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Regulation Tomorrow: What Happens When Technology Is Faster than the Law?

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REGULATION TOMORROW: WHAT HAPPENS WHEN TECHNOLOGY IS FASTER THAN THE LAW?

MARK FENWICK,* WULF A. KAAL,** AND ERIK P.M. VERMEULEN***

In an age of constant, complex and disruptive technological innovation, knowing what, when, and how to structure regulatory interventions has become more difficult. Regulators find themselves in a situation where they believe they must opt for either reckless action (regulation without sufficient facts) or paralysis (doing nothing). Inevitably in such a case, caution tends to trump risk. But such caution merely functions to reinforce the status quo and makes it harder for new technologies to reach the market in a timely or efficient manner.

The solution: lawmaking and regulatory design needs to become more proactive, dynamic, and responsive. So how can regulators actually achieve these goals? What can regulators do to promote innovation and offer better opportunities to people wanting to build a new business around a disruptive technology or simply enjoy the benefits of a disruptive new technology as a consumer?

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INTRODUCTION

Imagine the following near future experience of shopping online:

You are in a café thinking about a last minute birthday present for a friend or relative who you will be meeting later that day. Using a smartphone, you find something suitable via Amazon or similar web-based retailer. You place the order, paying a slight premium for instant delivery. Twenty minutes later you receive a notification that a drone will be arriving shortly at a delivery-port close to the café. You make the five minute walk to the designated meeting point. A drone then swoops down beside you and releases the package having confirmed your identity and location via phone connection.

Most commentators seem to agree that the combination of online transaction and drone delivery represents the future of fast, clean, and efficient shopping.¹

And yet, for the moment, this type of service is not available. Thinking about some of the reasons why this technology is not available can teach us something important about how we currently deal with disruptive technology and how we might want — or need — to adapt our approach to a new world in which innovation cycles are shorter and new technology is constantly being developed.

Returning to the example of drone-based delivery, a major reason why this type of service is not yet available is technological.² Clearly, there are technological issues that need to be overcome.³ For example, ensuring that the service is reliable and safe is crucial before fleets of drones are released on to the world. But even when all of the main technology issues are

1. See Tom Simonite, *Amazon Lays Out Its Vision for a Sky Thronging with Delivery Drones*, MIT TECH. REV. (July 28, 2015), <https://perma.cc/D9AR-DA4J> (quoting Gur Kimchi, a cofounder of Amazon's drone project, saying, "[w]e think it's going to be more economical, faster, environmentally sound, and that customers are going to like it"); Sally French, *Drone Delivery Is Already Here — and It Works*, MKT.WATCH (Dec. 15, 2015, 7:32 AM), <https://perma.cc/57XC-EBT7> (explaining how the drone delivery process might work).

2. Erik P.M. Vermeulen, *Artificial Intelligence, FinTech, Big Data . . . Or, What Happens When Technology is Faster than the Law?*, Emergent Future (Sept. 3, 2016), <https://medium.com/emergent-future/artificial-intelligence-fintech-big-data-or-what-happens-when-technology-is-faster-than-the-6c2c1528738c#.k4ohle1im>; Keith Wagstaff, *Could Drone Delivery Really Take Off? Experts Weigh In*, NBC NEWS: MACH (Nov. 15, 2016, 4:32 PM), <http://www.nbcnews.com/mach/technology/could-drone-delivery-really-catch-experts-weigh-n456806>; Farhad Manjoo, *Think Amazon's Drone Delivery Idea Is a Gimmick? Think Again*, N.Y. TIMES (Aug. 10, 2016), <https://www.nytimes.com/2016/08/11/technology/think-amazons-drone-delivery-idea-is-a-gimmick-think-again.html>; Samuel Gibbs, *Are Drone Deliveries a Realistic Prospect?*, GUARDIAN (July 29, 2016), <https://www.theguardian.com/technology/2016/jul/29/are-drone-deliveries-a-realistic-prospect>.

3. Vermeulen, *supra* note 2.

resolved there are other obstacles that can prevent consumers and entrepreneurs from enjoying the benefits and opportunities offered by new technologies or services, such as drone delivery.

These obstacles are not the result of technological limitations, but human choice. The law — and other regulations — can often prohibit, or otherwise limit, commercial exploitation of, and public access to, new technology. However, as disruptive technologies arrive more frequently and at a faster pace, debates around such regulatory constraints on new technologies are more pressing.⁴

II. DISRUPTIVE INNOVATION IN THE LITERATURE

Since the mid-1990s, the literature on management has studied the implications of disruptive technologies and innovation.⁵ The literature warned businesses to act quickly when disrupters appear by either acquiring the disrupter or incubating a competing business that embraces the disruptive technology, because disrupter startup companies could attract new lower-end consumers by offering inexpensive substitutes for products and gradually move upmarket by attracting higher-end consumers.⁶ A lack of investment in disruptive technologies can result in the abrupt loss of market dominance and often even total replacement in such markets.⁷ When market leaders do not extend their market dominance through the use of disruptive technologies, smaller entrepreneurial firms with no established customer base can take advantage of disruptive technologies and redefine such markets.⁸

4. See Wulf A. Kaal, *Dynamic Regulation for Innovation*, in PERSPECTIVES IN LAW, BUSINESS & INNOVATION (Mark Fenwick et al. eds., forthcoming 2017) [hereinafter Kaal, *Innovation*].

5. See GEOFFREY A. MOORE, *CROSSING THE CHASM* (Harper Bus. 1991). See generally CLAYTON M. CHRISTENSEN, *THE INNOVATOR'S DILEMMA: WHEN NEW TECHNOLOGIES CAUSE GREAT FIRMS TO FAIL* (Harv. Bus. Rev. Press 1997).

6. Larry Downes & Paul Nunes, *Big-Bang Disruption*, 91 HARV. BUS. REV. 44, 46 (2013). *Contra* Andrew A. King & Baljir Baatartogokh, *How Useful Is the Theory of Disruptive Innovation?*, MIT SLOAN MGMT. REV. (Sept. 15, 2015), <http://sloanreview.mit.edu/article/how-useful-is-the-theory-of-disruptive-innovation> (“In summary, although Christensen and Raynor selected the 77 cases as examples of the theory of disruptive innovation, our survey of experts reveals that many of the cases do not correspond closely with the theory. In fact, their responses suggest that only seven of the cases (9%) contained all four elements of the theory that we asked about.”).

7. Joseph L. Bower & Clayton M. Christensen, *Disruptive Technologies: Catching the Wave*, 73 HARV. BUS. REV. 43, 43 (1995) (“One of the most consistent patterns in business is the failure of leading companies to stay at the top of their industries when technologies or markets change.”).

8. *Id.* at 51 (“Small, hungry organizations are good at placing economical bets, rolling with the punches, and agilely changing product and market strategies in response to feedback from initial forays into the market.”); Constantinos D. Charitou &

So-called big-bang disruptions differ from more-traditional innovation. First, big-bang disruptors often offer more innovative products that are cheaper and often better integrated with other products and services.⁹ Second, big-bang disrupters typically launch businesses without a foundation, using cloud computing, open platforms built on the internet, and fast-cycling mobile devices. Finally, big-bang disrupters often produce multiple new products to identify which products may take hold in the market. While most such products will fail, the payoff associated with the unconstrained growth of those products that succeed is substantial and facilitates and often accelerates other forms of disruptive innovation.¹⁰

In the foreseeable future, artificial intelligence (“AI”) is likely the most significant field of disruptive innovation. AI is different from a regular computer algorithm. AI tries to emulate human thought processes and rational human behavior through self-learning and storage of experiences.¹¹ Because it emulates human behavior, AI can act differently in the same situations, depending on the actions previously performed. However, AI still lacks the ability to engage in creative new ways of combining previously learned contexts.¹² The rapid advances of AI have

Constantinos C. Markides, *Responses to Disruptive Strategic Innovation*, MIT SLOAN MGMT. REV. (Jan. 15, 2003), <http://sloanreview.mit.edu/article/responses-to-disruptive-strategic-innovation> (“[D]isruptive strategic innovations usually start out as small and low-margin businesses. That’s why they rarely gain support or long-term commitment from established competitors. The innovations are small and are not attractive until they start growing.”). *Contra* Downes & Nunes, *Big-Bang Disruption*, *supra* note 6, at 46 (explaining that the strategic model of disruptive innovation we’ve all become comfortable with has a blind spot. It assumes that disrupters start with a lower-priced, inferior alternative that chips away at the least profitable segments, giving an incumbent business time to start a skunkworks and develop its own next-generation products. That advice hasn’t been much help to navigation-product makers like TomTom, Garmin, and Magellan. Free navigation apps, now preloaded on every smartphone, are not only cheaper but better than the stand-alone devices those companies sell. And thanks to the robust platform provided by the iOS and Android operating systems, navigation apps are constantly improving, with new versions distributed automatically through the cloud).

9. Downes & Nunes, *supra* note 6, at 46.

10. *See id.*

11. *See* Paulius Cerka et al., *Liability for Damages Caused by Artificial Intelligence*, 31 COMPUTER L. & SEC. REV. 376, 378 (2015). *See generally* STUART RUSSELL & PETER NORVIG, *ARTIFICIAL INTELLIGENCE: A MODERN APPROACH* 5 (2013) (describing the different major definitions for AI); Robert D. Hof, *10 Breakthrough Technologies 2013: Deep Learning With Massive Amounts of Computational Power, Machines Can Now Recognize Objects and Translate Speech in Real Time. Artificial Intelligence is Finally Getting Smart*, MIT TECH. REV., <http://www.technologyreview.com/featuredstory/513696/deep-learning/> (last visited Sept. 27, 2017).

12. Jeanne Carstensen, *Robots Can’t Dance: Why the Singularity Is Greatly Exaggerated*, *Nautilus* (Jan. 22, 2015), <http://nautil.us/issue/20/creativity/robots-cant-dance> (“We may be making progress in being able to do things like recognize a cat in a

already affected many of the sectors of the economy during the past decade.¹³ The exponential development of AI and the associated disruptive innovation pose substantial challenges for policy makers in education, financial markets, labor markets, and other areas.¹⁴

Big data in combination with AI and machine learning is a significant driver of disruptive innovation.¹⁵ Big data in the form of digitized data that grows at exponential rates and can be captured and manipulated electronically draws on several core sources including the internet of things, public records, social media, and cameras, as well as satellite tracking.¹⁶ Downsides associated with big data include its use of such

photograph. But there's a huge gulf between that and doing something creative."); Margaret A. Boden, *Artificial Creativity: Why Computers Aren't Close to Being Ready to Supplant Human Artists*, MIT TECH. REV. (Oct. 20, 2015), <https://www.technologyreview.com/s/542281/artificial-creativity/>; Margaret A. Boden, *Creativity and Artificial Intelligence*, 103 ARTIFICIAL INTELLIGENCE 347, 355 (1998), ("These two bottlenecks interact, since subtle valuation requires considerable domain expertise. Valuation, thus far, is mostly implicit in the generative procedures used by the program, or interactively imposed by a human being. Only a few AI-models can critically judge their own original ideas. And hardly any can combine evaluation with transformation. The ultimate vindication of AI-creativity would be a program that generated novel ideas which initially perplexed or even repelled us, but which was able to persuade us that they were indeed valuable. We are a very long way from that.").

13. See Craig E. Karl, *The Three Breakthroughs That Have Finally Unleashed AI on the World*, WIRED (Oct. 27, 2014, 6:30 AM), <http://www.wired.com/2014/10/future-of-artificial-intelligence/> ("Over the past five years, cheap computing, novel algorithms, and mountains of data have enabled new AI-based services that were previously the domain of sci-fi and academic white papers.").

14. See ERIK BRYNJOLFSSON & ANDREW MCAFEE, *THE SECOND MACHINE AGE: WORK, PROGRESS, AND PROSPERITY IN A TIME OF BRILLIANT TECHNOLOGIES* 205–28 (2014) (discussing policy in the face of projected automation of low-skill labor); Tess Townsend, *Peter Diamandis: A.I. Will Lead to Massive Disruption Across Industries*, INC. (Sept. 24, 2015), <http://www.inc.com/tess-townsend/diamandis-artificial-intelligence.html>.

15. See James Canton, *From Big Data to Artificial Intelligence: The Next Digital Disruption*, HUFFINGTON POST, http://www.huffingtonpost.com/james-canton/from-big-data-to-artificial-intelligence_b_10817892.html (last updated July 6, 2017); Jitendra Waral, Anurag Rana & Sean Handrahan, *Artificial Intelligence: Disruption Era Begins*, BLOOMBERG PROF. SERVS.: BLOOMBERG INTELLIGENCE (Sept. 29, 2016), <https://www.bloomberg.com/professional/blog/artificial-intelligence-disruption-era-begins/>; Rebecca Merrett, *Intelligent Machines Part 1: Big Data, Machine Learning and the Future*, CIO (June 4, 2015), <http://www.cio.com.au/article/576664/intelligent-machines-part-1-big-data-machine-learning-future/>.

16. See Townsend, *supra* note 14; JOHN PODESTA ET. AL., EXEC. OFFICE OF THE PRESIDENT, *BIG DATA: SEIZING OPPORTUNITIES, PRESERVING VALUES* 53 (2014), ("Big data technologies, together with the sensors that ride on the 'Internet of Things,' pierce many spaces that were previously private. Signals from home WiFi networks reveal how many people are in a room and where they are seated."). See generally JAMES MANYIKA ET AL., *BIG DATA: THE NEXT FRONTIER FOR INNOVATION, COMPETITION, AND PRODUCTIVITY* 15 (McKinsey Glob. Inst., 2011).

disparate sources, which creates challenges for the integration of data and normalizing.¹⁷ The literature mostly takes issue with the big data inaccuracies that occur when collecting data from databases that merely require generalized accuracy.¹⁸ Big data is often not the output of instruments designed to generate valid and reliable data suitable for scientific analysis. Foundational data issues of construct validity, measurement, reliability, and data dependencies are the same regardless of data quantities.¹⁹ Some critique the implicit assumption of big data researchers that big data is a substitute for traditional data collection and analysis rather than a mere supplement,²⁰ while others see big data and small data not as mutually exclusive, but as reinforcing and supporting

17. MANYIKA ET AL., *supra* note 16, at 12 (“To capture value from big data, organizations will have to deploy new technologies (e.g., storage, computing, and analytical software) and techniques (i.e., new types of analyses). The range of technology challenges and the priorities set for tackling them will differ depending on the data maturity of the institution. Legacy systems and incompatible standards and formats too often prevent the integration of data and the more sophisticated analytics that create value from big data. New problems and growing computing power will spur the development of new analytical techniques. There is also a need for ongoing innovation in technologies and techniques that will help individuals and organizations to integrate, analyze, visualize, and consume the growing torrent of big data.”); *see also* Christian Bizer et al., *The Meaningful Use of Big Data: Four Perspectives — Four Challenges*, 40 SIGMOD REC. 56, 57 (2011) (“My challenge is meaningful data integration in the real, messy, often schema-less, and complex Big Data World of databases and the (Semantic) Web using multi-disciplinary, multi-technology methods.”).

18. *See* Bizer et al., *supra* note 17, at 57; IAN AYRES, SUPER CRUNCHERS: WHY THINKING-BY-NUMBERS IS THE NEW WAY TO BE SMART 60–63 (2007) (identifying big data phenomenon). *See generally* Andrea Lancichinetti et al., *High-Reproducibility and High-Accuracy Method for Automated Topic Classification*, 5 PHYSICAL REV. X 011007 (2015) (detailing the inaccuracy problems associated with big data text analysis/machine reading (called LDA)).

19. *See* David Lazer et al., *The Parable of Google Flu: Traps in Big Data Analysis*, 343 SCI. 1203 (2014); Gary Marcus & Ernest Davis, *Eight (No, Nine!) Problems with Big Data*, N.Y. TIMES (Apr. 6, 2014), <http://www.nytimes.com/2014/04/07/opinion/eight-no-nine-problems-with-bigdata.html> (suggesting that “[r]eliable statistical information can be compiled about common trigrams, precisely because they appear frequently. But no existing body of data will ever be large enough to include all the trigrams that people might use, because of the continuing inventiveness of language.”); Tim Harford, *Big Data: Are We Making a Big Mistake?*, FIN. TIMES (Mar. 28, 2014), <https://www.ft.com/content/21a6e7d8-b479-11e3-a09a-00144feabdc0#axzz30INfAyMi> (“Statisticians have spent the past 200 years figuring out what traps lie in wait when we try to understand the world through data. The data are bigger, faster and cheaper these days — but we must not pretend that the traps have all been made safe. They have not.”).

20. Jeff Leek, *Why Big Data Is in Trouble: They Forgot About Applied Statistics*, SIMPLY STATS. (May 7, 2014), <http://simplystatistics.org/2014/05/07/why-big-data-is-in-trouble-they-forgot-about-applied-statistics/> (“Statistical thinking has also been conspicuously absent from major public big data efforts so far.”).

each other.²¹ Big data shortcomings can largely be addressed with artificial intelligence, and the combination of big data and artificial intelligence opens up significant additional big data applications.²² Being able to analyze entire populations via big data applications, rather than being required to deal with limited sample sizes, allows researchers to understand correlations that are completely unprecedented and can help revolutionize our world.²³

III. THE FACTUAL BASIS OF MODERN REGULATION

Reforming the regulatory framework to address increasing and growing regulatory concerns associated with disruptive technologies becomes increasingly important. Designing a regulatory framework that ensures the safety of users and the public, whilst facilitating the commercial use and consumer enjoyment of disruptive innovation is by no means easy.²⁴ This is particularly true in contemporary settings, where innovation is quicker and the global dissemination of that technology is much faster.²⁵ In such

21. Lazer et al., *supra* note 19, at 1205.

22. Jo Ann S. Barefoot, *Disrupting Fintech Law*, 18 FINTECH L. REP. 3, 6 (2015); Daniel E. O’Leary, *Artificial Intelligence and Big Data*, 28 IEEE INTELLIGENT SYS. 96, 97, 99 (2013) (“AI researchers have long been interested in building applications that analyze unstructured data, and in somehow categorizing or structuring that data so that the resulting information can be used directly to understand a process or to interface with other applications. As an example, Johan Bollen and Huina Mao [footnote omitted] found that stock market predictions of the Dow Jones Industrial average were improved by considering the overall ‘sentiment’ of the stock market — this is an unstructured concept, but based on structured data generated from Google.”); Maryam M. Najafbadi et al., *Deep Learning Applications and Challenges in Big Data Analytics*, 2 J. BIG DATA 1, 11 (2015) (“[P]erforming discriminative tasks in Big Data Analytics one can use Deep Learning algorithms to extract complicated nonlinear features from the raw data, and then use simple linear models to perform discriminative tasks using the extracted features as input. This approach has two advantages: (1) extracting features with Deep Learning adds nonlinearity to the data analysis, associating the discriminative tasks closely to Artificial Intelligence, and (2) applying relatively simple linear analytical models on the extracted features is more computationally efficient, which is important for Big Data Analytics.”).

23. See generally KENNETH CUKIER & VIKTOR MAYER-SCHONBERGER, *BIG DATA: A REVOLUTION THAT WILL TRANSFORM HOW WE LIVE, WORK AND THINK* (2013).

24. Anna Butenko & Pierre Larouche, *Regulation for Innovativeness or Regulation of Innovation?*, 7 L. INNOVATION AND TECH. 52, 72 (2015).

25. Rita McGrath, *The Pace of Technology Adoption is Speeding Up*, HARV. BUS. REV. (Nov. 25, 2013), <https://hbr.org/2013/11/the-pace-of-technology-adoption-is-speeding-up>; Drew Desilver, *Chart of the Week: The Ever-Accelerating Rate of Technology Adoption*, PEW RES. CTR. (Mar. 14, 2014), <http://www.pewresearch.org/fact-tank/2014/03/14/chart-of-the-week-the-ever-accelerating-rate-of-technology-adoption/>. But see Bronwyn H. Hall & Beethika Khan, *Adoption of New Technology 1* (Nat’l Bureau of Econ. Research, Working Paper No. 9730, 2003) (explaining that the diffusion of technology usually “appears as a continuous and rather slow process”).

circumstances, regulators can often struggle to keep up.²⁶ The last two decades offer multiple examples of such regulatory struggles: genetically modified food, artificial intelligence, and, of course, driverless cars.²⁷

AI and its disruptive capabilities present a prominent example for the possible disruptive potential and regulatory challenges associated with such disruption in the existing regulatory framework. Because national and international law do not currently recognize AI as a subject of law, AI has no legal personality and as such cannot be held personally liable for damages.²⁸ With autonomous AI playing an expanding role in society, an increasing number of scientists and entrepreneurs suggest that government regulation may be necessary to reduce the risks to the public associated with the rapid advances in AI.²⁹ While some favor an indirect form of AI

26. See BRADEN A. ALLENBY, THE GROWING GAP BETWEEN EMERGING TECHNOLOGIES AND LEGAL-ETHICAL OVERSIGHT: THE PACING PROBLEM 3 (Gary E. Marchant et al. eds. 2011) (“Moore’s Law notoriously states that the ‘functional capacity of ICT products roughly doubles every 18 months’, with the same dynamics manifesting in biotechnology, and namely in sequencing human genome. As a result, regulating innovation involves what is called a ‘pacing problem’ in the academic literature from the US, or the ‘challenge of regulatory connection’ or ‘regulatory disconnection’ in European-based scholarship.”); Butenko & Larouche, *supra* note 24, at 66 (“The ‘pacing problem’ commonly refers to the situation when technology develops faster than the corresponding regulation, the latter hopelessly falling behind. The metaphor of ‘the hare and the tortoise’ is often conjured up. As summed up by Marchant and Wallach, ‘at the rapid rate of change, emerging technologies leave behind traditional governmental regulatory models and approaches which are plodding along slower today than ever before’.”).

27. See GREGORY N. MANDEL ET AL., INNOVATIVE GOVERNANCE MODELS FOR EMERGING TECHNOLOGIES 44, 45 (Gary E. Marchant et al. eds. 2013) (“One obstacle to this goal is that new technologies are often met with highly polarized debates over how to manage their development, use and regulation. Prominent examples include nuclear energy and genetically modified foods.”); *see id.*, at 136 (“Emerging technologies such as nanotechnology, biotechnology, personalized medicine, synthetic biology, applied neuroscience, geoeengineering, social media, surveillance technologies, regenerative medicine, robotics and artificial intelligence present complex governance and oversight challenges. These technologies are characterized by a rapid pace of development, a multitude of applications, manifestations and actors, pervasive uncertainties about risks, benefits and future directions, and demands for oversight ranging from potential health and environmental risks to broader social and ethical concerns. Given this complexity, no single regulatory agency, or even group of agencies, can regulate any of these emerging technologies effectively and comprehensively.”); Tracy Hresko Pearl, *Fast & Furious: The Misregulation of Driverless Cars* 1, 50 (Aug. 5, 2016) (unpublished manuscript) (SSRN Working Paper), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2819473 (“The United States is on the cusp of a revolution in transportation. The sale and widespread use of both semi-autonomous and fully autonomous vehicles, also known as ‘driverless cars,’ are both imminent and likely to significantly change the way in which citizens commute, interact, and travel.”).

28. See Pearl *supra* note 27.

29. See Sharon Gaudin, *A.I. Researchers Say Elon Musk’s Fears ‘Not Completely Crazy’*, COMPUTERWORLD (Oct. 29, 2014, 1:16 PM), <http://www.computerworld.com/>

regulation based on differential tort liability,³⁰ others oppose rigid regulation of AI because regulation may inhibit the socially beneficial innovations associated with AI, or they suggest such regulation is impossible in the face of such a powerful and exponentially growing technology.³¹ While AI is currently not able to match human-level reasoning,³² and for the foreseeable future, lacks the ability to be creative, it can still have an impact on the service industries, among others.³³

To take an even simpler, but nevertheless important, example: current rules in many jurisdictions do not allow self-driving cars on the roads. Making this change is relatively simple. For example, the 1968 *Vienna Convention on Road Traffic*, to which seventy-two countries are party, was amended in March 2014 to take such new technologies into consideration.³⁴

However, there are many other more complex regulatory issues that will need to be addressed. The driverless car will generate an enormous amount of data for possible alternative usage, which is likely to create new issues related to data security and privacy concerns.³⁵ In a tort context, questions

article/2840815/ai-researchers-say-elon-musks-fears-not-completely-crazy.htmlgoo.gl/3K91LD (“‘I think we should be very careful about artificial intelligence,’ Musk said when answering a question about the state of AI. ‘If I were to guess at what our biggest existential threat is, it’s probably that . . . [w]ith artificial intelligence, we are summoning the demon. In all those stories with the guy with the pentagram and the holy water, and he’s sure he can control the demon. It doesn’t work out.”); Rory Cellan-Jones, *Stephen Hawking Warns Artificial Intelligence Could End Mankind*, BBC NEWS (Dec. 2, 2014), <http://www.bbc.com/news/technology-30290540> (“The development of full artificial intelligence could spell the end of the human race.”).

30. See Matthew U. Scherer, *Regulating Artificial Intelligence Systems: Risks, Challenges, Competencies, and Strategies*, 29 HARV. J. L. & TECH. 353, 393 (2016).

31. See *You, Robot?*, ECONOMIST (Sept. 1, 2012), <http://www.economist.com/node/21560986> (“Regulators must tread carefully. Noel Sharkey, a computer scientist at the University of Sheffield, observes that overly rigid regulations might stifle innovation. But a lack of legal clarity leaves device-makers, doctors, patients and insurers in the dark. The RoboLaw researchers hope to square this circle when they deliver their findings in 2014. So far, though, they seem to have more questions than answers.”). See generally John Danaher, *Is Regulation of Artificial Intelligence Possible?*, HUMAN. + MAG. (July 15, 2015), <http://hplusmagazine.com/2015/07/15/is-regulation-of-artificial-intelligence-possible/>.

32. Richard Waters, *Artificial Intelligence: Machine v. Man*, FIN. TIMES (Oct. 31, 2014), <https://www.ft.com/content/abc942cc-5fb3-11e4-8c27-00144feabdc0>.

33. Harry Surden, *Machine Learning and Law*, 89 WASH. L. REV. 87, 88 (2014).

34. Vienna Convention on the Law of Treaties, art. 31, May 23, 1969, 1155 U.N.T.S. 331, 8 I.L.M. 679. See generally Economic and Social Counsel, Inland Transportation Committee, Working Party on Road Traffic Safety, U.N. Doc. ECE/TRANS/WP.1/145 (Mar. 24-6, 2014); Press Release, UNECE, UNECE paves the way for automated driving by updating UN international convention (Mar. 23, 2016).

35. Mark van Rijmenam, *Self-driving Cars Will Create 2 Petabytes of Data, What Are The Big Data Opportunities for the Car Industry?*, DATAFLOQ (July 18, 2016), <https://datafloq.com/read/self-driving-cars-create-2-petabytes-data-annually/172> (“The

will need to be resolved as to who is at fault in the event of an accident involving driverless cars.³⁶

Moreover, driverless cars will need to communicate both among themselves and with the transport infrastructure to be most effective in their operation. To facilitate this, regulators will need to safeguard telecommunication frequencies and protect against security threats, most obviously the possibility of “car-hacking.”³⁷

This all seems fairly obvious. But a less-documented aspect of this issue

self-driving car from Google already is a true data creator. With all the sensors to enable the car to drive without a driver, it generates nearly 1 Gigabyte every second. It uses all that data to know where to drive and how fast to drive. It can even detect a new cigarette butt thrown on the ground and it then knows that a person might appear all of a sudden from behind a corner or car. 1 Gigabyte per second, imagine the amount of data that will create every year: On average, Americans drive 600 hours per year in their car. That equals 2,160,000 seconds or approximately 2 Petabyte of data per car per year. With the amount of cars worldwide to surpass one billion, it is almost unimaginable how much data will be created when Google’s self-driving car will become common on the streets.”); Adrienne LaFrance, *How Self-Driving Cars Will Threaten Privacy*, ATLANTIC (Mar. 21, 2016), <http://www.theatlantic.com/technology/archive/2016/03/self-driving-cars-and-the-looming-privacy-apocalypse/474600/> (“The companies building self-vehicles have been cagey, so far, about how they’re thinking about using individual data.”).

36. See Adam Thierer & Ryan Hagemann, *Removing Roadblocks to Intelligent Vehicles and Driverless Cars*, 5 WAKE FOREST J.L. & POL’Y 339, 340 (2015) (“Living in fear of hypothetical worst-case scenarios and basing policy on them will mean that the best-case scenarios associated with intelligent vehicles will never come about. Thus, patience and regulatory forbearance are generally the wise policy dispositions at this time, bearing in mind that the tort system will continue to evolve to address harms caused by intelligent-vehicle systems.”); see also Bryant Walker Smith, *Proximity-Driven Liability*, 102 GEO. L.J. 1777 (2014) (“This Article first describes how companies are embracing new technologies that expand their information, access, and control, with primary reference to the increasingly automated and connected motor vehicle. It next analyzes how this proximity to product, user, and use could impact product-related claims for breach of implied warranty, defect in design or information, post-sale failure to warn or update, and negligent enabling of a third-party’s tortious behavior.”).

37. See Jeffrey K. Gurney, *Driving into the Unknown: Examining the Crossroads of Criminal Law and Autonomous Vehicles*, 5 WAKE FOREST J.L. & POL’Y 393, 433 (2015) (“In addition to physically interfering with an autonomous vehicle, people will be able to virtually interfere with the operation of an autonomous vehicle, also known as hacking.”); see also Tom Simonite, *Your Future Self-Driving Car Will Be Way More Hackable*, MIT TECH. REV. (Jan. 26, 2016), <https://www.technologyreview.com/s/546086/your-future-self-driving-car-will-be-way-more-hackable/> (“‘We are a long way from securing the non-autonomous vehicles, let alone the autonomous ones,’ said Stefan Savage, a computer science professor at the University of California, San Diego, at the Enigma security conference in San Francisco on Tuesday. The extra computers, sensors, and improved Internet connectivity required to make a car drive itself increase the possible weak points, he said. ‘The attack surface for these things is even worse,’ said Savage.”).

concerns what we might think of as the basis or foundation of any regulation, namely some empirical facts about that technology and its likely social, economic or health effects.³⁸ In this respect, regulation is always premised on a selection of relevant facts about a particular technology.

Crucially, the selected facts are those that are seen as relevant by the regulators in deciding *what*, *when* and *how* they should make a regulatory intervention.

The “what question” concerns identifying the disruptive technology that must be regulated or requires regulatory reform.³⁹ Demarcating the scope of a technology may not always be self-evident. For example, when should a car be thought of as autonomous, rather than merely providing driver-assistance? Facts about a particular technology are crucial for this kind of definitional judgment.

The “when question” concerns the timing of any regulatory intervention.⁴⁰ This entails ensuring that regulation is not adopted too soon

38. Andrew Askland, *Why Law and Ethics Need to Keep Pace with Emerging Technologies*, in *THE GROWING GAP BETWEEN EMERGING TECHNOLOGIES AND LEGAL-ETHICAL OVERSIGHT: THE PACING PROBLEM*, xix, xx (Gary E. Marchant et al. eds., Springer, 2011) (“Accelerating advances in science and technology exacerbate the problem of unrevised statutes, but the crux of the problem is the same: a dissymmetry between law and newly arising facts because the law has not anticipated these new facts and attempts to govern them with an antiquated grasp of their meaning. Reprising the description of law as the matching of facts and principles, the challenge for law is to be keenly attentive to new facts in order to fashion principles that will sort out the challenges that they present.”).

39. Alberto Alemanno et al., *Conclusions*, in *BETTER BUSINESS REGULATION IN A RISK SOCIETY* 285, 287 (Alberto Alemanno et al. eds., 2013) (“The concept of trust shapes not only the relationship between regulators and regulated (e.g. pharmaceutical industry), but also the very object (i.e. the ‘what’ question) of policies.”).

40. Lyria Bennett Moses, *Agents of Change: How the Law ‘Copes’ with Technological Change*, 20 GRIFFITH L. REV. 763, 768-69 (2011) (“The urge for legal change in response to technological change has a greater sense of *timing*: laws regulating railroads are only needed after track is laid; uncertainties relating to the split of genetic and gestational motherhood need only be resolved *in response to* the availability of *in vitro* fertilisation. There is no doubt that legal change may be demanded as a result of changes in our collective knowledge and beliefs, or social change more broadly, but differences in how such changes are timed and perceived (as well as limitations of space) explain why this article focuses only on part of the story (which is not to say that it might not, in some places, have a broader resonance.”); see SHRUPTI SHAH ET AL., *THE REGULATOR OF TOMORROW*, DELOITTE 2, 3 (June 11, 2015) (“The exponential pace of technological change. New technologies that used to have two-year cycle times now can become obsolete in six months, and the pace of change is not slowing. Moore’s Law posits that computer processing power will double every two years, and this exponential rate of increase has also been shown to hold true in industries beyond computing. When combined with software that is ‘eating the world,’ new technologies can be developed, deployed, and iterated faster than ever. This presents a unique timing challenge for regulatory agencies: Regulate too early and you risk stymieing innovators; wait too long and you risk losing the opportunity to regulate a technology

and stifles or distorts technological development, but not so late that problems arise as a result of the absence of effect regulation. The time frame for rulemaking in the existing regulatory infrastructure is largely inadequate to address regulatory challenges associated with disruptive innovation. While rulemakers may be able to update regulations and regulatory guidance to address regulatory issues created by disruptive innovation, given the exponential nature of disruptive innovation, they are less able to *adequately* update existing rules in the existing regulatory framework where regulators and commentators are engaged in a long, drawn-out feedback process that involves hearings, proposed rules, the submission of comment letters, before finally agency lawyers finalize a rule after considering the comments.⁴¹ Formal rulemaking is simply too time-consuming.⁴² The speed of product innovation makes it possible to bring a new product to market while formal rulemaking in the existing regulatory infrastructure, taking months and often years of regulatory procedure, is still dealing with the last product launch. New regulations pertaining to an innovative product could be obsolete before they are finalized.⁴³

The “how question” is about the form and substance of the regulation.⁴⁴

or service before it becomes widespread, potentially harming consumers or markets in the interim.”).

41. Lynn E. Blais & Wendy E. Wagner, *Emerging Science, Adaptive Regulation, and the Problem of Rulemaking Ruts*, 86 TEX. L. REV. 1701, 1706 (2008).

42. Cass R. Sunstein, *Is the Clean Air Act Unconstitutional?*, 98 MICH. L. REV. 303, 371 (1999) (“With respect to systematic effects: A great deal of attention has been paid to the phenomenon of the ‘ossification’ of notice-and-comment rulemaking, and indeed a high priority, for the future of administrative law, is to devise means to overcome the problem. Originally intended as a quick and effective alternative to formal, on-the-record rulemaking, executive and especially judicial innovations have converted notice-and-comment rulemaking into an exceptionally time-consuming affair, often consuming many years, frequently half a decade and more. In fact EPA estimates that informal rulemaking typically takes five years.”); Thomas O. McGarity, *Some Thoughts on “Deossifying” the Rulemaking Process*, 41 DUKE L.J. 1385, 1385 (1992) (“Although informal rulemaking is still an exceedingly effective tool for eliciting public participation in administrative policymaking, it has not evolved into the flexible and efficient process that its early supporters originally envisioned. During the last fifteen years the rulemaking process has become increasingly rigid and burdensome.”).

43. Barefoot, *supra* note 22, at 10.

44. See Julia Black, *Forms and Paradoxes of Principles Based Regulation*, LSE L., SOC’Y & ECON. WORKING PAPERS 1, 14 (2008) (“A rule, any rule — legal or non-legal, issued by a regulator or formed within a firm — has a number of different dimensions. These are first its substance: what it concerns. Second, its status: whether it is legally binding or not, and the sanction, if any, which attaches to its breach. Third, its character, whether it prohibits, permits, discourages or mandates certain behaviour. Fourth, its linguistic structure: whether the language which the rule uses is vague or precise, whether the rule is simple or complex in its requirements, whether its language is clear and easily understood, or opaque.”).

Should the technological innovation be encouraged, prohibited or restricted in some way? And what substantive rules or principles should be adopted to achieve this regulatory goal? The existing regulatory infrastructure cannot sufficiently distinguish and harness beneficial innovation. In fact, the existing rulemaking process often prohibits *ex parte* communications,⁴⁵ involves very little brainstorming, and undermines innovation.⁴⁶ Because technological transition is going to be a permanent state in the age of disruptive innovation, rulemakers' inability to address regulatory issues associated with disruptive innovation will likely generate high levels of legal uncertainty and inconsistency⁴⁷ that inhibit innovation during technological transition periods. The current regulatory framework lacks a mechanism that succinctly and anticipatorily informs rulemakers of beneficial innovative ideas.

In each case, these policy judgments are made by politicians and bureaucrats based — in large part — on facts provided by experts. The delegation of regulatory decisions to a combination of democratically chosen politicians and bureaucrat–experts is one way of conceptualizing the distinctiveness of political modernity.

In this context, however, we are more interested in the identification of the relevant facts. Some of the relevant facts may be obvious. The fact that drones may interfere with low flying planes or inadvertently land on innocent bystanders, for example, makes establishing reliable information on the likelihood of such occurrences vital. However, there are various potential problems with this fact–identification exercise. Some facts may be difficult to empirically establish or contested, even amongst experts in

45. 5 U.S.C. § 557(d)(1) (2012); *Ex Parte Communications in Informal Rule-making Proceedings* (Recommendation 77–3), 42 Fed. Reg. 54,251, 54,253 (Oct. 5, 1977) (listing other advantages associated with restraining *ex parte* communications, including reducing possibility of unfair influence over decision makers and affording interested parties opportunity to respond to information relied upon in the decision-making process).

46. See Peter H. Schuck, *When the Exception Becomes the Rule: Regulatory Equity and the Formulation of Energy Policy Through an Exceptions Process*, 1984 DUKE L.J. 163, 197 (1984) (“Hastily prepared, overbroad rules can be disastrous for those who technically are covered by the rules but to whom the rules should not, in justice or sound policy, be applied. Inflexible application of such rules may quickly create grave competitive distortions, perhaps even driving firms out of business before the rules can be refined or eliminated.”); see also Blais & Wagner, *supra* note 41, at 1705 (“Agencies are increasingly turning to even more informal methods — which lack adequate opportunities for public participation and evade meaningful judicial oversight — to promulgate important policies. And, not surprisingly, agencies are increasingly reluctant to revisit rules after enactment, even if the factual or policy predicates underlying them have changed.”).

47. Barefoot, *supra* note 22, at 9.

that field. The task of establishing facts about new technology may be made difficult by the lack of an adequate sample or other reliable data on the effects of new technology.⁴⁸

Identification of relevant or irrelevant facts may also be distorted or otherwise influenced by the concerns of entrenched interests about new (and commercially threatening) technologies.

Finally, other facts may be — to quote Donald Rumsfeld — “unknown unknowns.”⁴⁹ We simply lack the experience or imagination to predict what negative possibilities may be associated with a piece of new technology.⁵⁰

In this respect, the “relevant facts” that form the basis of regulation are never going to be obvious or settled. The regulation of any disruptive new technology is always going to be reactive and based on an uncertain and politicized factual basis.

We need to be careful not to overstate the newness of this issue. To some degree, these kind of difficulties have always been around, at least since the rise of industrial capitalism and the acceleration in technological advancement that it facilitated.⁵¹

48. Gregory N. Mandel, *Emerging Technology Governance*, in INNOVATIVE GOVERNANCE MODELS FOR EMERGING TECHNOLOGIES 44, 62 (Gary E. Marchant et. al. eds., 2013) (“Given the uncertainty surrounding an emerging technology’s development and risks, there will be inherent limitations concerning how specific a framework can be developed at early stages.”).

49. Press Conference, Donald Rumsfeld, U.S. Sec’y of Def., NATO HQ, Brussels (June 6, 2002), <http://www.nato.int/docu/speech/2002/s020606g.htm> (“The message is that there are no “knowns.” There are thing we know that we know. There are known unknowns. That is to say there are things that we now know we don’t know. But there are also unknown unknowns. There are things we don’t know we don’t know. So when we do the best we can and we pull all this information together, and we then say well that’s basically what we see as the situation, that is really only the known knowns and the known unknowns. And each year, we discover a few more of those unknown unknowns.”).

50. See Wulf A. Kaal, *Dynamic Regulation of the Financial Services Industry*, 48 WAKE FOREST L. REV. 791, 799 (2014) [hereinafter Kaal, *Financial Services Industry*] (“Anticipation of unknown future contingencies and the preemption of possible future crises do not play a significant role in the current regulatory framework or in the literature on financial regulation.”).

51. Schumpeter described as early as the 1940s the “gaels of creative destruction,” often unleashed by technology, that periodically sweep through industries and sink weak and outdated firms. JOSEPH A. SCHUMPETER, CAPITALISM, SOCIALISM, AND DEMOCRACY 83–84 (3d ed. 1962) (“The opening up of new markets, foreign or domestic, and the organizational development from the craft shop and factory to such concerns as U.S. Steel illustrate the process of industrial mutation that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one. This process of Creative Destruction is the essential fact about capitalism. It is what capitalism consists in and what every capitalist concern has got to live in . . . Every piece of business strategy acquires its true

An obvious solution to this regulatory dilemma might be to adopt some form of policy experimentation, i.e., testing different regulatory schemes and then comparing the results.⁵² But such experimentation poses a problem for regulators.⁵³ Too often, regulators define “success” in negative terms, as in the avoidance of catastrophe.⁵⁴ Avoiding grounds for criticism inevitably results in an overly cautious approach, called the “precautionary principle.”⁵⁵

From the perspective of entrepreneurs and consumers, such caution can be a “disaster” or at least less preferable.⁵⁶ The result is that, all too often, there is a disconnect between regulation and commercial and consumer access to that innovation.⁵⁷

significance only against the background of that process and within the situation created by it. It must be seen in its role in the perennial gale of creative destruction; it cannot be understood irrespective of it or, in fact, on the hypothesis that there is a perennial lull.”); *see also* John Komlos, *Has Creative Destruction Become More Destructive?* (Nat’l Bureau Econ. Research, Working Paper No. 20379, 2014), (suggesting that the creative destruction aspect of capitalism is being amplified, especially in labor markets, by the exponential pace of technology).

52. Wulf Kaal, *What Happens When Technology Is Faster Than the Law?*, CLS BLUE SKY BLOG (Sept. 22, 2016), <http://clsbluesky.law.columbia.edu/2016/09/22/what-happens-when-technology-is-faster-than-the-law/>.

53. *Id.*

54. *See* Noah M. Sachs, *Rescuing the Strong Precautionary Principle from Its Critics*, 2011 U. ILL. L. REV. 1285, 1298 (2011) (“One defining feature of the Strong Precautionary Principle is that it places a governmental entity in a role as a risk gatekeeper. Implicit in the Principle is the idea that there must be a ‘decider’ who will determine whether the proponent of the activity has met its burden of proof on safety. The preventive thrust of Strong Precaution further implies that this review of risks should occur *before* the activity commences or the potentially risky product reaches the market.”).

55. The “precautionary principle” is a term used prominently by the UN on declaring regulatory policy on environmental issues. *See, e.g.*, United Nations Conference on Environment and Development, Rio de Janeiro, Braz., June 3–14, 1992, The Rio Declaration on Environment and Development, U.N. Doc. A/CONF.151/5/Rev.1 (June 13, 1992), reprinted in 31 I.L.M. 874, 879 (1992) (showing the UN’s prominent use of the precautionary principle when declaring regulatory policy on environmental issues); *see also* Robert W. Kahn & Cass R. Sunstein, *The Precautionary Principle as a Basis for Decision Making*, 2 ECONOMISTS’ VOICE, 1, 1 (2005) (“We argue that the precautionary principle does not help individuals or nations make difficult choices in a non-arbitrary way. Taken seriously, it can be paralyzing, providing no direction at all.”); John D. Graham, *The Perils of the Precautionary Principle: Lessons from the American and European Experience*, HERITAGE FOUND.: HERITAGE LECTURES (Jan. 15, 2004), <http://www.heritage.org/research/lecture/the-perils-of-the-precautionary-principle-lessons-from-the-american-and-european-experience>.

56. Kaal, *supra* note 52.

57. *Id.*

A. Facts Today

In spite of these problems, a fact-based approach to regulation may have worked relatively well in the past when innovation cycles were longer and the pace of disruptive innovation occurred over decades.⁵⁸ Regulators had the necessary time to get their facts in order before making a regulatory intervention.⁵⁹

In this respect, it is again instructive to consider the origins of the modern automobile industry. Karl Benz was awarded a patent for the internal combustion engine in 1879, and started producing automobiles in the mid-1880s.⁶⁰ However, Benz's engine did not disrupt the horse and carriage industry or bring the automobile into the mainstream of everyday life. This only occurred much later, in 1908, when Henry Ford started to mass produce the Model T.⁶¹

The slower pace of technological disruption explains why, until relatively recently, the public was happy to delegate regulatory decisions about new technology to policy makers relying on the scientific advice of

58. Vermeulen, *supra* note 2; Rick Rieder, *Tech Adoption Rates Have Reached Dizzying Heights*, MKT. REALIST (Dec. 24, 2015, 9:32 AM), <http://marketrealist.com/2015/12/adoption-rates-dizzying-heights/>; Rita Gunther McGrath, *The Pace of Technology Adoption Is Speeding Up*, HARV. BUS. REV. (Nov. 25, 2013), <https://hbr.org/2013/11/the-pace-of-technology-adoption-is-speeding-up>.

59. See ALLENBY, *supra* note 26, at 10 (“But it is not just that each NBRIC technology system is powerful; it is that they are combining in unexpected ways that are both beyond any single technological domain, and very potent.”); Steven W. Popper, *Technological Change and the Challenges for 21st Century Governance*, AAAS SCI. AND TECH. POL’Y Y.B. 83, 86 (2003) (“We see a growing divergence between time cycles of government and those of technology development. Quite simply, this presents government operations with a Hobson’s choice: Either live within a shorter response time and run the concomitant risk of ill-considered actions (or inactions) or see government input become less relevant and assume reduced stature. The risk of insufficient access to information is large. This goes beyond the problem of gaining awareness of and collating relevant data series. A related and in many ways more problematic issue is that of managing and accounting for data and other knowledge resources. There is then, of course, the central task of analyzing and providing an interpretation of the data. These issues are already of concern and will increase in time.”).

60. JOHN COAD, FINDING AND USING OIL 48 (2008) (“He received his first patent in 1879, and founded Benz & Company to produce industrial engines in Germany. He began designing a ‘motor carriage.’ Benz designed his three-wheel carriage engine with an electric ignition, differential gears and water cooling. It was first driven in Mannheim in 1885. On January 29, 1886, he was granted a patent for his gasoline-fuelled automobile.”).

61. ALAN AXELROD & CHARLES PHILLIPS, WHAT EVERY AMERICAN SHOULD KNOW ABOUT AMERICAN HISTORY: 225 EVENTS THAT SHAPED THE NATION 210 (3d ed. 2008) (“The company was profitable from the start but become even more so in 1908, when Ford introduced the Model T. Up to this point, all manufacturers, including Ford himself, had seen the automobile as a custom-made luxury item for the wealthy.”).

experts.⁶² Although the public once had a relatively high degree of trust in both the political process and the scientific/expert method, consistent empirical evidence demonstrates that both trust in government and experts has declined in recent years.⁶³

In today's world, the incessant speed of technological change means that this kind of approach faces insurmountable challenges. The pressure of time means that the facts surrounding a piece of new technology or other innovation may not be there, or the regulators may simply select the "wrong" — or at least contested or otherwise irrelevant — facts as the basis of regulation. The lack of time means that establishing facts or negotiating with entrenched interests becomes much more difficult.⁶⁴

62. Rebecca M. Bratspies, *Regulatory Trust*, 51 ARIZ. L. REV. 575, 576–77 (2009) ("Beck explains that unceasing technological innovation significantly contributes to risk and uncertainty in modern industrial society by forcing a constant reassessment of the relationships between scientific knowledge, technology, and public policy. In particular, new technologies underscore a growing divergence between market incentives and social welfare. As a society, we often turn to regulation to bridge that gap. But, in contexts as diverse as the licensing of agricultural biotechnology, the approval of new drugs or oversight of new financial instruments, the same refrain plays over and over — regulators must make high-stakes regulatory choices that implicate poorly understood risks.").

63. See Cary Funk & Lee Rainie, *Public and Scientists' Views on Science and Society*, PEW RES. CTR., (Jan. 29, 2015), <http://www.pewinternet.org/2015/01/29/public-and-scientists-views-on-science-and-society/> ("Despite broadly similar views about the overall place of science in America, citizens and scientists often see science-related issues through different sets of eyes. There are large differences in their views across a host of issues."); *Beyond Distrust: How Americans View Their Government*, PEW RES. CTR., (Nov. 23, 2015), <http://www.people-press.org/2015/11/23/1-trust-in-government-1958-2015/> ("The erosion of public trust in government began in the 1960s. The share saying they could trust the federal government to do the right thing nearly always or most of the time reached an all-time high of 77% in 1964. Within a decade — a period that included the Vietnam War, civil unrest and the Watergate scandal — trust had fallen by more than half, to 36%. By the end of the 1970s, only about a quarter of Americans felt that they could trust the government at least most of the time Amid the war in Iraq and economic uncertainty at home, trust in government continued to decline. By July 2007, trust had fallen to 24%. Since then, the share saying they can trust the federal government has generally fluctuated in a narrow range, between 20% and 25%."); see also Bratspies, *supra* note 62, at 577 ("Trustworthy regulators have the potential to enhance society's overall resilience, but uncertainty erodes the public's trust and alienates citizens from the regulatory institutions intended to serve them. Declining levels of trust in government institutions both document and reflect this grim reality. Loss of trust undermines regulatory effectiveness and diminishes society's overall capacity to persevere and even thrive in the face of multiple, unpredictable risks.").

64. Vermeulen, *supra* note 2; Wulf A. Kaal, *Dynamic Regulation via Investment Data as a Remedy for Law's Diminishing Capacity to React to Innovation*, OXFORD BUS. L. BLOG (Sept. 18, 2016), <https://www.law.ox.ac.uk/business-law-blog/blog/2016/09/dynamic-regulation-investment-data-remedy-law%E2%80%99s-diminishing-capacity>; Kaal, *Innovation*, *supra* note 4.

Moreover, there is a much greater degree of skepticism about the policy makers and scientists. Most people may not be familiar with terms such as “agency capture” or “minoritarian bias,”⁶⁵ but they are acutely aware of the way that political and scientific processes have been distorted by vested interests and lobbying on the part of well-organized interest groups.⁶⁶

Take *Airbnb*, for example. Regulators in some countries have become concerned that individuals looking to get rich from renting out properties via *Airbnb* are buying housing in desirable urban residential areas, thus distorting property prices and — potentially — creating housing shortages in such areas.⁶⁷

65. See Neil K. Komesar, *A Job for the Judges: The Judiciary and the Constitution in a Massive and Complex Society*, 86 MICH. L. REV. 657, 671 (1988) (“Minoritarian bias supposes an inordinate power of the few at the expense of the many. The power of these few stems from better access to the seats of power through personal influence, organization, information, or sophistication. In our society, influence can be gained by identifying important political figures and delivering what those political figures want. The terms of trade may be as crass as graft or as innocent as information.”); Neal D. Fortin, *The Hang-Up with HACCP: The Resistance to Translating Science into Food Safety Law*, 58 FOOD & DRUG L.J. 565, 582 (2003) (“Agency capture has been described as the occasion when a regulated firm wins ‘the hearts and minds of the regulators.’ Capture in this instance, however, is not an all-or-nothing phenomenon, but a matter of degrees. In the subtlest sense, capture exists any time an agency moves too far toward accommodating a single interest while moving away from its statutory mission.”).

66. See John C. Coffee, Jr., *The Political Economy of Dodd-Frank: Why Financial Reform Tends to Be Frustrated and Systemic Risk Perpetuated*, 97 CORNELL L. REV. 1019, 1036 (2012) (“The alternative view, here presented, agrees that crisis is a precipitant, allowing legislative inertia to be overcome. After a crisis, Congress tends to adopt proposals long-favored by the relevant administrative agency but frustrated by powerful lobbies. Only with a crisis can reformers — or ‘political entrepreneurs’ in the political science vernacular — aggregate sufficient support to pass reform legislation. For example, in the years prior to the Enron and WorldCom crisis in 2001 and 2002, SEC Chairman Arthur Levitt sought to respond to a soaring number of financial statement restatements and campaigned to restrict auditor conflicts of interest. Levitt was rebuffed, however, by the industry. With the Enron and WorldCom insolvencies and the evidence of financial impropriety manifest to all, Levitt and others — most notably, Senator Paul Sarbanes — convinced Congress to replace auditor self-regulation with a new body: the Public Company Accounting Oversight Board (PCAOB).”); Roberta Romano, *Regulating in the Dark* 4 (Yale Law Sch. John M. Olin Ctr. for Studies in Law, Econ., and Pub. Pol’y, Research Paper No. 442, 2011), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1974148 (“A typical pattern in a financial crisis is a media clamor for action, reflecting, if not spurring, a similar popular demand, and as a crisis intensifies, an accompanying suggestion that government inaction is prolonging the pain and suffering. A risk averse legislator, whose objective is reelection, will, no doubt, conclude that there is a need to respond without seeking to ascertain, if it were even possible, whether such demands are media-driven, or popularly shared, or, in fact, necessary to resolve the problem.”).

67. See Tim Logan et al., *Airbnb and Other Short-Term Rentals Worsen Housing Shortage, Critics Say*, L.A. TIMES (Mar. 11, 2015, 3:00 AM), <http://www.latimes.com>

The solution? A rule that requires those renting accommodation via *Airbnb* to be actually living in the property when it is being used.⁶⁸

Of course, the selection of the “relevant facts” in this case and the resulting rule benefits certain vested interests, most obviously the hotel industry who stand to lose out from the new competition from *Airbnb*.⁶⁹

But are the selected facts in this case relevant or even correct? A possible effect of a rule requiring residency of rented accommodation is that it may limit *Airbnb* in certain markets, so it is clearly important to get this right.⁷⁰

Are the people intending to offer *Airbnb* accommodation really only in it for the money? In many cases, renting accommodation may be about connecting with people from other cultures or offering a welcoming experience for tourists visiting a new city.⁷¹

The “factual” premise or basis of the regulation — i.e., individuals looking to make easy money from residential properties — may simply be

.com/business/realestate/la-fi-airbnb-housing-market-20150311-story.html (“A study released Wednesday from Los Angeles Alliance for a New Economy, a labor-backed advocacy group, estimates that more than 7,000 houses and apartments have been taken off the rental market in metro Los Angeles for use as short-term rentals.”); see also Biz Carson, *The Fight Between Airbnb and San Francisco Just Got Nastier*, BUS. INSIDER (May 15, 2015, 9:00 PM), <http://www.businessinsider.com/san-francisco-report-blames-airbnb-for-housing-shortage-airbnb-strikes-back-2015-5> (“On Monday, the Board of Supervisors Land Use and Transportation Committee will vote on how to amend the regulation. One proposal from the Mayor’s office puts the cap at 120 days a year for short term rentals. Another option set forward by Supervisor David Campos was to limit short term rentals to a max of 60 days a year and compels Airbnb to release its data to the city.”).

68. See, e.g., Will Coldwell, *Airbnb’s Legal Troubles: What are the Issues?*, GUARDIAN (July 8, 2014), <https://www.theguardian.com/travel/2014/jul/08/airbnb-legal-troubles-what-are-the-issues> (“For example, in New York owners or tenants cannot legally rent their apartments out for short periods (less than 30 days) unless they are also living in the property.”).

69. Vermeulen, *supra* note 2; Ahmed Mahmoud, *The Impact of Airbnb on Hotel and Hospitality Industry*, HOSPITALITYNET (Mar. 7, 2016), <http://www.hospitalitynet.org/news/4074708.html> (noting that HVS Consulting & Valuation “estimated that hotels lose approximately \$450 million in direct revenues per year to Airbnb. Between September 2014 and August 2015, 480,000 hotel room nights were reserved while over 2.8 million room nights were booked on Airbnb. By 2018, HVS estimates that Airbnb room nights will reach 5 million per year”).

70. Vermeulen, *supra* note 2; Gideon Yaffe, Op-Ed, *Activists Say Airbnb Drives Up Rents. But Is That Actually True? L.A. Needs to Find Out*, L.A. TIMES (May 13, 2016, 5:00 AM), <http://www.latimes.com/opinion/op-ed/la-oe-0513-yaffe-airbnb-ordnance-la-20160513-story.html>.

71. Vermeulen, *supra* note 2; Airi Lampinen & Coye Cheshire, *Hosting via Airbnb: Motivations and Financial Assurances in Monetized Network Hospitality*, in PROCEEDINGS OF THE 2016 CHI CONFERENCE ON HUMAN FACTORS IN COMPUTING SYSTEMS 1669 (2016).

incorrect. The selected facts may not even be facts, or at least, the most relevant facts about a particular innovation.⁷²

As a second example, consider *Uber* or similar “taxi-like” car sharing services. There is no doubt that services like *Uber* are disrupting the taxi industry.⁷³ The effect is that regulatory debates around *Uber* are currently dominated by an unfair competition argument:

*“Trustworthy and reliable taxi companies are facing unfair competition from Uber and this kind of unlicensed activity poses enormous risks for consumers.”*⁷⁴

*“US startup companies, in particular, don’t respect the legal order that protects the European labor market.”*⁷⁵

72. Vermeulen, *supra* note 2; *Proposed MA House Bill #2816 and Your Airbnb*, MYURB.BNB (June 18, 2015), <http://myurbanbnb.com/proposed-ma-house-bill-2816-and-your-airbnb/> (noting that “many use this income to help pay off mortgages, college tuition, fix up their property or to supplement their earnings due to retirement, unemployment or an unexpected occurrence”).

73. See Megan Garber, *After Uber, San Francisco Has Seen a 65% Decline in Cab Use*, ATLANTIC (Sept. 17, 2014), <http://www.theatlantic.com/technology/archive/2014/09/what-uber-is-doing-to-cabs-in-san-francisco-in-1-crazy-chart/380378/> (“The news was . . . not good, for San Francisco’s taxi industry, anyway. The precipitous rise of services like Uber (and its fellow shared-ride services, like Lyft and Sidecar) has meant — markets being what they are — a precipitous decline in taxi rides taken across the city. The SFMTA’s interim director Kate Toran reported to her board that the average trips per taxicab in the city had declined from 1,424 a month in March 2012 to only 504 as of July 2014.”); see also Brishen Rogers, *The Social Costs of Uber*, 82 U. CHI L. REV. DIALOGUE 85, 86 (2015) (“Uber is sparking two major transformations of the car-hire sector. First, it is eliminating various transaction costs that have plagued the sector, particularly search costs, thereby creating something akin to a free market for car-hire services. Second, it is encouraging vertical and horizontal integration of the sector, which is highly fragmented in many cities.”).

74. Vermeulen, *supra* note 2; see, e.g., Dean Baker, *Don’t Buy the ‘Sharing Economy’ Hype: Airbnb and Uber are Facilitating Rip-Offs*, GUARDIAN, <https://www.theguardian.com/commentisfree/2014/may/27/airbnb-uber-taxes-regulation> (last modified July 14, 2017) (“Insofar as Airbnb is allowing people to evade taxes and regulations, the company is not a net plus to the economy and society — it is simply facilitating a bunch of rip-offs. Others in the economy will lose by bearing an additional tax burden or being forced to live next to an apartment unit with a never-ending parade of noisy visitors, just to cite two examples. The same story may apply with Uber. Uber is currently in disputes with regulators over whether its cars meet the safety and insurance requirements imposed on standard taxis. Also, many cities impose some restrictions on the number of cabs in the hopes of ensuring a minimum level of earnings for drivers, but if Uber and related services (like Lyft) flood the market, they could harm all drivers’ ability to earn even minimum wage.”).

75. *Id.*; see also Evan Rudowski, *Uber, Uber Alles? Not in Europe*, TECHCRUNCH (Feb. 17, 2016), <https://techcrunch.com/2016/02/17/uber-uber-alles-not-in-europe/> (“Germans love speed, but they don’t love recklessness: the reason one can drive fast on the autobahn is because one can be confident that other drivers will follow the rules of the road. American companies, by contrast, are accustomed to a culture built on rejecting rules and deregulation has been gospel to the American political and

These “facts” are then used to justify regulatory intervention that effectively attempts to kill *Uber* in certain markets.

But, as with the *Airbnb* case, are these facts really facts? Or, at least, are they the most relevant facts? Do taxis really offer a better service than *Uber*? Is *Uber* any less safe than a licensed taxi? And is a lack of respect for labor laws a pertinent factor motivating companies like *Airbnb*?

The two-way rating system (drivers rate customers and customers rate drivers) and an algorithm-based system for matching up drivers and customers appear to offer an effective means of policing *Uber* drivers and ensuring a safe ride for customers.⁷⁶ And is most people’s experience of licensed taxis really so great, at least when compared with *Uber*?

Most consumers just want a quick, clean and respectful service, but — all too often — incumbent taxi companies offer a disrespectful or unreliable driver and a dirty cab. There is a disconnect between the facts that regulators identify as important and the experience and wishes of most consumers.

None of this is to necessarily blame the regulators. Agency capture, in which entrenched interests distort regulatory decisions, has always posed some risk,⁷⁷ but the acceleration in innovation cycles means that even in the best conditions and with the best of intentions, selecting relevant facts is a difficult task. And the option of simply waiting seems likely to result in further complications and criticism.

In an age of constant, complex and disruptive technological innovation,

economic mainstream since the 80s In European markets, succeeding within the rules is a badge of honor. Breaking the rules, even in pursuit of a seemingly worthy goal such as improving market efficiency or consumer choice, can be seen as offensive and not something to necessarily be applauded.”); *Should Uber Be Allowed to Compete in Europe and if so How?*, COMPETITION POL’Y INT’L (Jun. 18, 2015), <https://www.competitionpolicyinternational.com/should-uber-be-allowed-to-compete-in-europe-and-if-so-how/> (“Uber’s arrival in Europe has generated massive demonstrations by taxi drivers and a number of court judgments banning or restricting Uber’s services on the ground that the company engaged in ‘unfair competition.’ Uber and other online-enabled car transportation services to connect passengers with drivers offer an attractive alternative to regular taxi services. The difficulty is that these services are protected by regulatory measures that create significant barriers to entry.”).

76. See *How Uber Ratings Work | 5-Star Tips*, UBER, <http://ubermovement.com/ratings-are-a-two-way-street/> (last visited Sept. 8, 2016) (“Providing two-way ratings and feedback allow us to celebrate the riders and drivers who make Uber great. This system also lets us know if the quality of service provided is consistently below Uber’s standards.”).

77. See Thomas O. McGarity, *MTBE: A Precautionary Tale*, 28 HARV. ENVTL. L. REV. 281, 325-26 (2004) (explaining that conflicts of interests arise within regulatory agencies when the agency only receives feedback on the effectiveness of regulations from regulatees and lead to the agency’s regulations reflecting the economic needs of the regulatee rather than the public interest).

knowing *what*, *when*, and *how* to structure regulatory interventions has become much more difficult.⁷⁸ Regulators can find themselves in a situation where they believe they must opt for either reckless action (regulation without sufficient facts) or paralysis (doing nothing). Inevitably in such a case, caution tends to trump risk. The precautionary principle becomes the default position.⁷⁹ But such caution merely functions to reinforce the status quo and the result is that new technologies struggle to reach the market in a timely or efficient manner.

B. A “Post-Fact Society”?

Should we conclude from the above analysis of the contemporary regulatory dilemma that we live in a “post-fact society?” A “post-fact society” means that facts no longer matter or that they can be reduced to the mere expression of political interests.⁸⁰

78. See Kaal, *Innovation*, *supra* note 4, at 5–6 (identifying the “pacing problem” faced by regulatory agencies; technological developments are occurring at an accelerating rate, while state and federal agencies are responding to these developments and a decelerating rate); Gary E. Marchant, *The Growing Gap Between Emerging Technologies and the Law*, in *THE GROWING GAP BETWEEN EMERGING TECHNOLOGIES AND LEGAL–ETHICAL OVERSIGHT: THE PACING PROBLEM*, 21–23 (Gary E. Marchant et al. eds., 2011) (identifying two causes of the pacing problem; first, legal frameworks are based on a static rather than dynamic view of technology and, second, regulatory institutions are slowing down with respect to their capacity to adjust to changing technologies); Moses, *supra* note 40, at 764 (explaining that the pacing problem is particularly evident in nanotechnology, biotechnology, robotics, information and communications technologies, and applied cognitive science); Lyria Bennett Moses, *How to Think About Law, Regulation and Technology: Problems with ‘Technology’ as a Regulatory Target*, 5 *L. INNOVATION & TECH.* 1, 7 (2013) (presenting different methods for approaching the pacing problem).

79. See Cass R. Sunstein, *Throwing Precaution to the Wind: Why the ‘Safe’ Choice Can Be Dangerous*, *BOS. GLOBE* (July 13, 2008), http://archive.boston.com/bostonglobe/ideas/articles/2008/07/13/throwing_precaution_to_the_wind/ (“[t]he precautionary principle, for all its rhetorical appeal, is deeply incoherent. It is of course true that we should take precautions against some speculative dangers. But there are always risks on both sides of a decision; inaction can bring danger, but so can action. Precautions, in other words, themselves create risks—and hence the principle bans what it simultaneously requires.”); Jonathan Adler, *The Problems with Precaution: A Principle without Principle*, *AEI* (May 25, 2011), <http://www.aei.org/publication/the-problems-with-precaution-a-principle-without-principle/> (analyzing the tendency of regulators to identify the risks of new technology without regard for the risks of existing technology).

80. See e.g., Michiko Kakutani, *Texts Without Context*, *N.Y. TIMES* (Mar. 17, 2010), http://www.nytimes.com/2010/03/21/books/21mash.html?_r=0 (“As Mr. Manjoo observes in ‘True Enough: Learning to Live in a Post-Fact Society’ (2008), the way in which ‘information now moves through society — on currents of loosely linked online groups and niche media outlets, pushed along by experts and journalists of dubious character and bolstered by documents that are no longer considered proof of reality’ — has fostered deception and propaganda and also created what he calls a

Much of the current discussion on this issue seems to go in this kind of direction.⁸¹ The stalemate resulting from competing claims to scientific authority has damaged — possibly even destroyed — trust in the capacity of science to provide definitive or indisputable knowledge that can form the basis of regulation.⁸² And a similar skepticism surrounds politicians and their ability to exercise independent judgment, fueling the rise of a populist style of “anti-politics” in many countries.⁸³

According to this type of skeptical account, we are left with a plurality of competing narratives and no criteria with which to make reliable judgments about which facts are “true.”⁸⁴ We inhabit a world of theatrics and instant messaging, where truth and facts are reduced to a game — albeit a very serious one — of image management and a rhetoric of persuasion.⁸⁵

The problem with this view is that it reinforces the type of regulatory

‘Rashomon world’ where ‘the very idea of objective reality is under attack.’ Politicians and voters on the right and left not only hold different opinions from one another, but often can’t even agree over a shared set of facts, as clashes over climate change, health care and the Iraq war attest.”)

81. See William Davies, *The Age of Post-Truth Politics*, N.Y. TIMES (Aug. 24, 2016), <http://www.nytimes.com/2016/08/24/opinion/campaign-stops/the-age-of-post-truth-politics.html> (questioning whether facts can still be called “‘facts’ when they no longer provide us with a reality that we all agree on?”).

82. *Id.* (“The problem is the oversupply of facts in the 21st century: There are too many sources, too many methods, with varying levels of credibility, depending on who funded a given study and how the eye-catching number was selected Like statistics or other traditional facts, this data is quantitative in nature. What’s new is both its unprecedented volume (the “big” in big data) and also the fact that it is being constantly collected by default, rather than by deliberate expert design. Numbers are being generated much faster than we have any specific use for. But they can nevertheless be mined to get a sense of how people are behaving and what they are thinking.”)

83. See e.g., Gerald F. Seib, *Behind the Rise of Populism, Economic Angst*, WALL ST. J., (Jan. 20, 2016), <http://www.wsj.com/articles/behind-the-rise-of-populism-economic-angst-1453199402> (reporting on the increasing public mistrust of formerly authoritative figures to represent reality accurately); *Trust in Government*, GALLUP, <http://www.gallup.com/poll/5392/trust-government.aspx> (last visited Sept 8, 2016) (A record 81% of Americans reported in 2015 to have only have some or no trust in the government in Washington to do what is right); Coffee, *supra* note 66, at 1078–79 (detailing the tendency for those mistrustful of government to blame economic downturns on overregulation despite mountainous evidence to the contrary).

84. See, e.g., Katherine Viner, *How Technology Disrupted the Truth*, GUARDIAN (July 12, 2016), <https://www.theguardian.com/media/2016/jul/12/how-technology-disrupted-the-truth>; Davies, *supra* note 81.

85. See Davies, *supra* note 81 (“As politics becomes more adversarial and dominated by television performances, the status of facts in public debate rises too high. We place expectations on statistics and expert testimony that strains them to breaking point. Rather than sit coolly outside the fray of political argument, facts are now one of the main rhetorical weapons within it.”).

paralysis highlighted above. If we live in a post-truth world then we don't have any objective basis on which to act, leading to inertia or the reproduction of the status quo.

And yet, rather than abandoning facts, we should be thinking about some alternative grounds for regulation that would allow the regulation of innovative products and services to be more effective and legitimate.

After all, many consumers want instant drone delivery and many entrepreneurs are willing to provide such a service.⁸⁶ Moreover, those markets that are “first movers” stand to gain the financial and other benefits that offering such a service promises. In a global society in which regulatory competition is the “new normal,”⁸⁷ regulators can pay a heavy economic price for being overly cautious or abandoning the project of trying to establish a meaningful basis for regulation.⁸⁸

IV. THREE PRINCIPLES FOR REGULATION TOMORROW

Lawmaking and regulatory design needs to become more proactive, dynamic and responsive.⁸⁹ So how can regulators actually achieve these goals? What can they do to promote innovation and offer better

86. See Teresa Hayes, *The Rising Demand for Drones in the Retail Sector*, MKT.RES.COM (June 29, 2016), <http://blog.marketresearch.com/the-demand-for-drones-in-the-retail-sector> (“Interest in drones from the retail sector is growing rapidly as competitive pressures push retailers and distributors to develop new ways to make their supply chains more efficient, to automate warehouses, and to reduce delivery costs. Walmart, the nation’s largest retailer, recently announced plans to use drones for inventory management in its warehouses. Amazon, the nation’s largest internet retailer, is researching the use of drones to deliver packages to consumers. Global e-commerce giant Alibaba is testing delivery drones in China while DHL is already using drones to deliver packages in Germany.”).

87. See Ehud Kamar, *Beyond Competition for Incorporations*, 94 GEO. L.J. 1725, 1725 (2006) (“This [a]rticle documents and analyzes a powerful form of regulatory competition—competition for investments—that has been transforming national corporate laws in the European Union in recent years. Unlike the competition for incorporations, competition for investments shapes corporate law when firms cannot easily incorporate outside the jurisdiction in which they operate High political payoffs await successful participants in the competition for investments, which enables enable them to overcome opposition that can stifle competition for incorporations.”).

88. See *id.*

89. See Kaal, *Innovation*, *supra* note 4, at 14–20; Kaal, *Financial Services Industry*, *supra* note 50, at 818–20 (noting financial rulemaking with dynamic elements); Wulf A. Kaal, *Evolution of Law: Dynamic Regulation in a New Institutional Economics Framework* 1, 1–4 (Univ. of St. Thomas (Minn.) Legal Studies Research Paper No. 13-17, 2013), <http://ssrn.com/abstract=2267560> [hereinafter Kaal, *Evolution of Law*]; Wulf A. Kaal & Erik P.M. Vermeulen, *How to Regulate Disruptive Innovation — From Facts to Data* 2, 17 (Univ. of St. Thomas (Minn.) Legal Studies Research Paper No. 16–13, 2016), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2808044 [hereinafter Kaal & Vermeulen, *Disruptive Innovation*].

opportunities to people wanting to build a new business around disruptive technology or simply enjoy the benefits of a disruptive new technology as a consumer?

Here are three principles that we believe can form the basis of regulation tomorrow:

A. Data Driven Regulatory Intervention

Relying on different sources of data surrounding new technologies can provide some signals or clues about *what*, *when* and, to a certain extent, *how* to regulate.

Of particular importance in this context, is data relating to investment in new technology and innovation.⁹⁰ Such data can be used as an index or proxy of the necessity of regulation.⁹¹

Collecting and collating such data may appear to be a tedious task for policy makers, regulators, lawmakers and alike. However, since government funding is often considered to be the main driver behind disruptive innovations, a plethora of investment data is readily available to make accurate predictions regarding what the next “big thing” is likely to be.⁹²

Moreover, the fact start-up companies usually challenge existing rules, laws, and regulations means that private data sources are widely available.⁹³ The proliferation of the better hand-collected global databases on the market, such as *CB Insights*, *PitchBook* and *Mattermark*,⁹⁴ can make an important contribution to a “data-driven” regulatory approach.⁹⁵

Figure 1 gives an indication of what such a data-set might look like. The Figure shows the global venture capital investment deals per industry

90. See Kaal & Vermeulen, *Disruptive Innovation*, *supra* note 89, at 7–8 (“We apply a data-driven approach that enables dynamic regulation as established by Kaal to regulatory issues associated with disruptive innovation.”).

91. *Id.*

92. Vermeulen, *supra* note 2.

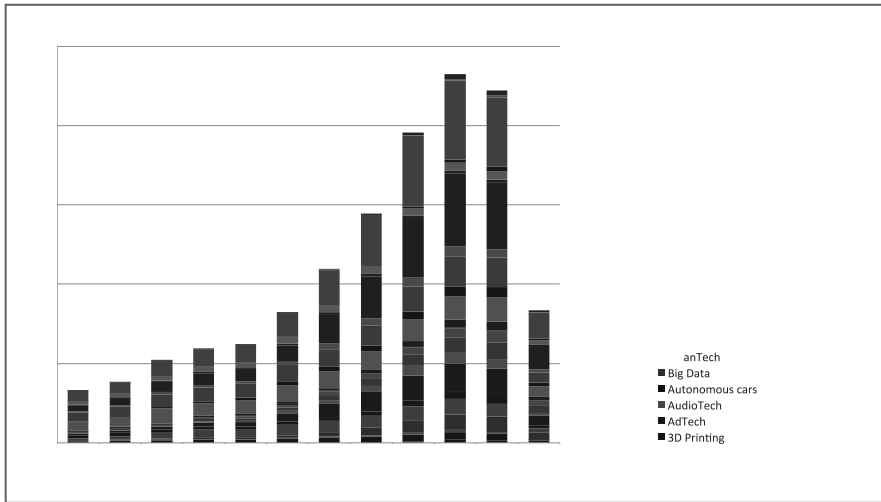
93. Brian Park & Erik P.M. Vermeulen, *Debunking Myths in Corporate Venture Capital: What Works, What Does Not, and How to Make It Happen*, 12 J. U.S.–CHINA PUB. ADMIN. 764, 773 (2015) (“The proliferation of global databases on the market such as Dow Jones VentureSource, CB Insights, PitchBook, and PWC MoneyTree contribute to improving the selection process for investors a great deal.”).

94. *Id.*

95. Vermeulen, *supra* note 2. The massive amounts of data provided by these sources, including company overviews, data on investors and investments, and on deals, people, financials, funds, mergers and acquisitions, and various other growth signals, such as web traffic and media mentions, provide emerging trends and early predictive intelligence which can provide insights into the potential timing and nature of regulatory actions.

tracked by data-provider *PitchBook* from 2005 to the first half of 2016. We could go much more granular than this, but even a broad perspective clearly indicates that certain areas, such as Fintech and the Internet-of-Things, are attracting more and more attention from investors.

In this way, investment data can help to develop a list of technologies and issues that need to be the focus of regulatory attention. From such data, we can get a better — and earlier — sense of which technologies are developing and which technologies need regulatory attention. This might then allow regulators to be more pro-active and avoid wasting resources on technologies that are unlikely to make it to market. It would also allow regulators to more accurately define the scope of a technology by focusing on the type of firm that is attracting attention.

Figure 1: Investment Data Used for Identifying Technology Trends

As to the question of *when* to make a regulatory intervention, investment data can be similarly helpful. When early stage investments peak and later stage investments are taking off, it arguably shows demand both on the commercial and consumer side. Data on the timing of investment appears to provide a reliable indicator of the commercial maturity of a technology, in the sense that high levels of investor activity indicate that a particular technology is about to be ready for commercial exploitation.⁹⁶ Figures 2 and 3 give examples in the field of “artificial intelligence” and “robotics and drones.”

As to the question of “*how* to regulate”, the starting point is that regulation needs to be “demand driven,” i.e., the substantial direction of the regulation needs to be based on the interests of consumers. If there is a genuine demand for certain products or technologies, then such technologies should, in principle, be permitted.⁹⁷

The focus on the demands of the consumers does not mean that policy makers, lawmakers and regulators should ignore the negative side effects or other risks of new technologies. What it does mean, however, is that entrenched interests with a clear interest in obstructing a disruptive product or service should not be allowed to dominate the debate.⁹⁸

Figure 2: Artificial Intelligence – Venture Capital Investments

96. *Id.*

97. *Id.*

98. *Id.*

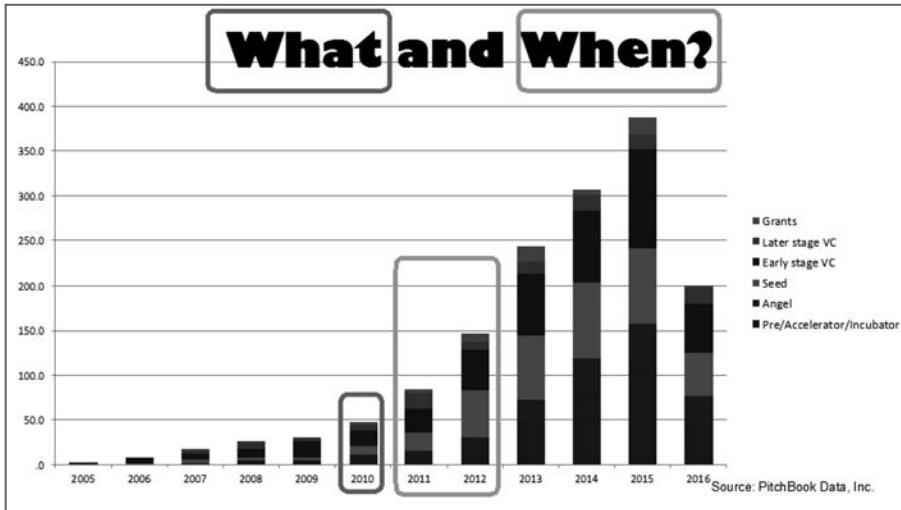
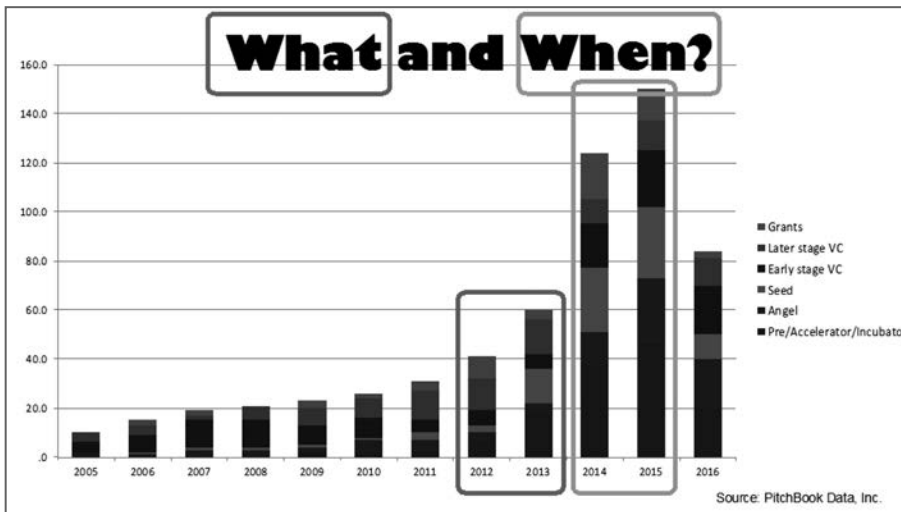
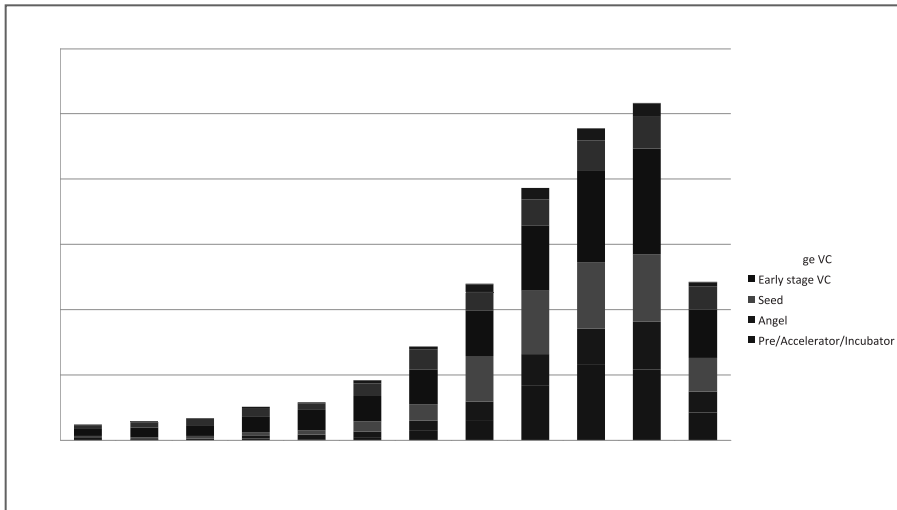


Figure 3: Robotics and Drones – Venture Capital Investments



Big Data is an example of this (see Figure 4). Clearly, the principle of respecting privacy is important, but is not without exception and can, for example, be overridden if there are clear diagnostic benefits in allowing people’s private health information to be used. In this context, regulatory experimentation strategies may offer a potential solution.⁹⁹

99. *Id.*; see also Michael Greenstone, *Toward a Culture of Persistent Regulatory Experimental and Evaluation*, in *NEW PERSPECTIVES ON REGULATION* 111 (David Moss & Asternino eds., 2009) (noting “we cannot know a regulation’s benefits and costs

Figure 4: Big Data – Venture Capital Investments

B. A Principle-Based Approach

Regulators need to take the idea of regulatory competition seriously. Most obviously, this entails a greater willingness to engage in policy and regulatory experiments in which different regulatory regimes are adopted and results compared.¹⁰⁰ To some extent, regulatory competition will occur “naturally,” as different jurisdictions adopt different regulatory models.¹⁰¹ But such experimentation is also important *within* a particular jurisdiction as it provides regulators with data on the real-world effects of a particular regulatory scheme in a comparable setting.

Embracing regulatory experimentation involves a re-thinking — or re-framing — of what decision-making involves in a regulatory context. French sociologist, Michel Callon, emphasizes how regulatory decisions should not be thought of as “final events” (to be made for all-time and from which we “all move on”).¹⁰² Rather, we should think of them as “measured decision-making,” i.e., open-ended and highly contingent

until it has been tested”).

100. See, e.g., Christian Kirchner, Richard W. Painter & Wulf A. Kaal, *Regulatory Competition I EU Corporate Law After Inspire Art: Unbundling Delaware’s Product for Europe*, 2 EUR. COMPANY & FIN. L. REV. 159 (2005).

101. See *id.* at 167–70.

102. See generally MICHEL CALLON ET AL., ACTING IN AN UNCERTAIN WORLD: AN ESSAY ON TECHNICAL DEMOCRACY (Wiebe E. Bijkeyet al. eds., Graham Burchell trans., The MIT Press) (2009).

choices that form one stage in a longer process.¹⁰³ Regulators need to abandon a fixation on finality and legal certainty and embrace contingency, flexibility and an openness to new ideas.¹⁰⁴

This shift in perspective also affects *how* we regulate disruptive technologies. A key element of a more open approach involves a shift from rules to principles. Certainly, a principle-based approach facilitates a greater degree of openness and flexibility on the part of regulators, and prevents innovative technologies (and the companies that have developed them) from becoming bogged down in the regulatory thicket that often results from a rule-focused approach.¹⁰⁵

Re-framing regulation in this way and adopting a principle-based approach facilitates action and allows future revisions in the regulatory regime to be based on the incorporation of new knowledge or subsequent discoveries.

In this way, the solution to the regulatory dichotomy of recklessness or paralysis is a willingness to move beyond the expectation of finality that surrounds regulatory decision-making. Principle-based “contingency” can facilitate a new flexibility, especially if it is combined with more open communication on the part of regulators.

However, despite the clear benefits, companies often raise concerns

103 Nathan Young, *Book Review*, 35 CANADIAN J. SOC./CAHIERS 327, 328 (2010) (reviewing MICHEL CALLON ET. AL, *supra* note 102) (“Rather than approaching decisions as final events (to be made for all-time and from which we all ‘move on’), *Acting in an Uncertain World* advances the alternative notion of ‘measured action’ or measured decision-making, where ‘you do not decide [an outcome], you take measures’ that are based on inclusive processes that involve both experts and the public, but that ultimately remain open-ended so as to incorporate new knowledge, discoveries, and claims. The need for finality, the authors argue, is usually overstated, more the product of expediency and habit than actual necessity. The antidote to the false dichotomy of recklessness versus paralysis is a willingness to remove the artificial temporal horizon that currently defines decision-making, while at the same time creating new mechanisms for consistent citizen involvement in the ongoing process of determining measured actions.”).

104 See Kaal, *Evolution of Law*, *supra* note 89, at 1212 (“[T]he institutional infrastructure for rulemaking was geared towards the creation of rules for governing a relatively stable society with less upward mobility and relatively stable economic and market environments.”); see also KARL R. POPPER, *THE POVERTY OF HISTORICISM* 46 (3d ed. 1961).

105 Kaal, *Innovation*, *supra* note 4, at 18 (“The law and technology literature heralded principles-based regulation as another promising remedy for the pacing problem. As contrasted with more rigid rules-based regulation, principles-based regulation emphasizes general and abstract guiding principles for desired regulatory outcomes The downsides of principles-based regulation include a costly and time consuming change from rules-based regulations to principles-based regulation, uncertainty, and compliance problems because of uncertainty.”)

about risks related to doing business in a principle-based environment.¹⁰⁶ The argument is that it is usually impossible to comply with principles that could change “after the fact.”¹⁰⁷ That is to say, a principle-based approach may facilitate policy makers, lawmakers, and regulators in promulgating facts-based laws and rules through the backdoor.¹⁰⁸ How then can we deal with this potential shortcoming of a principle-based strategy?

C. *The Minimum Regulatory “Sandbox”*

The Financial Conduct Authority (“FCA”), the financial regulatory body in the United Kingdom, may offer some clues. In April 2016, the FCA broke new ground by announcing the introduction of a “regulatory sandbox,” which allows both startups and established companies to roll out and test new ideas, products, and business models in the area of Fintech (i.e., new technologies aimed at making financial services, ranging from online lending to digital currencies, more efficient).¹⁰⁹ The investment data suggests that the UK regulator is moving in the right direction with this kind of decision (see Figure 5).

The idea behind the sandbox is to provide a safe space for testing innovative products and services without being forced to comply with the applicable set of rules and regulations.¹¹⁰ With the sandbox, the regulator

106. Julia Black et al., *Making a Success of Principles-Based Regulation*, 1 L. & FIN. MKTS. REV. 191, 196 (2007) (“One of the criticisms usually raised against Principles-based regimes is that they do not give the industry the comfort of knowing where it stands because the meaning of the Principles is not sufficiently certain.”).

107. Kaal, *Innovation*, *supra* note 4, at 18 (“Dynamic regulatory mechanisms can avoid the downsides of principles-based regulation. Similarities between dynamic regulatory mechanisms and principles-based regulation include the ability to respond to changing industry practices and the ability to improve relationships between regulators and regulated companies. Dynamic regulation can respond to changing industry practices through feedback effects and enhanced information for regulation. Dynamic regulation improves the relationship between regulators and companies through for-cause regulation based on real-time high quality information for regulation and associated feedback effects.”).

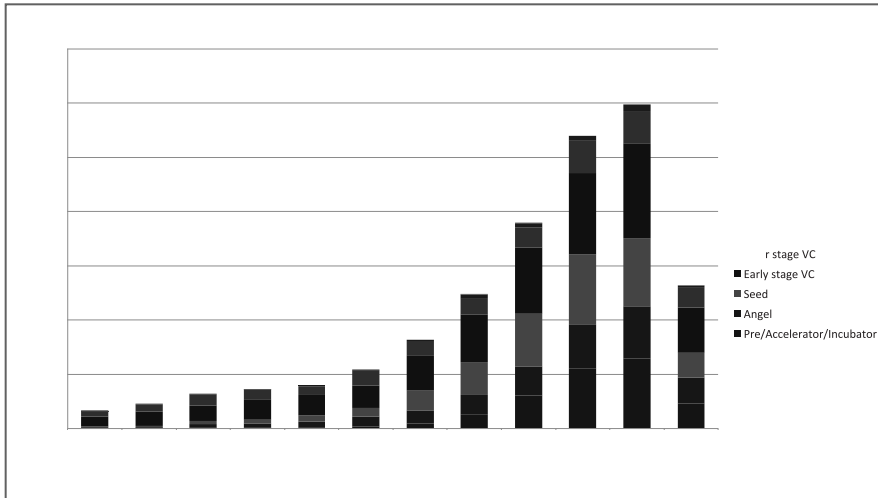
108. *Id.*

109. See generally Christopher Woolard, FCA Dir. of Strategy and Competition, Address at the Innovate Finance Global Summit (Apr. 11, 2016).

110. FCA, *Foreword* to REGULATORY SANDBOX 1, 1 (2015), (“This paper is a report to Her Majesty’s Treasury on the feasibility and practicalities of developing a regulatory sandbox that is a ‘safe space’ in which businesses can test innovative products, services, business models and delivery mechanisms without immediately incurring all the normal regulatory consequences of engaging in the activity in question. We believe there is opportunity to expand Project Innovate and introduce a regulatory sandbox. In this report, we set out our plans for implementing the sandbox and proposals for how we can work with industry and the Government to further support businesses.”).

aims to foster innovation by lowering regulatory barriers and costs for testing disruptive innovative technologies, while ensuring that consumers will not be negatively affected.¹¹¹

Figure 5: FinTech – Venture Capital Investments



What is perhaps most interesting about the sandbox is that new ideas, product, and services can be tested in a “live” environment.¹¹² In order to create this environment, the FCA defined a set of default parameters that can be altered on a case-by-case basis.¹¹³ These parameters include:

Duration — as a default the FCA considers three to six months to be appropriate.

111. See *id.* at 3 (noting that the three key questions that were investigated by the FCA on the sandbox proposal were the following: regulatory barriers [how and to what extent can they be lowered?], safeguards [(what safeguard should be in place to ensure safety)], and legal framework [(what regulatory arrangements are mandated by EU law]).

112. See Chris Tobey, *The Financial Conduct Authority (FCA) Went Live With Project Innovate in October 2014 With the Aim to Encourage Competition in the Finance Industry Through Disruptive Innovation in the Interest of Consumers*, SWORD APAK (June 16, 2016, 15:54 PM), <http://sword-apak.com/blog/posts/2016/june/the-fca-regulatory-sandbox-is-here-to-disrupt-the-finance-industry-in-a-big-way/> (“Unauthorized firms will be given restricted authorization to test their products/strategies in a live environment without the concerns of costs and standard regulatory requirements.”).

113. FCA, *supra* note 110, at 3 (“The FCA sandbox unit will offer a range of options: Firms face different regulatory challenges depending on a range of factors, including regulatory status and type of activity. We have identified a range of available options for helping firms to address some of these challenges while testing in the sandbox (see section 3.5 and following).”).

Customers — the number of customers should be big enough to generate statistically relevant data and information. This means that customers should be selected based on certain criteria that are appropriate for the product and service. Clearly, pre-agreed safeguards and protections should be in place.

Disclosure — customers should be accurately informed about the test and available compensation (if needed). Moreover, indicators, parameters and milestones that are used during the testing phase should be clear set out from the outset.

What makes the regulatory sandbox so attractive is that, insofar as technology has consequences that flow into everyday lives, such technology will be open to discussion and democratic supervision and control. In this way, public entitlement to participate in regulatory debates can help to create a renewed sense of legitimacy that justifies the regulation.

It should come as no surprise that “regulatory sandboxes” are currently being discussed and considered by other regulators, such as the Australian Securities and Investment Commission (*ASIC*), Singapore’s Monetary Authority (*MAS*) and Abu Dhabi’s Financial Services Regulatory Authority (*FSRA*).¹¹⁴

CONCLUSION

Regulators seem to understand that we have moved away from a model in which regulatory decision-making is fact-based and delegated to politicians and experts. In a data-based regulatory environment there is a clear need for measures that are built on flexible and inclusive processes that involve startups and established companies, regulators, experts and the public. This regulatory approach is already adopted in the financial industry. It is only to be expected that this trend will expand to other areas

114. See Patrick Dwyer, *Regulatory Sandboxes: ‘Safe Spaces’ for Start-Ups*, FIN TECH BUS. (June 27, 2016), <http://www.fintechbusiness.com/blogs/399-regulatory-sandboxes-safe-spaces-for-startups> (“These sandboxes will allow start-ups to test their services in a live environment with a reduced level of regulation, much like a clinical trial for a new drug. In the words of the UK’s Financial Conduct Authority (FCA), the regulatory sandbox is a ‘safe space’ for fintech start-ups. A regulatory sandbox scheme was launched by the FCA last year. The Monetary Authority of Singapore (MAS), keen to promote Singapore as a fintech innovation centre, released a proposal paper on its regulatory sandbox on 6 June.”); see also *Innovation Hub*, AUSTL. SEC. & INV. COMMISSION (last updated Nov. 7, 2016), <http://asic.gov.au/for-business/your-business/innovation-hub/> (“Through the hub, eligible businesses can request to receive informal guidance from ASIC on the licensing process and key regulatory issues that should be considered as you set up your business. This information is designed to help you understand your options and, if relevant, prepare your applications for licenses or waivers from the law.”).

of innovation and technology.