

When Is IO Membership Just Cheap Talk – And When Does It Have Behavioral Implications? Innovation, Antitrust/Competition Law, and the International Competition Network

Tim Büthe* and Cindy Cheng**
Technische Universität München (TUM)

September 2019

Submission to the 13th Annual PEIO Conference
Simon Fraser University and University of British Columbia, Vancouver, Feb. 2020

Abstract

Increased innovation is one of the key hoped-for benefits of market competition and by extension also an expected consequence of antitrust/competition law and policy. Büthe and Cheng's (2017) analysis of the innovation effects of competition law showed, for the first time in a large panel spanning more than a hundred countries over half a century, that the introduction of competition law significantly boosts the level of (patentable) innovations – in developed and developing countries alike. The developing country finding, in particular, was surprising, given that competition law has in the last 30 years spread from an OECD core to many countries better known for weak state capacity and corruption than for strong rule of law. This paper subjects the earlier findings to further scrutiny, focusing on whether a subject-matter-specific international organization, the transgovernmental International Competition Network (ICN), might play a role in ensuring the faithful implementation of competition law. In analyses that model the effect of competition law on innovation conditional on formal membership and actual participation in the transgovernmental ICN of antitrust regulators, we show that competition law indeed can boost innovation, but that this effect is conditional on ICN membership and participation.

* Professor and Chair for International Relations, *Hochschule für Politik* at the Technical University of Munich, TUM School of Governance and TUM School of Management; as well as Senior Fellow, Kenan Institute for Ethics, Duke University. Email: buthe@hfp.tum.de.

** Lecturer and Postdoctoral Research Associate, *Hochschule für Politik* at the Technical University of Munich (TUM) TUM School of Governance. Email: cindy.cheng@hfp.tum.de.

Introduction

Competition law seeks to constrain market power and safeguard market entry and contestability by prohibiting – as well as authorizes and regulates government intervention to prevent or punish – unilateral anti-competitive conduct (where a single firm with market power or a dominant position in a given market, at the extreme a monopoly, uses that market power to extract rents or to avoid market competition¹) as well as anti-competitive agreements between two or more firms.² Safeguarding market competition through competition (or in U.S. parlance: antitrust) law is widely seen as boosting economic efficiency and growth, increasing both consumer and aggregate welfare.

A key means by which competition law may yield these benefits is by creating or increasing incentives to innovate (Baker 2007): Much innovation is geared toward improving goods and services or producing the same goods or services more efficiently, resulting in cost savings that allow lower prices, better quality, higher profits, or some combination thereof. Boosting innovation has therefore long been considered one of the hoped-for benefits of competition law and policy, although calls to explicitly recognize innovation as one – or maybe even *the* – key objective of competition law have only emerged in the last few years (e.g., Hovenkamp 2011; Shapiro 2012; Wu 2012).

Empirical analyses of the effectiveness of competition law in boosting innovation have so far been far and few between – notwithstanding a large literature in economics about the question at what point the incentives to innovate due to market competition might be overwhelmed by a reduction in resources to invest in innovations if competition drives profits toward zero (for a comprehensive review of half a century of empirical analyses, see Cohen 2010).³ The distinction between market competition and competition *law* is worth making, because innovations can themselves be anti-competitive when lower costs are strategically or tactically passed on to consumers so as to drive or keep competitors out of the market (Patrick G. Porter 1969), and because some observers suggest that innovating firms tend to attract the scrutiny of competition law enforcement agencies, so that competition law may suppresses innovation and entrepreneurship (Rodriguez and Menon 2010: xix, 36, 64, 143). Moreover, having a law hardly yet ensures its effective implementation and enforcement (we will return to this issue below).

It may be therefore be unsurprising that the findings of the empirical literature have been mixed: Economic historians' case studies of particular firms across a range of industries have

¹ Classic ways in which a dominant firm prevents competition include impeding the entry of new competitors into the market or by keeping existing competitors from actually competing, e.g., by threatening them with a ruinous price war should they compete.

² Such agreements typically maintain the appearance that the firms are competing with each other while in fact they conspire or collude (in the extreme by setting up a market-sharing or price-fixing cartel). In most countries, competition law also prohibits mergers, acquisitions, or joint ventures that eliminate or substantially reduce competition or create or strengthen market dominance – and therefore mandates advance regulatory review and approval of mergers above a certain size.

³ On this tradeoff, see also Scherer (1967); Kamien and Schwartz (1976); Aghion *et al* (2005); and Tingvall and Poldahl (2006).

tended to find that actual or expected antitrust enforcement prompted those firms or their competitors to innovate more and bring those innovations to the market.⁴ By contrast, the small number of – usually single-country – statistical analyses yield only inconclusive or outright contradictory findings regarding the effect of competition law on innovation.⁵

Büthe and Cheng (2017) have recently presented the first large-scale panel analysis of the innovation effects of competition law, based on an original large panel dataset, spanning more than a hundred countries over half a century. Their findings suggest that the introduction of competition law significantly boosts the level of (patentable) innovations, even when controlling for various other possible political and economic drivers of innovation.

Strikingly, their findings hold not only for developed countries but also for the large subsample of developing (non-OECD) countries. The developing country findings, in particular, are surprising given two observations: First, the mechanisms identified by Büthe and Cheng to explain their findings all rely upon competition law getting sufficiently effectively enforced that it actually increases the level of competition and/or the contestability of markets – or incumbent firms believing that competition law enforcement will target their abuse of market power unless they either innovate to keep markets fluid or seek rents from market power via patents and licensing. Second, the near-global diffusion of competition law in the last 30 years (Büthe and Minhas 2015) has meant that it has spread to many countries that are better known for weak state capacity and corruption than for strong rule of law, making it seem unlikely that competition law operates as it ideal-typically should. To put it another way: We wonder whether the estimated average innovation-boosting effect of competition law, estimated by Büthe and Cheng, might hold rather unevenly, yet systematically.

In this paper, we specifically examine to what extent engagement with an international organization, specifically the International Competition Network (ICN), may condition the effectiveness of competition law in fostering innovation. The ICN is a transgovernmental network of competition agencies, founded in 2000/2001 by the United States and Europe to facilitate epistemic exchanges among (governmental) competition law (enforcement) experts and foster the development of common understandings and best practices; it is open to competition-regulatory agencies (or public officials working on antitrust/competition policy matters) from any country (Djelic and Kleiner 2006; Aydin 2010; Fingleton 2010; Botta 2013).

Competition Law, Innovation, and the International Competition Network

Recent literature has in various issue areas shown that international institutions can have behavioral implications for member state government, constraining behavior that might be individually rational in the short run even if is detrimental in the long run or collectively (e.g., Simmons 2000; Büthe and Milner 2008; Grieco, Gelpi, and Warren 2009; Büthe and Milner

⁴ There are case studies of particular firms in traditional basic materials industries such as steel and chemicals (Dupont), consumer and industrial consumption products (lightbulbs, GE) as well as (relatively) high tech industries such as film (Eastman Kodak), telecommunications (AT&T), and computing (IBM) (Didrichsen 1972; J. K. Smith and Hounshell 1986; Chandler 1994; Hart 1998-99). For a contrary finding, cf. Mazzone and Mingardi's analysis of the EU's Intel case (2011).

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2014). Transgovernmental networks of regulatory agencies might be expected to have such an effect to a much lesser extent than highly institutionalized international organization or legally binding treaties, but they might nonetheless have a similar effect for at least two reasons: First, networks of mostly like-minded officials such as the ICN expose those who engage in the network to regularized reinforcements of the core norms of competition law and policy, which might result in convergence through learning processes, especially if norms of open dialogue are observed (Ansell 2011). Second, such networks provide an ideal experimentalist setting (in the sense of Sabel and Zeitlin 2010, 2012), as stipulated for the European Competition Network by Svetiev (2010). Regularized social interactions (at least once a year at the annual ICN Meeting) provide for an exchange of information and experience with elements of peer review where the experimentalist liberty to deviate from established "best practices" is balance with the need to explain and justify such deviations vis-à-vis one's peer agencies. This should constrain and hence reduce the likelihood of competition law getting abused, making a positive effect on innovation more likely.

It is important to differentiate, however: "Membership" in the ICN has a low threshold and requires no more than declaring oneself a member vis-à-vis the agency official who serves as the secretary of the ICN at the time (currently an official at the Korean FTC). Membership alone might not have much of an effect, since it is a "cheap talk" signal. The implications of engaging in/with the ICN, spelled out above, should be expected instead to arise from actual involvement or participation in ICN meetings.

Empirical Analysis

Measuring Innovation: The Dependent Variable

Measuring innovation entails some well-known challenges (see, e.g., Kuznets 1962; Sanders 1962). The most common measures are Research and Development (R&D) expenditures and patent filings (OECD Secretariat 2010; Keith Smith 2005). Neither measure is perfect. In international comparisons, higher R&D expenditures may be a function of the scarcity of technical talent or a function of inefficiency rather than greater innovation. Reported R&D expenditures may also differ across countries due to tax code rules, and cross-national aggregate data for R&D are only available for a very limited number of countries. Patent filings are no panacea either, especially in light of the "patent wars" of recent years, which have driven firm in many high-tech industries to seek "war chests" of patents to sue or counter-sue competitors to disrupt their ability to bring a new product to market (or defend against a competitor using this tactic, see Bessen and Meurer 2008; Hall and Ziedonis 2001). In the developing country context, it is also a legitimate question whether innovation at the patentable technological cutting edge is the kind of innovation that most advances their economic development. Nonetheless, patent filings generally are thought to capture variation in innovation across time and space quite well, and data are reasonably readily available (see below).

We use two different measures of patents to assess the relationship between innovation and the adoption of antitrust laws.⁶ The first measure is the number of patent applications in the

⁶ In particular, we use as our dependent variable 'utility patents'. These are issued "for the invention of a new and useful process, machine, manufacture, or composition of matter, or a new and useful improvement thereof" and

United States in a given year by the country of residence of the first-named inventor. This data is available as "patent applications by country of origin" from the United States Patent and Trademark Office (USPTO) from 1965 to 2015.⁷ The second measure is the number of patents applied for by residents of a country in their country of origin available from the World Intellectual Property Organization (WIPO) from 1965 to 2017.⁸

U.S. patent applications are an attractive measure of innovation for two reasons. Generally, using patent applications filed in one location helps ensure a uniform standard of review for patent applications and eases comparisons of patents as a unit of account. Moreover, the U.S. patent bureau applies a high standard for patentability, because the United States has for many years been at the forefront of technological innovation (Michael E. Porter and Stern 2002). Due to its size and relative wealth, the United States also is generally the first jurisdiction of choice for inventors considering filing in a foreign country.

Meanwhile, using data for patents for which investors or businesses applied in their home countries (to which we will hereafter refer as "WIPO patents" after the organization that collects the data from national patent offices) captures precisely what U.S. patent data cannot. Since patents generally give rights to the inventor only in the country in which the patent is issued,⁹ domestic competition law might be expected to most directly affect the incidence of domestic patents. Moreover, if innovation leads to economic growth not only through the profits it generates for the inventor but also through the multiplier effect it may have when it solves real problems confronted by a given society, then in some respects WIPO patents may represent a more robust measure of innovation than U.S. patents. That is, WIPO patents are arguably better at measuring the extent to which technology is being developed to address problems that are specific to the inventor's home country. At the same time, the numbers for WIPO patents may be less strictly comparable across countries than the numbers for U.S. patents if national patent offices vary in the standards they apply, the fees and administrative hurdles that they demand for patent applications, etc. Given that neither measure is clearly superior, we use and report the results for both (in separate analyses).

represent approximately 90% of recently issued patents. See <http://www.uspto.gov/web/offices/ac/ido/oeip/taf/patdesc.htm> for a description of different patent types.

⁷ Online at: http://www.uspto.gov/web/offices/ac/ido/oeip/taf/appl_yr.htm, (last accessed 15 May 2015). We use the number of patent applications instead of the number of patent grants because a substantial amount of time may elapse between the time when a patent is applied for and the final decision of whether to grant it or not, and we are interested in whether antitrust law stimulates innovation, patent application should track more closely when the new idea was conceived than the grant of a patent. We also considered using citation-weighted patents to better capture the underlying innovativeness of each patent (see Kogan *et al.* 2012), but unfortunately, for many years, this measure is available for fewer than 30 countries, making it impossible to conduct separate statistical analyses by year or for developing countries, only.

⁸ WIPO patent applications data for 1980 to 2017 is available online at: <http://ipstats.wipo.int/ipstatv2/?lang=en>, (last accessed 15 May 2015 with the selection: '1a – Direct applications' and 'Resident and abroad count by applicant's origin (equivalent count)'). WIPO patent data prior to 1980 is available as a zip file on the WIPO patent statistics home page: <http://www.wipo.int/ipstats/en/statistics/patents/>. For some countries, the data for the number of patent applications in the inventor's country of origin actually reaches back as far as 1883. However, given the data availability of the covariates, we restrict our analysis to 1965–2017.

⁹ Note however that the process of obtaining a patent in another country is facilitated if one's home country and the country in which one wishes to obtain the patent are both signatories of the Patent Cooperation Treaty.

Measuring Competition Law: Toward International Comparability

Our key interest regarding each country's competition regime (for the purposes of this paper) is whether the country has a substantively meaningful competition law and for how long such a law has been in effect. The specific empirical measures used in our analyses are based on content analyses of all competition-related statutes that we could identify for 217 jurisdictions, including 195 countries, 17 non-country jurisdictions, and 7 regional bodies.¹⁰ For this coding work, we built on the collection of competition laws by Bütte and Bradford (2012), which we doubled-checked and extended to cover non-country jurisdictions and the additional years since 2010. We then reviewed the texts of each jurisdiction's earliest laws with competition-related provisions. To be considered what we here call a "substantively meaningful competition law," the legislation under review had to:

- (i) have, at least *inter alia*, the declared purpose of fostering or safeguarding market competition in the national economy; and
- (ii) contain, at a minimum, a prohibition of cartels or cartel-like forms of collusion (i.e., disallow price-fixing agreements or coordinated reductions in production, market-sharing agreements, etc.).¹¹

The first criterion has the intent and effect of excluding from consideration constitutional provisions that might prohibit monopolies, cartels, or market manipulation generically, even if such provisions occur in the context of a general commitment to a market economy.¹² And it excludes from consideration as a country's first "competition law" legislation that only applies to a specific industry or sector, even if for that industry the legislation might provide well-designed and strong competition provisions and even if the legislation is competition-specific.¹³ The rationale for these exclusions is in part feasibility: reliably identifying every industry-specific statute for approximately two hundred jurisdictions, to assess the competition provisions possibly contained therein, seemed like an impossible task even with tremendous research assistance. The first exclusion is also motivated by an assessment of likely effectiveness: Pro-competitive constitutional provisions are likely to require additional implementing legislation before they

¹⁰ We follow Gleditsch and Ward (1999) in distinguishing between countries and non-country jurisdictions that nonetheless have sufficient legislative and judicial autonomy to be considered as separate (potential) competition regimes. We therefore considered for inclusion in our dataset the following 15 non-country jurisdictions: Bermuda, the Cayman Islands, the Faroe Islands, French Polynesia, Greenland, Guernsey, Hong Kong, Isle of Man, Jersey, Macao, New Caledonia, Sint Maarten (the Dutch part of the Caribbean island of St. Martin), Turks and Caicos Islands, the British Virgin Islands, and the West Bank and Gaza ("Palestine"). Indeed, 9 of the 15 have at some point during the past 30 years adopted a competition law. We include all of them provided that we were able to obtain patent data for at least some of the years.

¹¹ In detailed spreadsheets that are available upon request, we recorded for each country the specific legislation and its specific provisions on which we based our coding decisions, i.e. how a given competition statute fulfilled each of the two criteria.

¹² For instance, the Bahraini constitution of 1973 in Article 98 prohibits monopolies unless "granted by law and for a limited time." Article 314 of the 2009 Bolivian constitution states "Private monopolies and oligopolies are prohibited, as well as any other form of association or public or private legal agreement by Bolivian or foreign persons, who attempt to control and have exclusivity over production or and commercialization of goods and services. Neither qualifies as a competition law based on the exclusion criterion 'i' above,

¹³ Bahrain, China, and Singapore, for instance, adopted laws or regulations for the telecommunications industry, which included competition provisions (supposed to constrain monopoly or collusion) before they passed a general competition law; Macedonia and Singapore also had sector-specific competition rules for energy and for media prior to their adoption of a national competition law

create incentives for innovation, and competition provisions that apply only to a single industry are unlikely to have a measurable effect on economy-wide measures of innovation.

The second criterion seeks to establish a substantive, readily cross-nationally comparable minimum threshold for what "counts" as a competition law, consistent with recent scholarship by, e.g., Gutmann and Voigt (2014) and Petersen (Petersen 2013:606). The rationale for requiring that a law contain a prohibition of cartels is that we consider a cartel prohibition necessary for competition legislation to have any chance of deterring anti-competitive behavior and safeguarding market competition to the point of creating incentives for innovation.

Austria provides a useful illustration of why imposing this requirement is important: Austria passed one of the first post-WWII "cartel laws" in 1951 (still in semi-sovereign status under joint oversight of the Allied Powers). But this law simply regulated the enforceability of cartel agreements in Austrian courts. Specifically, it required prior notification of a cartel agreement to a government registry before it could be enforced in an Austrian court of law. This registration requirement eventually proved quite important when—in a series of amendments or replacements of the cartel law in 1972, 1988, and 2002—the Austrian government decided to impose increasingly strict constraints on the permissible cartels. But even the 2002 amendment to the 1988 law remained focused on public registration (transparency) and administrative procedures for efficiently obtaining approval for anti-competitive agreements under various conditions. Only in 2005 did the Austrian parliament pass the first law "*against* cartels and other competition-reducing measures" (emphasis added), which indeed contained a clear prohibition of cartels.

Applying these criteria in our review of the specific content of the competition-related provisions of each jurisdiction's pertinent laws, we identified 195 countries, 7 regional bodies, and 17 non-state jurisdictions that had adopted at least one actual competition law prior to 8/13/2019.¹⁴ To do so, we built on prior work (see, in particular, Büthe 2014:esp. 220f) and supplemented our own reading of the laws' provisions with the discussion of the country's competition regime (or the absence thereof) in a wide range of sources.¹⁵ We then recorded the year when the first competition law that met our selection criterion came into effect.

Even with very explicit criteria, which any legislation had to fulfill to "count" as a competition law, encoding our competition law variable(s) required making a number of judgment calls. One issue was deciding whether to record the year during which a country first enacted a competition law that met the above criteria, which might be considered the key

¹⁴ For a new, spatial analysis of the underlying near-global diffusion process of antitrust law, see Büthe and Minhas (2015).

¹⁵ Sources consulted include all "peer reviews" conducted under the auspices of the OECD and the Competition and Consumer Protection Policies Programme of the UN Conference on Trade and Development, UNCTAD (for which a country's competition law and policy is reviewed by competition agency officials and independent experts from several other countries, resulting in an often detailed written report); Keith Hylton's Antitrust World Wiki, William Kovacic's World Competition Law & Policy Database at George Washington University (<http://www.gwclc.com/World-competition-database.html>), UNCTAD's collection of competition laws, and the U.S. Federal Trade Commission's unofficial database of competition laws; national competition agency websites; and journals that publish the texts of competition laws in translation (sometimes accompanied by a brief legislative history), such as the *European Competition Law Review*; as well as published works discussing comparative data, such as Gutman and Voigt (2014); Kronthaler (2007, 2010); and Voigt (2009); as well as a large number of country-specific articles, chapters, and books. We thank all these scholars, practitioners, and institutions for making their data available to us.

moment in time insofar as enacting the law sends a signal to potential innovators, or to record the year when the first competition law came into effect, i.e. when its provision became legally binding. The difference matters insofar as a number of countries afforded their business community a periods of anywhere between 3-4 months and (usually no more than) two years between passing the legislation and having it come into effect. Considering the latter more likely to change the incentives for innovation, we use the latter for the analyses presented in this paper, but we recorded both years for each law and also conducted the analyses using the year-of-law-enactment variable to ensure that our findings are robust to this choice.

Another key issue was determining which competition law should count as a given country's "first" such law. One option was to count simply the chronologically first legislation that fulfilled the above criteria. For most countries, this was straightforward, but not for all. The biggest issue was discontinuity. Argentina, Norway, Poland, and South Africa, for instance, all passed a first competition law between World Wars I and II (in 1923, 1926, 1933, and 1933, respectively), but—after an often patchy record of enforcement during the early years—suspended or even revoked the law during the Great Depression or World War II.¹⁶ And it then took them until 1980, 1993, 1987 and 1998, respectively, before these countries passed a new competition law that met the above criteria *and then continuously kept a qualifying competition law on the books*. A few countries suspended or overruled their initial competition laws at other, later times, usually in response to economic crises (such as Ireland, whose expansive 1958 price control legislation rendered its 1953 competition law moot), or passed a first competition law but failed to pass the implementing secondary legislation that was required for the original law to take effect (such as Colombia, whose 1959 "Ley por la cual se dictan algunas disposiciones sobre prácticas comerciales restrictivas" did not become fully operational until the required secondary legislation was passed in 1992).¹⁷ A related phenomenon is observable in Bangladesh: When East Pakistan became the newly independent country of Bangladesh in 1971, it started out with all pre-independence Pakistani laws nominally on the books, including the 1970 Monopolies and Restrictive Trade Practices (Control and Prevention) Ordinance, but the applicability of the general principle was contested for laws passed just prior to independence, and experts note that neither the Bangladeshi legislature nor the executive ever acknowledged the 1970 law as applicable in Bangladesh, arguably making the 2012 Bangladeshi Competition Act the first competition law for the country.¹⁸ Given that it is theoretically conceivable that either the chronologically first law or the first continuously-in-effect law (or both) could boost the level of innovation in the country, we encoded both measures to make them available for future research. In the analyses below we focus on the latter for which we consider the theoretical rationale to be stronger.

Another important coding decision concerns regional competition regimes. The European Community has long been known for having adopted a competition law and policy well before several of its member states. Yet, while for the EU the question of how to treat such regional competition rules relative to the member states' rules is interesting only for the early years of our panel, it is an increasingly important question for international comparative competition law analysis, because there is a growing number of regional bodies with

¹⁶ These pre-1945 competition laws are discussed, *inter alia*, in Gerber (2010:esp.163-165) and Baskoy (2008:57-59), as well as the respective countries' peer reviews.

¹⁷ See OECD Peer Review 2009.

¹⁸ See, e.g., Evrard et al. (2014:2); Raihan (2015:esp. 5).

supranational competition rules, especially in Africa and Latin America. And for a number of regional bodies they are considered increasingly consequential, including CARICOM, which in 2008 set up a supranational agency to enforce its competition rules, adopted in 2001 (effective 2002); COMESA, which in 2013 set up a supranational competition agency to implement its 2004 competition regime, and WAEMU/UEMOA, which also is increasingly active in enforcing its 2002/03 competition regime. This raises the difficult question of whether to consider the regional competition rules in lieu of any national competition law, and if so, whether to "count" the regional rules only for countries that do not have a competition law at the national level.¹⁹ And if the regional rules are to be coded even for countries with a prior national competition regime, should this already be done for the early years of the regional rules when their status might have been uncertain and enforcement might have made the national competition laws far more meaningful, as in the case of WAEMU and Senegal (Bakhoun and Molestina 2011; Weick 2010)? Since these questions have no easy, clear answers, we have for the analyses in this paper *de facto* ignored the regional competition regimes and simply analyzed each country's domestic (national-level) competition law. We expect to address this issue in subsequent papers.

Finally, note that for the analyses reported in this paper, we focus on the mere existence of a substantively meaningful competition *law* (as defined above); then calculate for each country-year the number of years since the first such law came into (continuous) effect and thus has been legally binding; 0 if the country has no competition law yet. We do not here use more differentiated measures of the content of the law, nor do we condition our law duration measure on some metrics of implementation or enforcement, the effectiveness of the jurisdiction's broader competition *policy*, or general measures of rule of law, state capacity, or government effectiveness. Such more differentiated analyses, from which we refrained in this initial, exploratory analysis should surely be done in subsequent work.

Measuring the Engagement with International Organizations

Thanks to original data received from the ICN, we created a dichotomous (country-year) measure of ICN membership, as well as measure of the size of the participating delegation (which is zero for country-years in which an agency did not participate in the annual ICN meeting). The correlation between the two measures is very low, as is to be expected: Membership in the ICN does not oblige a member agency to show up to the meetings. Conversely, it is possible to participate in ICN meetings with delegations of quite variable size, and even without yet being a member. We will examine the possible conditioning effect of these two measures in separate analyses.

Control Variables

We include in our analyses of the effect of competition law on innovation a number of control variables that have been found to be important predictors of innovation in the most comprehensive previous attempt to statistically model innovation using patent applications

¹⁹ There are, for instance, as of January 2016, 8 COMESA member states that currently have no domestic competition law that meets the above criteria, yet the common market competition rules apply: Comoros, Democratic Republic of Congo, Djibouti, Eritrea, Libya, Sudan, South Sudan, and Uganda.

(Cheng, Grieco, and Guzman 2014): population, GDP per capita, trade and FDI flows, political institutions, and a measure of state capacity.²⁰

We include two basic demographic covariates in every statistical model: Population straightforwardly controls for the number of *potential* innovators in each country. We also include population squared to allow for a non-linear relationship: a larger population surely increases the number of patent filings (*ceteris paribus*), but it may exhibit diminishing returns in bringing about new, patentable ideas.²¹

We also include one basic economic control variable in every model: To account for a country's level of economic (and thus usually technological) development—and the domestic resources that a given inventor or business may be able to draw upon—we include GDP per capita (in constant 2005 dollars), expecting a strongly statistically significant positive coefficient.

A surely important aspect of the legal environment—especially in light of how we have operationalized "innovation"—is whether a country has a patent law. It seems likely that having such a law at home will increase the incentives to innovate for a given country's residents such that it will boost U.S. patent registrations by the country's residents. And for the WIPO measure of patent registrations, having such legislation is presumably a prerequisite for registering "innovation" by the country's residents. For consistency with our competition law measure, however, we do not simply use an indicator ("dummy") variable for whether or not the country has such a law. Instead, for the main analyses, we use the number of years since the country's patent law came into effect as our control variable, thus allowing for the possibility that the effect of having an IP-law on innovation increases quasi-linearly over time. The data for this variable was collected from the WIPO Lex database ("Main IP Laws: Enacted by Legislature").²² The earliest piece of legislation identified by WIPO as providing patent protection for a given country was used.

In addition, we include two economic and two political control variables. Trade as a percentage of GDP and net inward FDI flows as a percentage of GDP are included as measures of connection and integration into international markets (Xu and Chiang 2005), even though the theoretical expectation regarding these variables is not entirely clear. On the one hand, increased integration into the world economy may increase the level of competition in a country's economy, providing greater incentives to innovate (see, e.g., Blackhurst 1991; Hazledine 1991).²³ On the other hand, greater linkages with the international community may allow greater technological spillovers across different markets such that greater relative effort is spent on licensing and adaption of international technology as opposed to spurring domestic innovation (Connolly 2003).²⁴

²⁰ Data for population, GDP per capita, trade as a percentage of GDP and net FDI flows as a percentage of GDP available retrieved from the World Bank's World Development Indicators (WDI) database, according to WDI metadata, the version we used was uploaded to the WDI server on 22 Dec 2015. Cheng, Grieco and Guzman use the Fraser Institute's rating of a country's business environment; for our purposes a measure of government effectiveness has a more compelling theoretical rationale.

²¹ Porter and Stern (2002) use the logged form of population in order to account for potential nonlinearities. We find that using population and population square leads to better model fit as measured by AIC scores/R squared.

²² Last accessed July 2019 at : http://www.wipo.int/wipolex/en/results.jsp?countries=&cat_id=1.

²³ For a critique of this neoclassical optimism, see Büthe (2014: esp. 215-219).

²⁴ Grossman and Helpman (1991) also support this view indirectly by showing that the returns to technologies produced in developed countries are reduced by imitators in developing countries—who thus devote resources to imitation instead of devoting it to innovative activity of their own.

A rich body of research has been devoted to investigating how political institutions stimulate or stymie growth (e.g., Barro 1996; Przeworski and Limongi 1993). While the specific hypothesized mechanisms differ, the importance of political institutions for growth is no longer in doubt: The nature of a country's political institutions is thought to provide a direct impetus for innovation and growth (Evans 1992) and shape incentives to make it more likely for individuals to behave in growth-conducive or at least -compatible ways (Acemoglu, Johnson, and Robinson 2001). In recognition of this finding, we include a measure of political institutions, *polity2*, from the Polity IV Project. *Polity2* combines a measure of democratic institutional features and an inverted measure of autocratic institutional features, resulting in a variable that has a range from -10 to 10 (where the extreme values identify fully autocratic and fully democratic regimes, respectively). While small unit changes in the *polity2* score are substantively difficult to interpret, interpretation of large unit changes can be fairly unambiguously interpreted, with higher scores indicating more democratic institutions.

Finally, we include a measure of state capacity in recognition of the fact that a competent government bureaucracy is a minimum requirement for patents to be meaningful, since they grant public privileges in the form of legal protections. Unfortunately, the exact meaning and therefore every empirical measure of state capacity is contested; recent scholarship mostly treats it as multidimensional, incorporating the degree of bureaucratic professionalization, rule of law, and fiscal capacity (see, e.g., Cárdenas 2010). Our main focus here is on the government's ability to implement and enforce its own policies and laws. Therefore, we use the World Governance Indicators' (WGI) indicator of Government Effectiveness, which is designed to capture "perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies."²⁵

Methodological Concerns 1: Multicollinearity

As always in multivariate regression, we are concerned about possible multicollinearity, that is, the possibility that two or more variables in our data may be highly correlated with each other, which could negatively affect the validity of our analysis. We investigate this possibility by calculating the variance inflation factor for each of our variables and performing a condition number test on the dataset.

The variance inflation factor provides an estimate of how much the variance of an estimated coefficient is increased because of multicollinearity. A variance inflation factor of 1 indicates that there is no collinearity between variables. The most common rule of thumb is that a variance inflation factor 10 or above indicates severe multicollinearity problems, though some use thresholds as high as 20, or 40 and others thresholds as strict is 5 (see O'Brien 2007). For our imputed dataset (see below for details on the imputation), all variables have variance inflation factors less than 10. Again, the between effect of WGI Government Effectiveness measure (more details on how we construct this measure below) has the highest variance inflation factor, 8.3.

²⁵ The WGI Government Effectiveness indicator is created by combining a perception-based governance data sources from a wide variety of stakeholders, including governments, business and NGOs and experts. The construction of this variable is done so in a way which maintains the cardinality of the underlying data, weights the different components by their relative precision but also accounts for the potential uncertainty of the resulting indicator (see Kaufmann, Kraay, and Mastruzzi 2010). Data for the Government Effectiveness indicator available at: www.govindicators.org

Overall then, the variance inflation factors for our imputed data suggest that multicollinearity should not drive the results that we find in our paper. In our analysis we use both the scaled and unscaled versions of our data and find that our results are robust to both. We present the unscaled results for ease of interpretability.

Methodological Concerns 2: Missing Data and Imputation

Missing data is a common problem in cross-national panel analyses, especially analyses that seek to take into account the experience of a broad cross-section of developing countries, which our analysis seeks to do. Missing data is a particular issue for our patent measures. Developing countries are more likely to have missing patent data either because they are less likely to have patents to report or because they are more likely to fail to report their data due to weak bureaucratic capacity or greater frequency of political and economic crises.²⁶ Note that under such conditions, patent levels are also likely to be low. Indeed, if we compare the means of the imputed and non-imputed values for U.S. and WIPO patent measures, we observe that the mean for the imputed data is substantially lower.

While it has long been common practice to implicitly ignore (or even exacerbate) the problem of missing data through list-wise deletion, methodological research suggests that such a strategy leads to biased and inconsistent results—a problem we need to worry about here because, as noted above, our observations with missing data appear to be disproportionately country-years with low values on the dependent variable. To address this problem, social scientists have increasingly used imputation, that is, replacing missing data with "substitute" data (see, e.g., King *et al.* 2001).

The goal of imputation is to replace missing values in such a way that it safeguards against the biased and inefficient estimates and standard errors that listwise deletion often produces. Different imputation methods attack this problem in different ways. They range from the simple mean imputation (in which the missing value is replaced by the mean of the non-missing values) to the complicated "multiple" imputation (in which multiple substitutes of each missing value are generated from a predictive model of the non-missing data). Unfortunately, simple imputation models like mean imputation often do little to address bias and inefficiency problems in the data, while more complicated models like multiple imputation often fail to converge (that is fail to result in a stable estimate for the substitute value) or require considerable computing power and time (e.g., Honaker, King, and Blackwell 2011; Van Buuren and Groothuis-Oudshoorn 2011).

The approach that we use in this paper addresses the potential for biased estimates, yet has the benefit of being relatively simple and fast to implement. It entails sampling our imputed

²⁶ Communication between the authors and the WIPO Economics and Statistics Division, which also supplies the data for US patents, on this subject was as follows : "WIPO collects data from national offices. Normally, for indicators based on collected data, a blank cell may indicate either a missing value or zero count. Unfortunately, we do not maintain a document showing which offices did not supply us data in the past, or that the data is missing."

values from the joint distribution of the existing data.²⁷ This approach is based on work by Hoff (2007) and has been further developed by Hollenbach *et al* (forthcoming).²⁸

Findings

Our panel dataset allows us to examine the effect of competition law on innovation across countries, as well as "within" countries over time – though we short duration of the time series may impeded finding much of an within effect (Büthe and Cheng's original analysis begins in the 1960s, but given our focus on the ICN including years from before 2001 would imply having entire years with no cross-national variance).

Since these effects may be quite different, we estimate a random effects models for up to 212 jurisdictions from 2001 to 2015 when using U.S. patents as the dependent variable and from 2001 to 2017 for models using WIPO patents as the dependent variable. Random effects models, however, can lead to biased estimates because of correlations between different levels of data. For our data, the particular concern is that correlations between variables that change over time (e.g., GDP per capita) and time invariant measures (i.e., a country dummy for being an OECD country) may lead to biased estimates. For example, while GDP per capita does change over time, the range of values that the GDP variable(s) may have is not independent of the country in question. That is, we do not expect a country with a GDP per capita comparable to the United States one year to subsequently have a GDP per capita comparable to Zimbabwe the next year. Thus, if time-variant measures exhibit variance across both time and units (countries), they may still be highly correlated with time-invariant measures, such that estimates of within-effects (over time) from traditional fixed effects models would be biased.

We circumvent these problems by using Bell and Jones' (2015) method for estimating both within and between effects in one random effect model. There is then no longer any risk of endogeneity because under this method, we explicitly separate each variable into its time variant and time invariant components.²⁹ Such a specification then allows us to estimate the effect of competition law on the level of innovation over time ("within" each country) and the effect of competition law on the level of innovation across countries ("between" each country).

We investigate whether ICN membership or participation might condition the relationship between competition law and innovation by including interaction terms in our models.³⁰ Given that the Bell and Jones method estimates between- and within-effects

²⁷ While a marginal distribution describes the probability of realizing an outcome for a single random variable, a joint distribution describes the probability of realizing multiple outcomes for multiple random variables. As such, each imputed value is estimated in a way that takes into account its relationship with all variables in the dataset.

²⁸ Actual implementation of the missing imputation was done using the "sbgcop" package (Hoff 2012) using the R statistical software. We also conducted all of our analyses using the original dataset with list-wise deletion and the imputed dataset. The resulting analyses are substantively quite similar. For purposes of parsimony, we present the results using the imputed data for the panel data only. Results from using non-imputed data are available upon request.

²⁹ Bell and Jones achieve this by demeaning each variable to separate its time-varying component (the "within" effect) and use the mean of each variable per country to estimate the time invariant component (the "between" effect). The demeaned "within" effect now has an overall mean of 0, such that the correlation between the "within" and the country-level random effect is by definition 0, which addresses the concern of a potential correlation among different levels of data, provided that both are estimated in the same model, which this methods allows.

³⁰ To minimize potential problems with multicollinearity, we here use a dichotomous indicator variable for *whether* a country had a competition law (continuously in effect, as discussed above). For these analyses, each country-year

simultaneously, we include the full set of 2x2 interaction terms, but we are really only interested only in the between*between interaction (and secondarily the within*within interaction) to get at any possible conditioning effect across counties (and over time).

Table 1 summarizes the Bell and Jones estimates considering four different scenarios.³¹ Models 1 and 2 use the U.S. patents measure as our dependent variable (by nationality of the first author, excluding patents by U.S. first-authors, as discussed above); models 3 and 4 the WIPO (domestic patents) measure as our dependent variable (all patents registered in the respective country's national patent registry).

when a country had a competition law that meets our criteria for at least 3 years is coded 1 in the underlying panel dataset; all other country-years are coded 0. Actual values used to estimate the reported coefficients then diverge when we estimate the between- and the within-effect for each country, but in essence these models implicitly assume that innovation is a step function of competition law adoption, where the level of innovation shifts – once, three years after the competition law enters into force, given the three year lag we used for all predictors in these models – and then holds steady (and a positive coefficient implies an upwards shift).

³¹ Note that the panel estimates reported here are based on estimating a linear model. We attempted nonlinear estimation of the panel data, using maximum likelihood estimation using either a Poisson or Negative Binomial model, but these model estimates were highly unstable.

Table 1

	Model 1 US Patents	Model 2 US Patents	Model 3 WIPO Patents	Model 4 WIPO Patents
Competition Law Continuously in Effect (Between)	0.321 (0.443)	-0.234 (0.219)	1.482 (0.695)	0.846 (0.273)
Competition Law Continuously in Effect (Within)	-0.358 (0.305)	0.0249 (0.147)	-0.592 (0.383)	-0.0310 (0.211)
ICN Member Dummy (Between)	-0.274 (0.469)		-0.984 (0.569)	
ICN Member Dummy (Within)	0.073 (0.210)		0.442 (0.329)	
ICN Member Participation (Between)		-0.361 (0.548)		-0.513 (0.653)
ICN Member Participation (Within)		0.136 (0.211)		0.041 (0.271)
Government Effectiveness (WGI)(Between)	1.235 (0.201)	1.195 (0.192)	0.403 (0.220)	0.333 (0.218)
IP Law in Effect(Between)	0.0780 (0.242)	$7.69e^{-3}$ (0.229)	0.344 (0.306)	0.210 (0.295)
Log GDP per capita(Between)	0.679 (0.116)	0.537 (0.114)	0.653 (0.131)	0.530 (0.132)
Log Pop(Between)	0.738 (0.0549)	0.629 (0.0560)	0.952 (0.0714)	0.822 (0.0788)
Trade (% GDP)(Between)	$-2.92e^{-4}$ ($2.37e^{-3}$)	$1.24e^{-3}$ ($2.37e^{-3}$)	$1.01e^{-3}$ ($2.62e^{-3}$)	$2.243e^{-3}$ ($2.86e^{-3}$)
FDI (% GDP)(Between)	$-1.58e^{-3}$ ($8.43e^{-3}$)	$-6.63e^{-3}$ ($8.12e^{-3}$)	$-9.90e^{-3}$ (0.0111)	-0.0161 (0.0110)
Polity2(Between)	0.0204 (0.0191)	$2.43e^{-3}$ (0.0184)	-0.0439 (0.0214)	-0.0584 (0.0213)
Government Effectiveness (WGI)(Within)	0.0827 (0.0786)	0.0875 (0.0754)	0.106 (0.197)	0.112 (0.190)
IP Law in Effect(Within)	-0.0242 (0.120)	-0.0289 (0.119)	-0.225 (0.146)	-0.202 (0.145)
Log GDP per capita(Within)	$4.00e^{-3}$ (0.130)	0.0100 (0.127)	0.0806 (0.172)	0.123 (0.170)
Log Pop(Within)	-0.0538 (0.167)	-0.0708 (0.167)	0.237 (0.667)	0.493 (0.633)
Trade (% GDP)(Within)	$1.11e^{-3}$ ($1.07e^{-3}$)	$1.04e^{-3}$ ($1.08e^{-3}$)	$1.88e^{-3}$ ($2.37e^{-3}$)	$2.24e^{-3}$ ($2.31e^{-3}$)
FDI (% GDP)(Within)	$1.86e^{-5}$ ($9.78e^{-4}$)	$5.37e^{-5}$ ($9.76e^{-4}$)	$-1.41e^{-3}$ ($2.19e^{-3}$)	$-1.41e^{-3}$ ($2.20e^{-3}$)
Polity2(Within)	$-6.05e^{-3}$ (0.0151)	$-6.78e^{-3}$ (0.0150)	$6.80e^{-3}$ (0.0214)	$5.99e^{-3}$ (0.0214)
Competition Law Continuously In Effect (Between) *	-0.333 (0.780)		0.0324 (1.096)	
ICN Member Dummy (Between)	0.715 (0.463)		0.957 (0.584)	
Competition Law Continuously In Effect (Within) *	0.193 (0.198)		-0.442 (0.303)	
ICN Member Dummy (Within)	-0.038 (0.405)		-0.129 (0.594)	
Competition Law Continuously In Effect (Between) *		0.733 (0.553)		0.784 (0.657)
Member Participation in ICN Conference (Between)		0.0810 (0.200)		0.116 (0.240)
Competition Law Continuously In Effect (Within) *		-0.123 (0.212)		-0.0469 (0.272)
Member Participation in ICN Conference (Within)		0.0461 (0.188)		0.0270 (0.246)
Competition Law Continuously In Effect (Within) *				
Member Participation in ICN Conference (Within)				
Intercept	-14.4 (1.51)	-11.7 (1.51)	-16.4 (1.75)	-13.5 (1.85)
N	2242	2242	1840	1840
Countries	188	188	154	154
AIC	6779	6769	6471	6473
BIC	6928	6917	6614.2	6616

Coefficients in bold significant at the 5% level.

The estimates shown in Table 1, however, are difficult to interpret, given that our primary interest is in the interactive effects. We therefore show in Figures 1-4 the marginal effects, based on simulations, and we focus our interpretation of the results on these predicted probability plots.

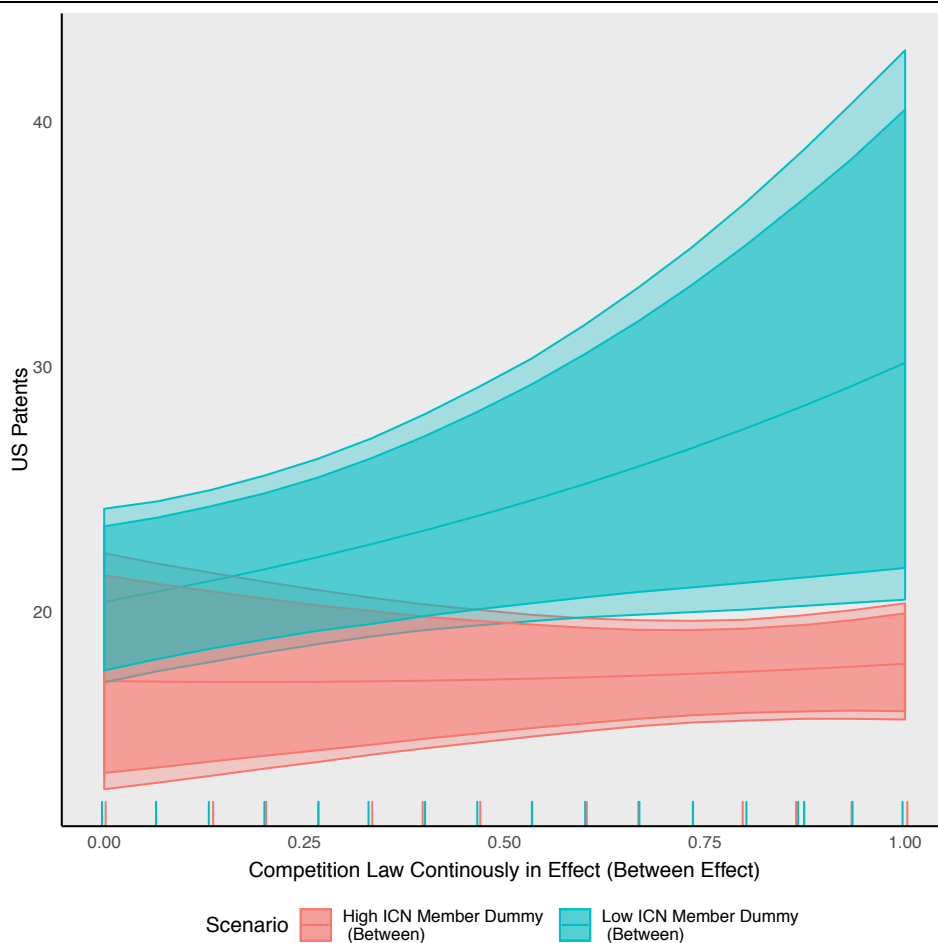


Figure 1
Estimated Conditional Effect of Competition Law on Innovation (U.S. Patents)

Authors' diagram based on Bell & Jones panel estimation of the ICN membership model (model 1) with full set of controls.

Figure 1 shows the predicted number of U.S. patents (along the y axis) across the range of the between effect for the competition law-continuously-in-effect measure (along the x axis) under two conditions: ICN members ("High," in red) and non-ICN members ("Low," in green). The range of the between-effect from 0 to 1 can be interpreted as the percentage of time a country has had a competition law continuously under effect. 0 indicates that a country has never had a competition law for the entire time period under study, 2001 to 2015, while 1 indicates that a country has had such a law for the entire period. Shown in the graphs are the results of simulations: in red the point estimates and confidence intervals (90% and 95%) for an "average" country with ICN membership (the amount of time spent with a competition law in

force is allowed to vary along the x-axis, and the other variables are for this synthetic country set (fixed) a their medians). Shown in green are the estimates for an otherwise identical synthetic country with no ICN membership (all other variables retain the same values as for the ICN member country).

Figure 1 suggests that there is a bifurcation in the relationship between U.S. patents and competition law depending on whether a country is an ICN member or not, where countries without ICN membership, surprisingly, exhibit a slightly higher level of innovation (though the difference is significant only for countries that have had a competition law for some time).

Figure 2, summarizing the findings regarding the interaction between our measure of actual participation in ICN meetings and competition law across countries for U.S. patents. The plot can be interpreted in the same way as Figure 1, but the finding is almost exactly the opposite: For countries that participate regularly in the ICN meetings, exposing themselves to the ICN best practices discourse and peer review, competition law boosts the level of innovation (the difference in the point estimate from left to right is notable for high participation countries, though not statistically significant at conventional levels). For countries with low ICN participation, competition law brings no benefit and might even be detrimental to innovation.

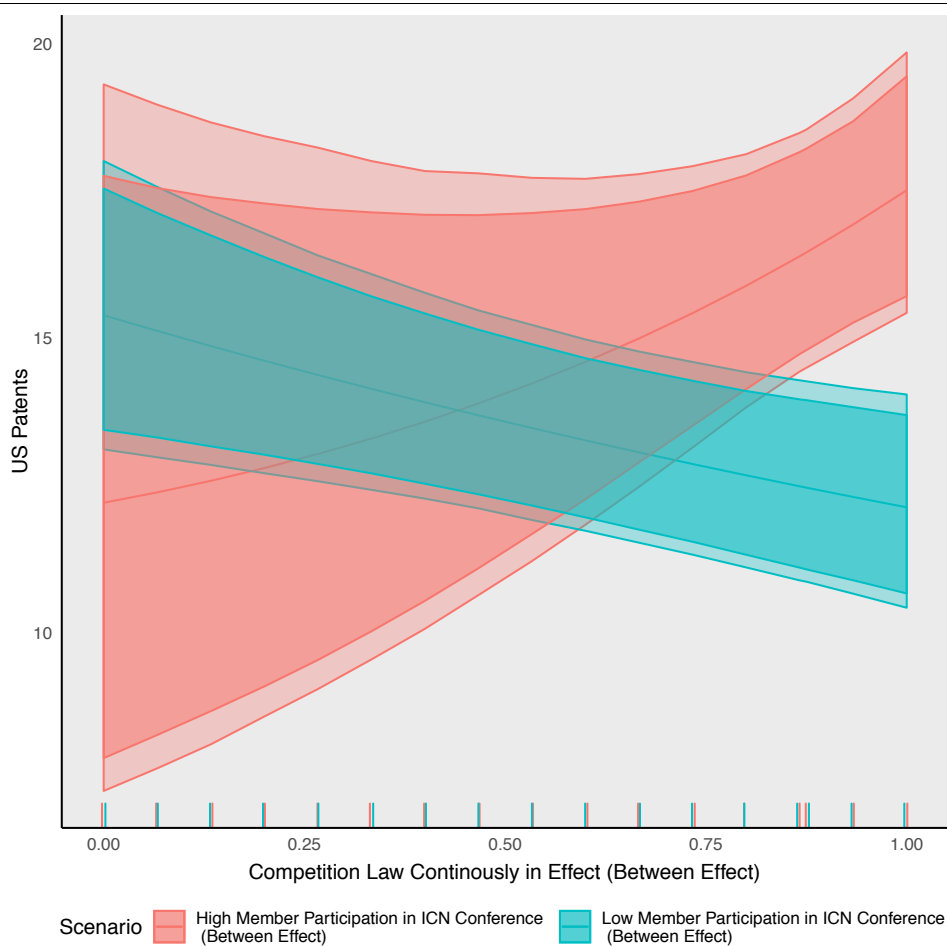


Figure 2
Estimated Conditional Effect of Competition Law on Innovation (U.S. Patents)

Authors' diagram based on Bell & Jones panel estimation of the ICN participation model (model 2) with full set of controls.

In Figures 3 and 4 (corresponding to models 3 and 4) we show the marginal effects for WIPO patents. While the point estimates differ, reflecting the difference in means and standard deviations between the U.S. and the WIPO measures.

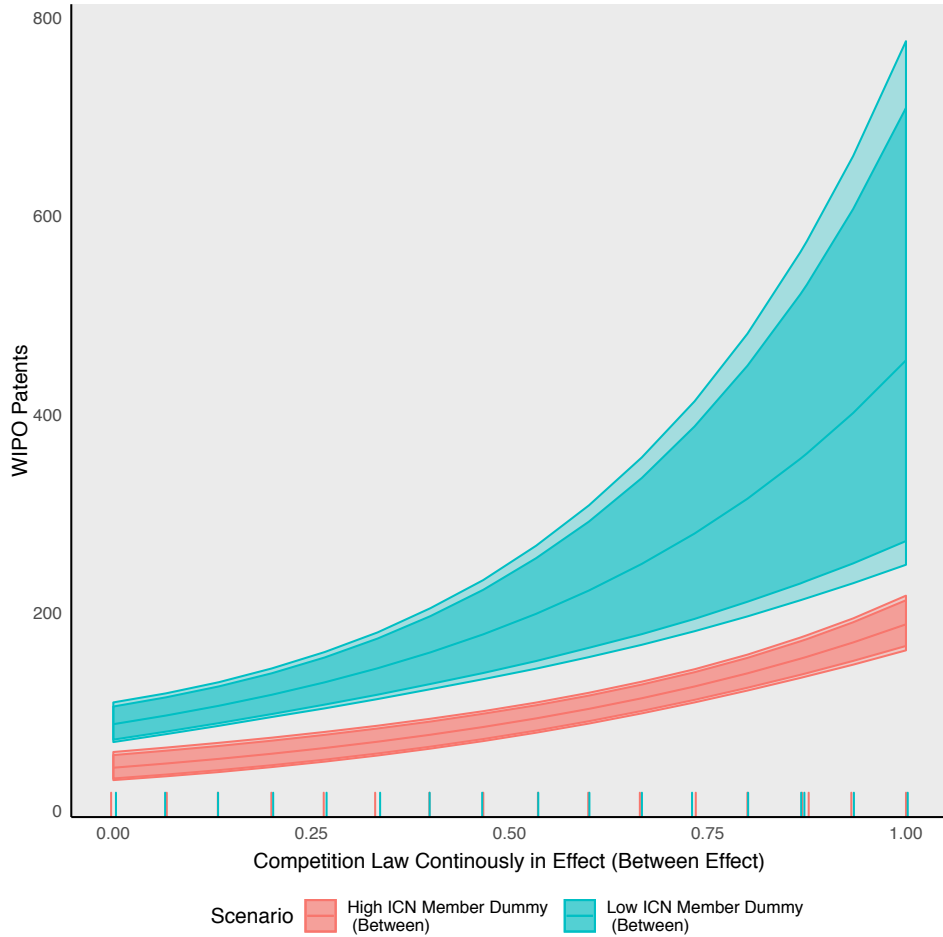


Figure 3
Estimated Conditional Effect of Competition Law on Innovation (WIPO Patents)

Authors' diagram based on Bell & Jones panel estimation (model 3) with full set of controls.

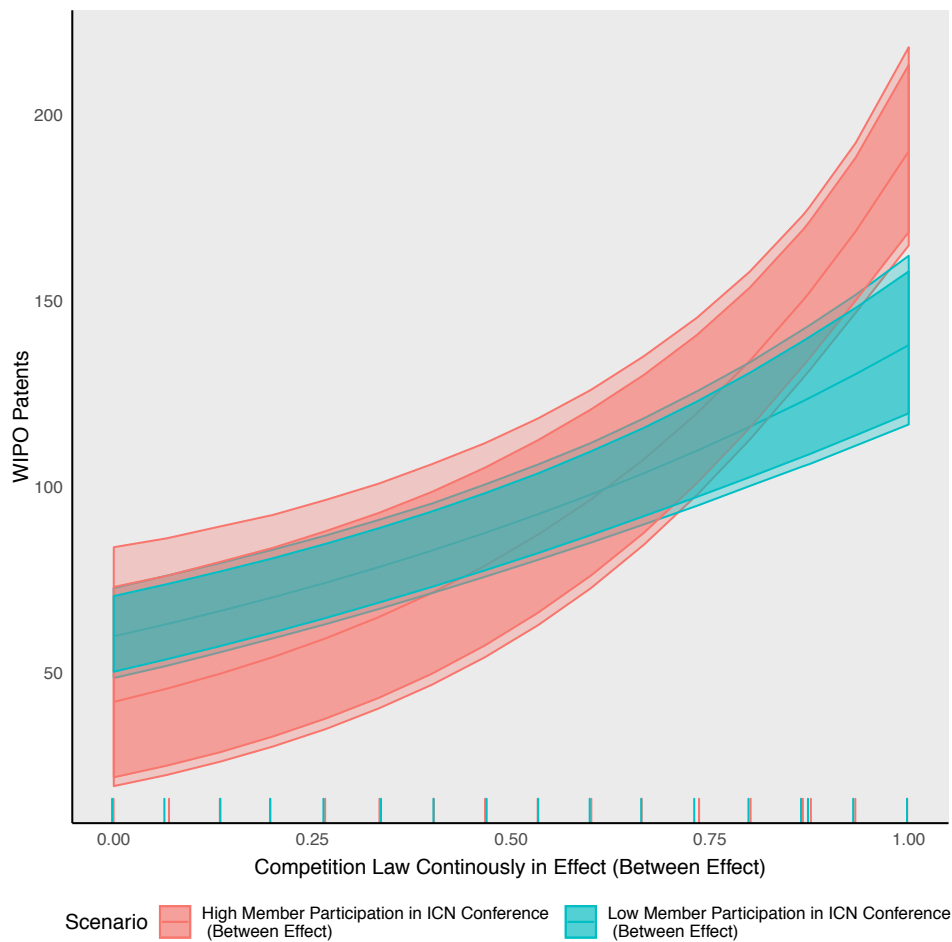


Figure 4
Estimated Conditional Effect of Competition Law on Innovation (WIPO Patents)

Authors' diagram based on Bell & Jones panel estimation (model 4) with full set of controls.

Conclusion

Maintaining and increasing incentives for innovation has long been recognized as a—possible and hoped-for—benefit of a well-designed and implemented competition policy. Fostering innovation has become an even more important goal of competition policy with the rise of endogenous growth theory and the increasing emphasis on dynamic efficiency as well as on dynamic effects in antitrust analysis (see Kovacic and Shapiro 2000:esp. 57f).³²

This paper reports analyses of the effect of competition law on innovation, conditional on the country's engagement with the International Competition Network. We find that formal membership in the ICN is not associated with higher levels of innovation. To the contrary, the

³² For a critical view of these developments, see Ginsburg and Wright (2012).

average numbers of patents for non-members is slightly higher than for members. Countries that actually participate in ICN meetings, and have done so over a much of the time since the ICN was established exhibit higher levels innovation than otherwise identical countries without participation in the ICN. We interpret this finding as an indication that membership alone is merely cheap talk, whereas participation creates social mechanisms for convergence with best practices within the network, which boosts the innovation effect of competition law – though in this preliminary analysis, we cannot rule out the possibility that the observed correlations might be due to selection effects.

References

- Acemoglu, D. and Robinson, J. A. 2000. Political Losers as a Barrier to Economic Development. *American Economic Review*, 90(2):126–130.
- Acemoglu, Daron, Simon Johnson, and James A. Robinson. 2001. "The Colonial Origins of Comparative Development: An Empirical Investigation." *American Economic Review* vol.91 no.5 (December 2001): 1369-1401.
- Aghion, Philippe, *et al.* 2005. "Competition and Innovation: An Inverted-U Relationship." *Quarterly Journal of Economics* vol.120 no.2 (May 2005): 701-728.
- Ansell, Christopher. 2011. *Pragmatist Democracy: Evolutionary Learning as Public Philosophy*. New York: Oxford University Press.
- Aydin, Umut. 2010. "The International Competition Network: Cooperation and Convergence in Competition Laws." *Rekabet Derisi (Competition Journal)* vol.11 no.3 (July 2010): 51-78.
- Baker, Jonathan B. 2007. "Beyond Schumpeter vs. Arrow: How Antitrust Fosters Innovation." *Antitrust Law Journal* vol.74 no.3 (2007): 575-602.
- Bakhom, Mor, and Julia Molestina. 2011. "Institutional Coherence and Effectiveness of a Regional Competition Policy: The Case of the West African Economic and Monetary Union." In *Competition Policy and Regional Integration in Developing Countries*, edited by Josef Drexler, *et al.* Cheltenham, UK: Edward Elgar, 2011: 89-115.
- Barro, Robert J. 1996. "Democracy and Growth." *Journal of Economic Growth* vol.1 no.1: 1-27.
- Baskoy, Tuna. 2008. *The Political Economy of European Union Competition Policy: A Case Study of the Telecommunications Industry*. London: Routledge.
- Bell, Andrew, and Kelvyn Jones. 2015. "Explaining Fixed Effects: Random Effects Modeling of Time-Series-Cross-Sectional and Panel Data " *Political Science Research and Methods* vol.3 no.1 (2015): 133-153.
- Bessen, James, and Michael J. Meurer. 2008. *Patent Failure: How Judges, Bureaucrats, and Lawyers Put Innovators At Risk*. Princeton: Princeton University Press.
- Blackhurst, Richard. 1991. "Trade Policy is Competition Policy." In *Competition and Economic Development*, edited by Kurt Stockman and Louis Emmerij. Paris: OECD, 1991: 253-258.
- Botta, Marco. 2013. "EU and Global Competition Networks." In *EU Policies in a Global Perspective: Shaping or Taking International Regimes?*, edited by Gerda Falkner and Patrick Müller. Milton Park, Abingdon (UK): Routledge, 2013: 76-92.
- Büthe, Tim. 2014. "The Politics of Market Competition: Trade and Antitrust in a Global Economy." In *Oxford Handbook of the Politics of International Trade*, edited by Lisa L. Martin. New York: Oxford University Press, 2014: 213-232.
- Büthe, Tim, and Anu Bradford. 2012. "The Law and Politics of Antitrust in Open Economies." (Proposal for collaborative research submitted to the Law and Social Sciences Program of the National Science Foundation, January 2012.).

- Büthe, Tim, and Cindy Cheng. 2017. "The Effect of Competition Law on Innovation: A Cross-National Statistical Analysis." In *A Step Ahead: Competition Policy for Shared Prosperity and Inclusive Growth*. Washington: World Bank and OECD, 2017: 187-224.
- Büthe, Tim, and Helen V. Milner. 2008. "The Politics of Foreign Direct Investment into Developing Countries: Increasing FDI through International Trade Agreements?" *American Journal of Political Science* vol.52 no.4 (October 2008): 741-762.
- . 2014. "Institutional Diversity in Trade Agreements and Their Effects on Foreign Direct Investment: Credibility, Commitment, and Economic Flows in the Developing World, 1971-2007." *World Politics* vol.66 no.1 (January 2014): 88-122.
- Büthe, Tim, and Shahryar Minhas. 2015. "The Global Diffusion of Competition Laws: A Spatial Analysis." (Paper presented at the 6th Meeting of the UNCTAD Research Partnership Platform in the context of the 7th United Nations Conference to Review the Set of Multilaterally Agreed Equitable Principles and Rules for the Control of Restrictive Business Practices (Competition Policy), Geneva, 10 July 2015).
- Cárdenas, Mauricio. 2010. "State Capacity in Latin America." *Economia* vol.10 no.2 (Spring 2010): 1-45.
- Chandler, Alfred Dupont. 1994. "The Competitive Performance of U.S. Industrial Enterprises since the Second World War." *Business History Review* vol.68 no.1 (Spring 1994, special issue on 'Competitiveness and Capital Investment: The Restructuring of U.S. Industry, 1960-1990): 1-72.
- Cheng, Cindy, Joseph Grieco, and Ana Guzman. 2014. "International Military Conflict and National Technological Innovation" *Unpublished manuscript* (Duke University, November 2014).
- Cohen, Wesley M. 2010. "Fifty Years of Empirical Studies of Innovative Activity and Performance." In *Handbook of the Economics of Innovation*, edited by Bronwyn H. Hall and Nathan Rosenberg. Amsterdam: Elsevier, 2010: 129-213.
- Connolly, Michelle. 2003. "The Dual Nature of Trade: Measuring Its Impact on Imitation and Growth." *Journal of Development Economics* vol.72 no.1 (October 2003): 31-55.
- Didrichsen, John. 1972. "The Development of Diversified and Conglomerate Firms in the United States, 1920-1970." *Business History Review* vol.46 no.2 (Summer 1972): 202-219.
- Djelic, Marie-Laure, and Thibaut Kleiner. 2006. "The International Competition Network: Moving Towards Transnational Governance." In *Transnational Governance: Institutional Dynamics of Regulation*, edited by Marie-Laure Djelic and Kerstin Sahlin-Andersson. New York: Cambridge University Press, 2006: 287-307.
- Evans, Peter. 1992. "The State as Problem and Solution: Predation, Embedded Autonomy, and Structural Change." In *The Politics of Economic Adjustment: International Constraints, Distributive Conflicts, and the State*, edited by Stephan Haggard and Robert Kaufman. Princeton: Princeton University Press, 1992: 139-181.
- Evrard, Sébastien J., et al. 2014. "Bangladesh." *Jones Day Antitrust & Competition: Asia in Focus* Spring 2014.
- Fingleton, John. 2010. "The International Competition Network: Planning for the Second Decade." (Paper delivered at the 9th Annual ICN Conference, Istanbul, Turkey, April 2010.).
- Gerber, David J. 2010. *Global Competition: Law, Markets, and Globalization*. New York: Oxford University Press.
- Ginsburg, Douglas H., and Joshua D. Wright. 2012. "Dynamic Analysis and the Limits of Antitrust Institutions." *Antitrust Law Journal* vol.78 no.1 (Spring 2012): 1-22.
- Gleditsch, Kristian S., and Michael Ward. 1999. "A Revised List of Independent States since the Congress of Vienna." *International Interactions* vol.25 no.4 (1999): 393-413.
- Grieco, Joseph M., Christopher Gelpi, and T. Camber Warren. 2009. "When Preference and Commitments Collide: The Effect of Relative Partisan Shifts on International Treaty Compliance." *International Organization* vol.63 no.2 (Spring 2009): 341-355.
- Grossman, Gene M., and Elhanan Helpman. 1991. *Innovation and Growth in the Global Economy*. Cambridge, MA: MIT Press.

- Gutmann, Jerg, and Stefan Voigt. 2014. "Lending a Hand to the Invisible Hand? Assessing the Effects of Newly Enacted Competition Laws." (Manuscript, University of Hamburg, February 2014).
- Hall, Bronwyn H., and Rosemarie Ham Ziedonis. 2001. "The Patent Paradox Revisited: An Empirical Study of Patenting in the U.S. Semiconductor Industry, 1979-1995." *Rand Journal of Economics* vol.32 no.1 (2001): 101-128.
- Hart, David M. 1998-99. "Antitrust and Technological Innovation." *Issues in Science and Technology* vol.15 no.2 (Winter 1998-99: Meeting New Challenges for U.S. Industry): 75-81.
- Hazledine, Tim. 1991. "Trade Policy as Competition Policy." In *Canadian Competition Law and Policy at the Centenary*, edited by R. Shyam Khemani and W. T. Stanbury. Halifax: Institute of Research on Public Policy, 1991: 45-60.
- Hoff, Peter D. 2007. "Extending the Rank Likelihood for Semiparametric Copula Estimation." *Annals of Applied Statistics* vol.1 no.1 (June 2007): 265-283.
- Hoff, Peter. 2012. "sbgcop: Semiparametric Bayesian Gaussian copula estimation and Imputation." R package version 0.975. URL: <http://CRAN.R-project.org/package=sbgcop>.
- Hollenbach, Florian M., et al. forthcoming. "Multiple Imputation Using Gaussian Copulas." *Sociological Methods and Research* (online first: October 2018).
- Honaker, James, Gary King, and Matthew Blackwell. 2011. "Amelia II: A Program for Missing Data." *Journal of Statistical Software* vol.45 no.7: 1-47.
- Hovenkamp, Herbert. 2011. "Antitrust and Innovation: Where We Are and Where We Should Be Going." *Antitrust Law Journal* vol.77 no.3 (2011): 749-756.
- Kamien, Morton I., and Nancy L. Schwartz. 1976. "On the Degree of Rivalry for Maximum Innovative Activity." *Quarterly Journal of Economics* vol.90 no.2 (May 1976): 245-260.
- Kaufmann, Daniel, Aart Kraay, and Massimo Mastruzzi. 2010. "The Worldwide Governance Indicators: Methodology and Analytical issues." *World Bank Policy Research Working Paper* no.5430 (September 2010).
- King, Gary, et al. 2001. "Analyzing Incomplete Political Science Data: An Alternative Algorithm for Multiple Imputation." *American Political Science Review* vol.95 no.1 (March 2001): 49-69.
- Kogan, Leonid, et al. 2012. "Technological Innovation, Resource Allocation, and Growth." *NBER Working Paper Series* no.17769.
- Kovacic, William E., and Carl Shapiro. 2000. "Antitrust Policy: A Century of Economic and Legal Thinking." *Journal of Economic Perspectives* vol.14 no.1 (Winter 2000): 43-60.
- Kronthaler, Franz. 2007. *Implementation of Competition Law in Developing and Transition Countries: Theoretical and Empirical Considerations*. Baden-Baden: Nomos Verlagsgesellschaft.
- . 2010. "Factors Influencing the Implementation of Recently Enacted Competition Laws: An Empirical Analysis." *International Research Journal of Finance and Economics* no.51: 71-87.
- Kuznets, Simon. 1962. "Inventive Activity: Problems of Definition and Measurement." In *The Rate and Direction of Inventive Activity: Economic and Social Factors*, edited by Richard R. Nelson. Princeton, NJ: Princeton University Press for the NBER, 1962: 19-43.
- Mazzone, Luca, and Alberto Mingardi. 2011. "Innovation, Competition and Antitrust: An Examination of the Intel Case." *Economic Affairs* vol.31 no.2 (June 2011): 68-75.
- OECD Secretariat. 2010. *Measuring Innovation: A New Perspective*. Paris: OECD.
- Petersen, Niels. 2013. "Antitrust Law and the Promotion of Democracy and Economic Growth." *Journal of Competition Law & Economics* vol.9 no.3 (September 2013): 593-636.
- Porter, Michael E., and Scott Stern. 2002. "National Innovative Capacity." In *Global Competitiveness Report 2001-2002*, edited by Klaus Schwab, Michael Porter and Jeffrey Sachs. New York: Oxford University Press, 2002: 102-119.

- Porter, Patrick G. 1969. "Origins of the American Tobacco Company." *Business History Review* vol.43 no.1 (Spring 1969): 59-76.
- Przeworski, Adam, and Fernando Limongi. 1993. "Political Regimes and Economic Growth." *Journal of Economic Perspectives* vol.7 no.3 (Summer 1993): 51-69.
- Raihan, Abdullah. 2015. "New Enacted Competition Law of Bangladesh and Major Challenges." Presentation at the South Asia Economic Summit: Making Growth Inclusive and Sustainable in South Asia. Islamabad, Pakistan, 7-8 December 2015.
- Rodriguez, A. E., and Ashok Menon. 2010. *The Limits of Competition Policy: The Shortcomings of Antitrust in Developing and Reforming Economies*. Austin, TX: Wolters Kluwer Law & Business.
- Sabel, Charles F., and Jonathan Zeitlin. 2012. "Experimentalist Governance." In *Oxford Handbook of Governance*, edited by David Levi-Faur. New York: Oxford University Press, 2012: 169-183.
- , eds. 2010. *Experimentalist Governance in the European Union: Towards a New Architecture*. New York: Oxford University Press.
- Sanders, Barkev S. 1962. "Some Difficulties in Measuring Inventive Activities." In *The Rate and Direction of Inventive Activity: Economic and Social Factors*, edited by Richard R. Nelson. Princeton, NJ: Princeton University Press for the NBER, 1962: 53-83.
- Scherer, Frederic M. 1967. "Market Structure and the Employment of Scientists and Engineers." *American Economic Review* vol.57 no.3 (June 1967): 524-531.
- Shapiro, Carl. 2012. "Competition and Innovation: Did Arrow Hit the Bull's Eye?" In *The Rate and Direction of Inventive Activity Revisited*, edited by Josh Lerner and Scott Stern. Chicago: University of Chicago Press, 2012: 361-405.
- Simmons, Beth A. 2000. "International Law and State Behavior: Commitment and Compliance in International Monetary Affairs." *American Political Science Review* vol.94 no.4 (December 2000): 819-835.
- Smith, J. K., and David Hounshell. 1986. "Wallace H. Carothers and Fundamental Research at Du Pont." *Science* (2 August 1986): 436-442.
- Smith, Keith. 2005. "Measuring Innovation." In *The Oxford Handbook of Innovation*, edited by Jan Fagerberg, David C. Mowery and Richard R. Nelson. New York: Oxford University Press, 2005: 148-177.
- Svetiev, Yane. 2010. "Networked Competition Governance in the EU: Delegation, Decentralization, or Experimentalist Architecture?" In *Experimentalist Governance in the European Union: Towards a New Architecture*, edited by Charles F. Sabel and Jonathan Zeitlin. New York: Oxford University Press, 2010: 79-120.
- Tingvall, Patrik Gustavsson, and Andreas Poldahl. 2006. "Is There Really an Inverted U-shaped Relation between Competition and R&D?" *Economics of Innovation and New Technology* vol.15 no.2 (2006): 101-118.
- Voigt, Stefan. 2009. "The Effects of Competition Policy on Development: Cross-Country Evidence Using Four New Indicators." *Journal of Development Studies* vol.45 no.8 (September 2009): 1225-1248.
- Weick, Daniel P. 2010. "Competition Law and Policy in Senegal: A Cautionary Tale for Regional Integration?" *World Competition* vol.33 no.3 (2010): 521-540.
- Wu, Tim. 2012. "Taking Innovation Seriously: Antitrust Enforcement If Innovation Mattered Most." *Antitrust Law Journal* vol.78 no.2 (2012): 313-328.
- Xu, Bin, and Eric Chiang. 2005. "Trade, Patents, and International Technology Diffusion." *Journal of International Trade and Economic Development* vol.14 no.1: 115-135.