

Towards Legal Empirical Macrodynamics: A Research Agenda

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ABSTRACT: Legal scholarship exists since the beginnings of science. Attempts to quantify the economic consequences of legal codifications have been made in the vibrant interdisciplinary field of law and economics. The socio-economic calculus of public policies has been addressed in new public management. Behavioral economics has entered the legal scientific discourse in the emerging field of empirical legal studies backed by ample evidence of the effect of law on socio-dynamics retrieved from manifold field and laboratory experiments. Behavioral insights is the most recent Nobel Prize crowned development to understand human decision making in the legal and public fields to help civil servants and legal executives foster the socio-economic outcomes of their work. All these variant interdisciplinary approaches aim at enlightening at legal codifications' socio-economic outcomes to improve public collectives. In all these cases, empirics derived from quantitative and qualitative research help gain inferences for legal theory building and the strengthening of public policy implementations. This article argues that the time is ripe to dare the next step in legal empirical analyses by drawing from insights retrieved from big data and algorithmic machine learning but also introduce the use of optimal control macrodynamic modelling—a methodology originating in physics that entered macroeconomics and related disciplines to quantify and optimally control economic theory and practice. Given the ongoing big data revolution and exponentially rising data transfer coupled with unprecedented computational power advancements, the means are now available—for the first time—to push for empirical legal studies embracing novel tools—such as hierarchical modelling Bayesian statistics as well as optimum control sophistications—to derive inferences on how to improve legal theory and practices in innovative ways as never before possible. On the brink of artificial intelligence (AI) entering the labor force at a large scale, legal scholarship can now adapt to the novel market opportunities with acknowledging unprecedented computational power and methodological sophistication in deriving insights from big data. Heralding a new age of legal empirical macrodynamics also serves the legal community in light of the predicted heightening demands for creativity as future valuable asset of humanoid legal practitioners and scholars in comparison to repetitive tasks likely soon being outsourced to AI and machine learning.

KEYWORDS: Artificial Intelligence (AI), Behavioral Economics, Behavioral Political Economy, Big Data, Governance, Machine Learning, New Public Management, Legal Scholarship, Optimal Control, Social Credit Score

Introduction

Empirical legal studies is a novel approach to understand law, legal procedure and legal theory through the use of empirical methods. As a heterodox legal stance, empirical legal researchers use empirical techniques that are common in economics, psychology, sociology and other related disciplines to quantify the impact of legal action. In a mixed methods approach, quantitative as well as qualitative social science methods reveal the real-world impact of law on society. Related disciplines include law and economics, legal psychology and the sociology of law, law-and-society as well as new legal realism. Behavioral economics has vividly uncovered the limitations of human decision making. The contemporary behavioral insights trend now has heralded a call for using behavioral knowledge retrieved from ample evidence of field and laboratory experiments to make societies more efficient, productive and healthy.

Empirical research methods have most recently been extended onto optimal control, a method which originated in physics. Optimal control theory is a branch of applied mathematics that aims to find a control law for dynamic systems over a period of time, so that an objective function is

optimized (Bryson 1996). As an extension of calculus of variations and its mathematical optimization, control policies shed light on the optimum states of steady and dynamic variables over time with finite and infinite time horizons (Sargent 2000). Applications for dynamic modelling using optimal control have ranged in all different fields of science and engineering, such as – for instance aeronautics, economics and fiscal and monetary policy—yet to this day there is no entrance of optimal control in legal empirical studies. Optimal control insights of legal frameworks and policy implications, however, could strengthen society by maximizing social welfare over time and within different legal settings around the globe.

Most recently the Big Data Revolution evolved. Big data is a combination of technology and data that integrates, reports and accesses all available data by filtering, reporting and correlating insights achievable with unprecedented speed and computational power. Big data has become the revolution of information technology which is transforming industries around the world. Big data analytics is the often complex process of examining large and varied data sets—or big data—to uncover information including hidden patterns, unknown correlations, market trends and customer preferences that can help policy makers make well-informed decisions. Combining technology and data that integrates, reports and accesses all available data filtering, reporting and correlating insights achievable with previous data technologies, the Big Data Revolution has led to unprecedented opportunities to understand big trends and societal movements over time. Enormous data transfers and data storage capacities at all times heights have shaped Information Technology Revolutions to derive inference over the state of the world around the globe.

Today data processing by algorithms has way surpassed any human capacity and scale. As never before there is data available, accelerating data storage capacity and computing power around the globe at low cost. Most recently, neural networks have also found a broad application across businesses and entered society. The previous years were the widespread adoption smart gadgets and services like Amazon Echo, Apple siri and Google Home, which depend solely on Algorithms of Deep Learning. This growth of advancements in ML algorithms in solving problems is heavily captivating investment managers to implement algorithms. Rapid evolutions of machine learning and algorithmic self-learning capacities of supercomputers have advanced our means to analyze convoluted datasets to an extent as never before in the history of humankind. And the amount of shared and collected data available through networked sensors, cloud and cluster computing as well as 5G entering household appliances and all our daily activities is expected to rise even more so in the years to come. Machine learning advancements allow analyzing vast datasets with unprecedented computational sophistication—such as hierarchical modelling and Bayesian statistics.

Given the ongoing big data revolution and exponentially rising data transfer coupled with unprecedented computational power advancements, the means are now available to push for empirical legal studies embracing novel tools—such as hierarchical modelling Bayesian statistics as well as optimum control sophistications—to derive inferences on how to improve legal theory and practices in innovative ways as never before possible. All these trends combined – the entrance of empirical studies in the legal field, optimal control entering various scientific discourses and Bayesian statics computational power during the Big Data era – demand for the inception of legal empirical macrodynamics, which should use the combined strengths of optimal control techniques applied in the legal field and operationalized in big data inferences.

Research Question

This article argues that the time is ripe to dare the next step in legal empirical analyses by drawing from insights retrieved from big data and algorithmic machine learning but also introduce the use of optimal control macrodynamic modelling – a methodology originating in physics that entered macroeconomics and related disciplines to quantify and optimally control economic theory and practice.

Theory

The optimal moment to address the question of how to improve legal scholarship with the insights derived from big data has arrived. Thanks to years of research by legal empirical scholars, the legal field is open to interdisciplinary extensions. As of today, the ongoing Big Data Revolution coupled with statistical advancements regarding unprecedented data storage and computational power, the time is ripe to develop a most sophisticated and detailed picture of the socio-economic impacts of legal and policy implications on our contemporary society.

This article argues that the time has come to focus attention on the search for strategies that will improve our insights on the socio-economic effect of legal action derived from big data and computational advancements. As legal errors are costly and are growing more costly, decision makers have become receptive to advancing the field by interdisciplinary approaches. Given the behavioral insights trends and the legal academic discourse has been opened by legal empirical studies for multiple related social science field, the time has come to introduce standard macroeconomic modeling techniques coupled with big data analyses. Since decades legal empiricists and behavioral insiders have amassed information on how to reduce biases to optimize control. Coupling these developments now with the ocean of information provided by big data and the precision reached in hierarchical modeling and methodological advancements, the time has come to improve strategies in legal empirical scholarship to optimize legal control.

It is not on us to dare the next step to integrate optimal control theory and the power of Bayesian statistics and hierarchical modeling to drive these advancement to the next level. In addition to calling for research on improvement strategies, future scientific endeavors should organize the existing literature pertaining to improvement strategies and highlight promising directions for future research. The time has come to integrate methodological advancements coupled with access to unprecedented big data insights to develop legal and policy improvement strategies founded on real-world evidence of socio-economic impacts of law. The standard normative models of economic theory, which generally offer a reasonable benchmark for optimal control are now to be enriched with real-world data points from around the globe and available to be analyzed over time. All these endeavors are aimed at making more reliable and detailed predictions on the socio-economic impact and effect of legal action and public policy implementations with unprecedented precision and accuracy.

Improving the efficiency and effectiveness of the impact of law is important as deviations from maximization of efforts are costly to society. Until now, hardly any optimal control theory has been applied to legal empirical studies, although now we have the means to quantify the impact of law on society. Legal frames shape the most important outcomes for individuals, families, businesses, governments and society of today and the future. Knowing more about the beneficial but also the inefficient outcomes of legal frames and policy decisions would thus benefit all individuals, collectives and institutions. After all, errors or biases as deviations from rationality and optimization lead to suboptimal conditions over time and around the globe. Given the massive costs that can result from irrational decision making or suboptimal policy control, it is critical for legal scholars and policy professionals to increase the effort on improving our knowledge with insights derived from big data, elucidated based on novel computational advancements. These suboptimality losses due to ignorance of the wealth of knowledge retrievable from big data analyzed with optimal control frames are expected to increase as the Big Data Revolution progresses and knowledge-based economies evolve. With more and more governments monitoring people and the corporate world continuing to collect more and more data on consumer behavior, a negligence to use the power of behavioral insights based on big data is expected to lead to a growing competitive disadvantage in the decades to come. Not using computational advancements to order and structure the massive amount of information collected to be analyzed under time pressure and growing competitive constraints, is thus expected to become a more and more erroneous ignorance. Those exposed to optimal control derived insights now start wondering to learn the practical implications of knowledge accumulated in big data. Such information can now create novel insights into how errors and deviations can be eliminated or at least reduced in optimal control. Through rigorous testing of what works and what not over time and in

comparison to other legal frames, we may surely develop a better understanding of the mechanisms underlying impacts of law on society. Also with a globalized society that currently transitions economically into an AI-driven economy, each biased decision or not studied legal or policy impact is likely to have implications for a broader swath of the global society. In addition, with intergenerational imbalances and predicaments arising on the horizon such as climate change, overindebtedness in the Western world and the rising need for a pension reform in aging societies, the absence of a finite time horizon optimal policy control appears simply delinquently ignorant (Puaschunder 2016a, b, c, d; 2017a, b, c; 2018 forthcoming a, b).

In order to release a society's optimal potential, it is important to discover multifaceted strategies to minimize suboptimal outcomes of law and policy implementations.

Theoretically, research should present an overview of the history of legal empirical studies from legal, economic, political and socio-psychological science perspectives with special attention to the United States, Europe and most recently China. Empirical research in law involves the study, through direct methods rather than secondary sources, of the institutions, rules, procedures, and personnel of the law, with a view to understanding how they operate and what effects they have (Baldwin & Davis 2005).

The introduction of Artificial Intelligence (AI) in our contemporary society implies historically unique opportunities for humankind. Big data revolutions coupled with computational power hold unprecedented opportunities for crowd understanding, trends prediction and civil control (Puaschunder 2019). The time has come to use insights gained by algorithms to draw inference about the populace and couple it with legal implications. In a most extreme case, the Chinese government is currently implementing the so-called Social Credit Score. China plans to rank all its citizens based on their "social credit" by 2020 and citizens can be rewarded or punished according to their scores. Like private financial credit scores, a person's social scores can move up and down according to their behavior. The Chinese state is setting up a vast ranking system that will monitor the behavior of its enormous population, and rank them all based on their social credit, which is mandatorily collected.

But in order to use big data inferences for determining legal implications, empirical legal studies may guide policy makers' rational with insightful knowledge drawn from big data. The data storage, computational power and hierarchical modelling has never been more advanced as of now, which paves the way to incept legal empirical macrodynamics coupling big data insights for the sake of deriving inferences of the power of legal action and optimum policy control. Drawing from normative models of economic theory could provide a clearer vision of how much better decision making could be.

Optimum control theory helps retrieve the necessary optimality conditions for the control of dynamic systems. Since the 1950s, optimal control theory has found entrance in very many different fields solving optimization predicaments with unprecedented precision with applications in engineering, social sciences and foremost macroeconomics. Computational power advances coupled with the big data revolution now herald a call for optimal control theory being used for understanding legal systems better. Optimization could aid to determine better policy outcomes around the world and over time. With Bayesian statistics and unprecedented computational power advancements as well as hierarchical modelling, the time is ripe to predict, call for and support an entrance of legal empirical macrodynamics.

As for implementation guidelines, the insights retrieved to solid research should offer warnings about the possibility of bias and erroneous policy choices in order to offer feedback and intervention plans designed to aid legal scholars and policy experts to improve policy outcomes for this generation's and coming generations' welfare of society.

Discussion

Empirically, an introduction to the basic control-theoretical methods should aid the meaningful introduction of optimal control in empirical legal studies. Remarkable features of structuring complex societal outcomes of different policies, which could be compared over time and comparatively around the world, could be promoted through hierarchical modeling approaches. Dynamic modeling could – for

the very first time – help draw inferences over the optimum control of policy outcomes over different finite and infinite time horizons based on real-world big data. Dynamic strategies seek to anticipate and capture the real effects of central planning with an economy. The influence of a decision maker on the state trajectory can be outlined with mathematical precision. The state trajectory thereby may be influenced by a decision maker's actions, in which case the decision maker exerts control over the dynamic process. The social credit revolution could now also help deriving inferences of optimum control in the social sphere. The time is now to combine and integrate big data for the improvement of society based on empirical legal insights. The insights gained could aid to sophisticate nudge theory, where small policy changes' impact on societal outcomes could be elucidated with economic precision over time and in a legal comparative way. Nudge theory has most recently been adopted by governments and global governance institutions around the world to help citizens to better their living conditions of today and the future. The growing field has been crowned by three recent Nobel prizes awarded to Daniel Kahneman and Amos Tversky, Elinor Ostrom, and Richard Thaler. The next cutting-edge extension is predicted for those who use the insights derived from big data for empirical legal studies with Bayesian and hierarchical modelling as well as optimal control methods.

This overall strategy will help accomplish objectives of individual profit maximization in harmony with the larger societal compound. Heterodox optimal control advancements also allow continuous-time and finite time-horizon maximizations over several periods. The research agenda may generate novel recommendations on legal codifications, economic action and public policy making. All these developments that have been called for are aimed at making policy choices more controlled and bestowing legal decision makers with an even elevated feeling that their choices were the scientifically-proven right ones.

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