^2	.804	.791	.834	.834
Sample Size (Excludes DC, HI)	(unknown)	2009	2009	2009

Notes: Sources and data are as described in Dezhbakhsh & Shepherd, *supra* note 33, at tbl.7. Population-weighted least squares regression also includes controls for state per capita real income, the unemployment rate, police employment, proportions of the population nonwhite, aged 15-19, and aged 20-24. ***, **, and * denote statistically significant at 1%, 5%, and 10%, respectively.

and another approach (event study analysis … common in Finance):

Figure 5. Homicides Before and After the Illinois Moratorium