Recombinant Pasts and CRISPR Futures:

Beneficially Constraining Gene Editing Regulation in the United States & Europe, 1975 to Present

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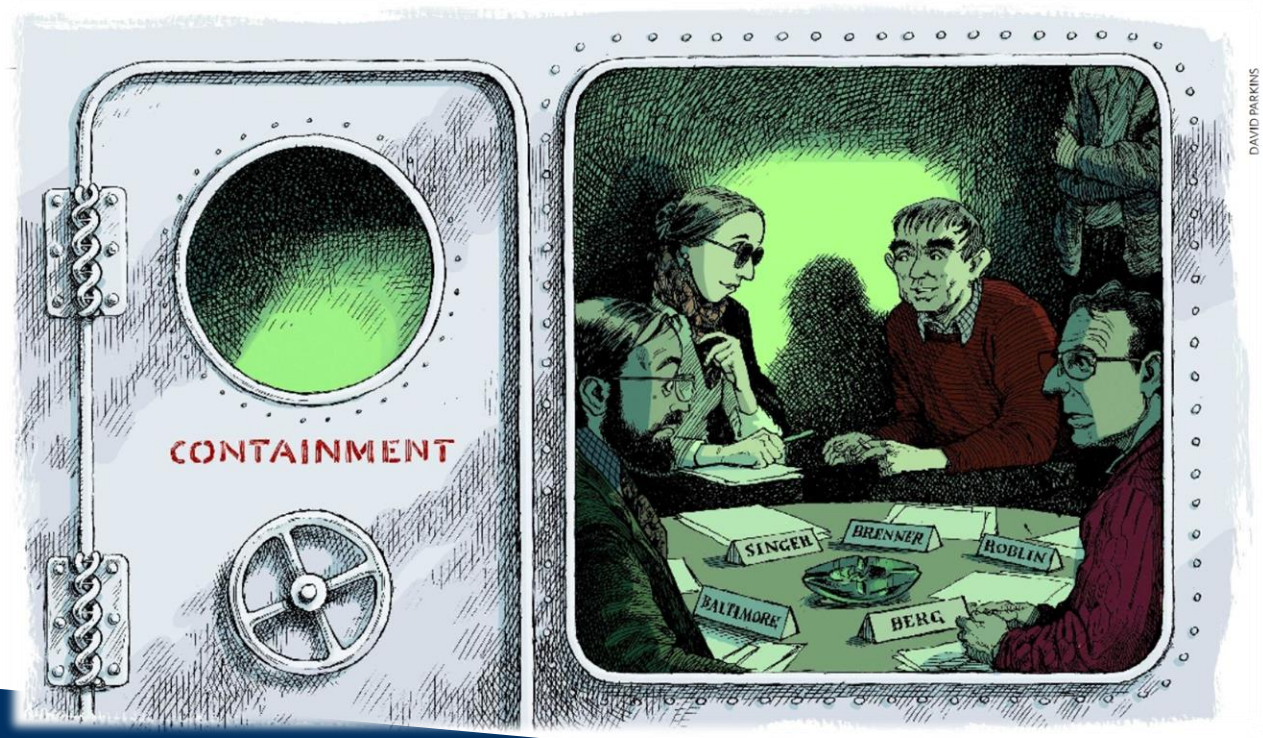
REGGOV 2021



Berkeley
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Cartoon of Asilomar 1975 from:
Berg, Paul. 2008. "Asilomar 1975: DNA Modification Secured." *Nature* 455 (September): 2.

Overview

- What is Gene Editing?
- Place in Dissertation
- Beneficial Constraints Imaginary
- Conclusions

Gene Editing (GE)

- Intentional alteration of genetic code
- Technoscientific Disruption
  - What once was dreamed now is possible
- Social Scientific Disruption
  - Who owns and who can use these tools and resultant genetically modified organisms (GMOs)

Gene Editing (GE), qualifications

- Humans have been altering genes since before we knew what they were
- But invention of recombinant DNA in 1973 “felt” like something new
- Scientists, citizens, and governments felt that something needed to be done

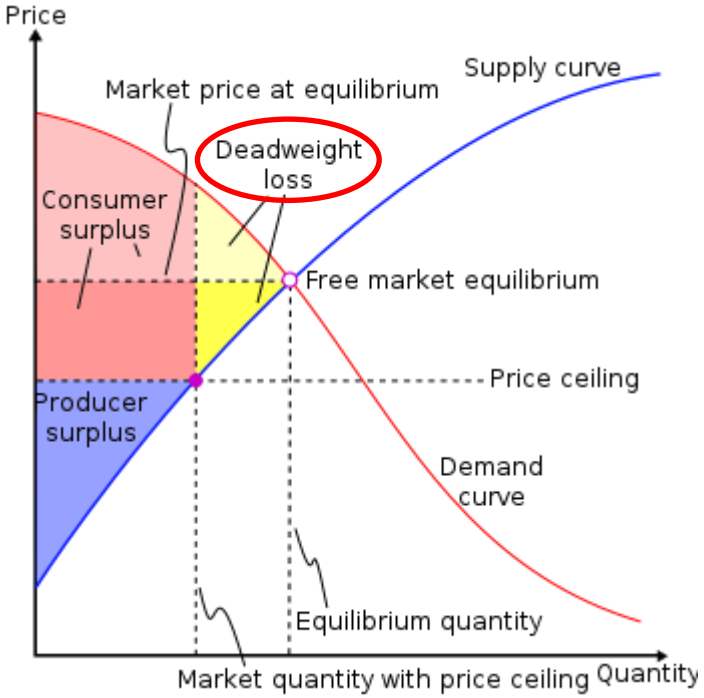
Governments Craft Constraints

- Coordinated Framework 1986 in USA
  - Built on 1976 Research Guidelines from Asilomar 1975
  - "substantially equivalent"
- Precautionary Principle (2001/2003) in EU
  - Repealed de facto ban by member states
  - Heightened scrutiny for GMOs

More than Mere Dead-Weight

The Variety of Ways Regulators, Entrepreneurs, and Innovators Coproduce Disruptive Technological Innovation

Stigler's *theory of economic regulation (1971)*



"...as a rule, regulation is acquired by the industry and is designed and operated primarily for its benefit."

(Stigler 1971, p. 3)

Graph: SilverStar

Stigler, G. J. (1971). The Theory of Economic Regulation. *The Bell Journal of Economics and Management Science*, 3-21.

Regulatory Imaginaries

- Based on Sociotechnical Imaginaries (Jasanoff & Kim 2009, 2015)
- a **collectively** held, publicly **performed**, and **desirable** statement of relationships between regulation and technological innovation which actors believe are (or should be) **institutionalized** within regulatory agencies.
- Animating logic behind regulatory regime.

Beneficial Constraints

"Recognition of the **economic benefits** of ***some*** social constraints **immunizes** against the received wisdom that *all* constraints are counterproductive by definition."

(Streeck 1997, p. 213)

Example: Gene Editing Regulation

Streeck, W. (1997). Beneficial Constraints: On the Economic Limits of Rational Voluntarism. In J. R. Hollingsworth, & R. Boyer (Eds.), *Contemporary Capitalism: The Embeddedness of Institutions* (pp. 197-218). Cambridge: Cambridge University Press.

Constitutive Variables

A Regulators…	Generalized Regulatory Response Models		
Relationship to Market Development	**Rulemaker → Stakeholder**		
Access to **Information** about Regulated Sector	**Lower** than Firms → **Higher** than firms		
Driver of Innovation Adoption	**Market** or **Regulator**		
# of Optimal Regulatory Arrangement **Outcomes**	**Zero,** (laissez faire)	**One,** (pareto optimality)	**Many** (Based on varied defn of "optimal")
Effect on Innovation	**Impediment → Moderator → Constrainer → Driver**		

Deductive Typology

- 24 Combinations of 4 constitutive variables
- Exhaustive Typology
- 6 trivial/logically inconsistent
- 18 combinations sorted into 7 substantive models
- 3 categories of particular interest

		Constitutive Variables (Independent Variables)				Dependent
Imaginary	**#**	**Relationship**	**Info**	**Driver**	**Outcomes**	**Effect**
Folk Economic Model (Christensen 1997)	1	Rulemaker	Lower	Market	Zero	Impediment
	2	Rulemaker	Lower	Market	One	Impediment
Market Ideological*	3	Rulemaker	Higher	Market	Zero	Impediment
	4	Stakeholder	Higher	Market	Zero	Impediment
State-as-Venue (Skocpol 1985)	5	Rulemaker	Lower	Regulator	Many	Moderator
	6	Stakeholder	Lower	Market	Many	Moderator
	7	Stakeholder	Lower	Regulator	Many	Moderator
Capture (Stigler 1971)	8	Stakeholder	Lower	Market	One	Constrainer
	9	Stakeholder	Lower	Regulator	One	Constrainer
Technology-Based Regulation "Conventional Command and Control" (Malloy 2010)	10	Rulemaker	Higher	Market	One	Constrainer
	11	Rulemaker	Lower	Regulator	One	Constrainer
	12	Stakeholder	Higher	Market	One	Constrainer
Beneficial Constrainer (Streeck 1997)	13	Rulemaker	Higher	Market	Many	Constrainer
	14	Stakeholder	Higher	Market	Many	Constrainer
Adoption Catalyst	15	Rulemaker	Higher	Regulator	Many	Catalyzer
	16	Stakeholder	Higher	Regulator	Many	Catalyzer
	17	Rulemaker	Higher	Regulator	One	Catalyzer
	18	Stakeholder	Higher	Regulator	One	Catalyzer
Trivial	19	*Rulemaker*	*Lower*	*Regulator*	*Zero*	*Impediment*
	20	*Stakeholder*	*Lower*	*Regulator*	*Zero*	*Impediment*
	21	*Rulemaker*	*Lower*	*Market*	*Many*	*Impediment*
	22	*Stakeholder*	*Lower*	*Market*	*Zero*	*Impediment*
Logically Inconsistent	23	~~Rulemaker~~	~~Higher~~	~~Regulator~~	~~Zero~~	~~n/a~~
	24	~~Stakeholder~~	~~Higher~~	~~Regulator~~	~~Zero~~	~~n/a~~

Beneficial Constraints

- Bayesian Type Verification of Gene Editing
- Results:
  - **Overwhelming** evidence against folk economic model, market ideological, state as venue for US & EU, against Adoption Catalyst for the EU.
  - **Reasonable** evidence against Technology based Regulation for US & EU, Capture for the US
  - **Suggestive to Reasonable** evidence against
    - Adoption Catalyst for the US
    - Capture for the EU

    Depending on priors

Common Reference Sounds

Decibels (dB)	Reference Sound
10	Adult hearing threshold; rustling leaves, pin drop
20	Whisper
30	Quiet bedroom or library, ticking watch
45	Sufficient to wake a sleeping person
50	Moderate rainstorm
60	Typical conversation
70	Noisy restaurant, common TV level
80	Busy curbside, alarm clock
90	Passing diesel truck or motorcycle
100	Dance club, construction site
115	Rock concert, baby screaming

Reproduced from (Fairfield and Charman 2017, 10)

Driver of Adoption: EHR (Total WOE)

Odds Ratio*	Naïve				Background Info				Skeptical			
	Prior	US Post	EU Post	Combo Posterior	Prior	US Post	EU Post	Combo Posterior	Prior	US Post	EU Post	Combo Posterior
Beneficial Constraints / Adoption Catalyst	0	20	200	220	-30	-10	170	190	- 60	-40	140	160
Beneficial Constraints / Capture	0	100	13	113	-30	70	-17	83	- 60	40	- 47	53
Beneficial Constraints / Technology Based Regulation	0	90	50	140	0	90	50	140	- 60	30	-10	80
Beneficial Constraints / State as Venue	0	150	180	330	-30	120	150	300	- 60	120	120	240
Beneficial Constraints / Folk Economic Model	0	175	388	563	0	175	388	563	- 60	125	328	503
Beneficial Constraints / Market Ideological	0	190	309	499	0	190	309	499	- 60	130	249	439

Conclusions

- Gene Editing was regulated from a Beneficial Constraints regulatory imaginary
  - EU might be "cultural capture" (Kwak 2014) but better understood as contest over "beneficial"
  - US certainly pro-adoption but does not cross over into catalyzing
- Distinguish between Regulatory method and regulatory goal
  - GE/GMO case often seen as divergent in goal but underappreciated similarity of method

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