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THE INTERNATIONAL PATENT PROPENSITY DIVIDE

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This Article contributes conceptually and empirically towards an innovation-based growth theory for developing countries. The proposed theory adheres to the growing importance given by theoreticians and policy makers alike to re-visiting the neoclassical economics "one size fits all" innovation policy propagated by current international intellectual property instruments.

In arguing for an innovation-based growth theory, the Article offers a unique statistical country panel data model for comparing patent propensity rates as a proxy for national innovation over sixteen years (1996–2011) between two groups of countries straddling the developing-developed countries divide: "Emerging Economies" and "Advanced Economies." The International Monetary Fund has labeled certain developing countries as "Emerging Economies," which are hotbeds of meaningful innovation within the developing world, and others as "Advanced Economies," which includes most of the countries belonging to the Organization for Economic Co-operation and Development.

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The model corroborates a statistical difference between a relatively high propensity to patent in Advanced Economies and a lower propensity to patent in neighboring Emerging Economies. The model further corroborates earlier related findings whereby countries today are converging to multiple innovation-based growth equilibria rather than to a single "one size fits all" model in their propensity to patent as a proxy for domestic innovation. In addition, the model confirms that Emerging Economies indeed are slowly, yet steadily, converging towards Advanced Economies in their propensity to patent.

I. INTRODUCTION

The effects of patenting on economic growth among countries are unclear. This Article offers a conceptual and empirical contribution thereof, focusing on an innovation-based growth theory for developing countries. The theory adheres to the growing critique by theoreticians and policy makers towards the present-day "one size fits all" innovation policy propagated by current international intellectual property-related organs of the United Nations ("UN"). These include the World Trade Organization's ("WTO") signing of the Agreement on the Trade Related Aspects of Intellectual Property ("TRIPS") and the innovation-related policy by the World Health Organization ("WHO"). It further includes recent policy initiatives by the World Intellectual Property Organization ("WIPO"). Such equal country innovation policy is also embedded in the Washington Consensus standard macroeconomic reform package for crisis-wracked developing countries promoted by the International Monetary Fund ("IMF"), World Bank, and the United States Treasury Department.

This Article aims to measure patenting activity among countries by comparing patent propensity rates between two groups of countries adjoining the developmental divide between developing countries and developed ones. In so doing, the Article contributes towards a theory that could replace the "one size fits all" innovation-based economic growth equilibrium: a theory that

examines two tentative equilibria across the archetypical development divide.

The IMF has labeled the country clusters across the development divide as the twenty-four Emerging Economies heading the developing world and the thirty-two Advanced Economies that are mostly member countries of the Organization for Economic Cooperation and Development ("OECD"). To approximate innovation of state-of-the-art technology by these two country clusters, the Article corresponds with Ed Mansfield's seminal definition of the propensity to patent as "the percentage of patentable inventions that are patented."[1] The empirics of patent propensity rates across countries analyzed in this Article thus flow naturally from the central role given to the measurement of research and development in relation with patenting itself. That is, patenting can be seen as a proxy for domestic innovation and economic growth among countries.

This Article corroborates the transition that growth theory has gone through in recent years: From growth theory's adherence to innovation-based economic growth as a *linear* historical process of technological development or innovation, to a non or less-linear innovation theory.[2] In the past, "[d]eveloping countries were deemed to be at an earlier stage than more advanced economies

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[1] Edwin Deering Mansfield, *Patents and Innovation: An Empirical Study*, 3 MGMT. SCI. 173, 176 (1986).

[2] *See generally* STEPS CENTRE, *Innovation, Sustainability, Development: A New Manifesto*, A NEW MANIFESTO (2010), http://www.anewmanifesto.org/manifesto_2010/; UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT, WORLD INVESTMENT REPORT (2005). For a historical account of the linear theory of innovation, see Benoît Godin, *The Linear Model of Innovation: The Historical Construction of an Analytical Framework*, 31 SCI. TECH. & HUM. VALUES 639, 639–45, 645–60 (2006). Godin explains that historically, the linear model was not an actual scientific model of innovation or intellectual progress, but rather a variety of individuals such as scientists seeking funding and economists advising government agencies. They have constructed the linear model of innovation to classify research activities, establish a connection between basic and applied research and eventually commercial activities.

along the linear path of historical progress."[3] This course naturally led to a neoclassical economics policy inclination towards a "one size fits all" international intellectual property instrument for fostering innovation-based economic growth worldwide.

The neoclassical economics-based innovation policy draws a parallel to the creation of the United Nations country-equal innovation policy-related organs as said.

Against the backdrop of the demise of the Washington Consensus theoretical setting, a growing theoretical inclination towards a non or at least less-linear innovation theory and policy is evolving. Riding the mounting gale of *non-linear* innovation dialectics, one distinct theory already has started to transform into policy at the OECD and at the European Union ("EU"). It is labeled as the "National Systems of Innovation" theory.[4] The National Systems of Innovation theory explains how innovation and technology development are the result of a complex set of

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[3] ORG. FOR ECON. CO-OPERATION & DEV., INNOVATION AND THE DEVELOPMENT AGENDA 40 (Erika Kraemer-Mbula & Watu Wamae, eds., 2010). *See generally* ALEXANDER GERSCHENKRON, ECONOMIC BACKWARDNESS IN HISTORICAL PERSPECTIVE (1966); W. W. ROSTOW, THE STAGES OF ECONOMIC GROWTH: A NON- COMMUNIST MANIFESTO (3d ed. 1991).

[4] For major academic contributions, see Bengt-Åke Lundvall, *Product Innovation and User-Producer Interaction*, *in* 31 INDUSTRIAL DEVELOPMENT RESEARCH SERIES, 28–29 (1985). *See generally* NATIONAL SYSTEMS OF INNOVATION: TOWARD A THEORY OF INNOVATION AND INTERACTIVE LEARNING (Bengt-Åke Lundvall, ed., 1993); NATIONAL INNOVATION SYSTEMS: A COMPARATIVE ANALYSIS (Richard R. Nelson, ed., 1993); P. PATEL & K. PAVITT, *The Nature and Economic Importance of National Innovation Systems*, STI REV, 14, (1994) (offering a comparison between the United States and European countries based on the nature of their national innovation systems); Chris Freeman, *The "National System of Innovation" in Historical Perspective*, 19 CAMBRIDGE J. ECON. 5 (1995) (offering analysis of innovation theory based on national and regional reference instead of a globalized "one-size-fits-all" one).

For a general overview, see also ORG. FOR ECON. CO-OPERATION & DEV., INNOVATION AND THE DEVELOPMENT AGENDA, *supra* note 3, at 41 n.3 ("The elements of the national innovation system (NIS) have close similarities to structuralist views stressing that development is neither linear nor sequential, but a unique process shaped by a specific history, culture and socioeconomic context.").

domestic relationships among various state institutions:[5] enterprises, universities, and government research institutes. Innovation, we are thus told, is and ought to remain subject to distinct archetypical national systems and equilibria.

This Article offers a novel empirical comparison of patent propensity rates among countries between 1996 and 2011. This Article aggregates an advanced variation of patent propensity analysis of both Emerging Economies and Advanced Economies as a proxy for their *non-linear*, and thus separate, innovation-based economic growth equilibria.

The model offered by this Article corroborates related earlier findings whereby countries converge to multiple innovation-based growth equilibria rather than to a single "one size fits all" theory in their propensity to patent. A second finding offered by the model confirms that Emerging Economies indeed are slowly, yet steadily, converging towards advanced countries in their propensity to patent. A full empirical account of the nooks and crannies of these phenomena should be completed in following research. A complete empirical account ultimately should lead to a novel non-linear innovation theory accompanied by policy recommendations that would work together to adapt present-day international intellectual property instruments.

II. PATENTING IN ECONOMIC GROWTH THEORY

A. *Patenting and Innovation-Based Economic Growth*

The effects of patents on innovation-led economic growth are unclear for two reasons. These two reasons relate to both the ambiguous impact of patent laws alongside patenting itself on economic growth. First, with respect to patent laws, much empirical ambiguity remains concerning their impact on the incentive to invest in research and development, their ability to increase quotas of foreign direct investment ("FDI"), or their ability to promote other forms of technology absorption and

[5] NATIONAL SYSTEMS OF INNOVATION: TOWARD A THEORY OF INNOVATION AND INTERACTIVE LEARNING, *supra* note 4; Freeman, *supra* note 4.

diffusion in different countries.[6] If anything, intellectual property rights ("IPRs") and patent law mostly seem to have failed in predicting economic growth across countries.[7]

The second reason that has resulted in uncertainty of the effect of patents on economic growth and the focal point of this Article follows. It relates to the effect of patenting itself compared across countries through patent propensity rates as a proxy for domestic innovation and related economic growth.[8]

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[6] The scope of present empirical ambiguity is rather startling. *See* José L. Groizard, *Technology Trade*, 45 J. DEV. STUD. 1526, 11–13 (2009) (using panel data of eighty countries for the period 1970 finding that FDI is higher for countries with stronger IPRs). On the other hand, Groizard found that a negative relationship exists between IPRs and human capital indicators. *Id.* Earlier findings are similarly ambiguous. While some researchers generally find that protection of IPRs positively affects technological innovation, others explain that lower IPRs can facilitate imitation, while on the other hand, innovation in developing countries increases in proportion to greater IPR protection. *See, e.g.*, Sunil Kanwar & Robert Evenson, *Does Intellectual Property Protection Spur Technological Change?*, 55 OXFORD ECON. PAPERS 235, 236 (2003), *But see* Yongmin Chen & Thitima Puttitanun, *Intellectual Property Rights and Innovation in Developing Countries*, 78 J. DEV. ECON. 474, 489 (2005). Furthermore, Rod Falvey, David Greenaway, and Zhihong Yu found evidence of a positive effect between IPR and economic growth for both low and high-income countries, but not for middle-income countries. *Extending the Melitz Model to Asymmetric Countries* (U. Nottingham Res. Paper Series, Research Paper 2006/07) (using panel data of seventy-nine countries and four sub-periods: 1975–1979, 1980–1984, 1985–1989, and 1990–1994). The positive relationship between IPR and economic growth in low-income countries cannot be explained by the potential fostering of R&D and innovation, but by the idea that stronger IPR protection promotes imports and inner foreign direct investment ("FDI") from high-income countries without negatively affecting the national industry based on imitation. *Id.*

[7] *See* THE WORLD BANK, GLOBAL ECONOMIC PROSPECTS AND THE DEVELOPING COUNTRIES 129–50 (vol. 12, 2002) ("At different times and in different regions of the world, countries have realized high rates of growth under varying degrees of IPRs protection."). *See generally* Walter G. Park & Juan Carlos Ginarte, Intellectual Property Rights and Economic Growth, 15 CONTEMP. ECON. POL'Y 51 (1997) (analyzing the relationship between intellectual property rights and economic growth for a cross-section of countries for the period 1960–1990).

[8] The Article focuses solely on the propensity to patent in the backdrop of other intellectual property regimes, which foster innovation, notably in

The central argument concerning economic growth across countries through innovation emerged from Cambridge University economist Nicholas Kaldor in 1957. Kaldor theorized differences in development stages across countries could be explained by differing rates in the adoption of technology.[9] The adoption of technology is often measured through patent statistics.[10] The underlying idea was that investment and learning were related and that the rate at which they took place determined technological progress.[11] Years later, this standpoint was rather inaccurately adopted by the United Nations towards developing countries.[12] The UN thought that there was a need for investing in research and development ("R&D") by Multi-National Corporations ("MNCs") to orient the direction of technological change. In order for this to

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developing countries. *But see, e.g.*, EMMANUEL HASSAN, OHID YAQUB & STEPHANIE DIEPEVEEN, INTELLECTUAL PROPERTY AND DEVELOPING COUNTRIES: A REVIEW OF THE LITERATURE 19 (2010) ("Several surveys carried out in developed countries have shown that other factors are much more effective than patents in enabling firms to profit from inventive efforts: trade secrecy, first-mover advantages and associated brand loyalty, the complexity of the learning curve and establishment of effective production, sales and marketing functions.") (internal citations omitted).

[9] Nicholas Kaldor, *A Model of Economic Growth*, 67 ECON. J. 591, 595 (1957).

[10] Stanford University Professors Charles Jones and Paul Romer recently exemplified the usage of patent statistics over Kaldor's growth theory. *See* Charles I. Jones & Paul M. Romer, *The New Kaldor Facts: Ideas, Institutions, Population, and Human Capital* 8 (Nat'l Bureau Econ. Research, Working Paper No. 15094, 2009) (offering cross-country patent statistics for measuring international flows of ideas alongside trade and FDI as key facets for economic growth).

[11] Kaldor, *supra* note 9.

[12] *See generally* CALESTOUS JUMA & LEE YEE-CHEONG, UNITED NATIONS MILLENNIUM PROJECT, INNOVATION: APPLYING KNOWLEDGE IN DEVELOPMENT (2005); COMMISSION FOR AFRICA, OUR COMMON INTEREST: REPORT OF THE COMMISSION FOR AFRICA (2005) (emphasizing the role of innovation and underlying investment needs as a basis for economic transformation). For additional literary critique on innovation policy for developing countries, see generally ANDREANNE LÉGER & SUSHMITA SWAMINATHAN, INNOVATION THEORIES: RELEVANCE AND IMPLICATIONS FOR DEVELOPING COUNTRY INNOVATION at 4–12 (Ger. Inst. for Econ. Research, Discussion Papers 743, 2007).

be effective, the UN should have recognized that such activity should be backed by a comparatively narrower form of independent technological learning by underdeveloped countries themselves.[13]

The internationalization of R&D by MNCs dramatically impacts economic development worldwide.[14] It is thus not surprising either that there is a large number of scientific studies on this occurrence, or that several of these studies show an increasing internationalization of innovative activity (mainly R&D) by MNCs.[15]

The growing emphasis on the internationalization of R&D by both growth theoreticians and succeeding policy makers, largely echoed another imperative theoretical breakthrough: Paul Romer's endogenous growth theory in 1990.[16] Romer found that economic

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[13] JUMA & YEE-CHEONG, *supra* note 12; COMMISSION FOR AFRICA, *supra* note 12. For an equivalent standpoint set by the World Intellectual Property Organization ("WIPO"), see WIPO, THE ECONOMICS OF INTELLECTUAL PROPERTY: SUGGESTIONS FOR FURTHER RESEARCH IN DEVELOPING COUNTRIES AND COUNTRIES WITH ECONOMIES IN TRANSITION 22 (2009) (R&D is the most important economic indicator on how effective the innovation process is).

[14] Frieder Meyer-Krahmer & Guido Reger, *New Perspectives on the Innovation Strategies of Multinational Enterprises: Lessons for Technology Policy in Europe*, 28 RES. POL'Y 751, 752 (1999).

[15] *See generally* ORG. FOR ECON. CO-OPERATION & DEV., COMPENDIUM OF PATENT STATISTICS (2008); Daniele Archibugi & Alberto Coco, *The Globalization of Technology and the European Innovation System*, *in* KNOWLEDGE, COMPLEXITY AND INNOVATION SYSTEMS 58 (Manfred M. Fischer, Josef Fröhlich, eds.) (2001); Pari Patel & Modesto Vega, *Patterns of Internationalization of Corporate Technology: Location vs. Home Country Advantages*, 28 RES. POL'Y 145 (1999); Alexander Gerybadze & Guido Reger, *Globalization of R&D: Recent Changes in the Management of Innovation in Transnational Corporations*, 28 RES. POL'Y 251 (1999); Pari Patel, *Localised Production of Technology for Global Markets*, 19 CAMBRIDGE J. ECON. 141 (1995) (offering evidence that there is no systematic evidence to suggest that widespread globalization of technological activities occurred in the 1980s).

[16] *See* Paul M. Romer, *The Origins of Endogenous Growth*, 8 J. ECON. PERSP. 3, 4–10 (1994); Paul M. Romer, *Endogenous Technological Change*, 98 J. POL. ECON. S71, S72 (1990) ("Technological change provides the incentive for continued capital accumulation, and together, capital accumulation and technological change account for much of the increase in output per hour worked.").

growth is primarily the result of endogenous investments in industrial research (and development) in innovation by forward-looking, profit-seeking agents.[17] In marked contrast to the neoclassical growth models formulated earlier by Robert Solow[18] followed by that of David Cass[19] and Tjalling Koopmans,[20] where long-run economic growth depends on an archetypical exogenous process being a by-product of investment in machinery and equipment—Romer's hallmark economic growth insight seemingly prevailed.[21] Albeit criticized by competing economic models for possible inaccuracies within United States patent-based innovative markets, Romer's model survived and ultimately lays the foundations to R&D-related growth altogether.[22] Henceforth,

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[17] *Id.*

[18] Robert M. Solow, *A Contribution to the Theory of Economic Growth*, 70 Q. J. ECON. 65, 68–73 (1956).

[19] David Cass, *Optimum Growth in an Aggregative Model of Capital Accumulation*, 32 REV. ECON. STUD. 233, 233–40 (1965).

[20] Tjalling Koopmans, *On the concept of optimal economic growth, in* (STUDY WEEK ON THE) ECONOMETRIC APPROACH TO DEVELOPMENT PLANNING, at 226–28 (1965).

[21] Romer's economic growth theory was also said to result from investment in human capital and knowledge. Romer's insight soon after became widely popular. *See* Ben Fine, *Endogenous Growth Theory: A Critical Assessment*, 24 CAMBRIDGE J. ECON. 245, 246 (2000) ("Over the past three years, the number of articles explicitly drawing upon [Romer's] endogenous growth theory almost certainly borders on a thousand.").

[22] The contributions by economists Aghion and Howitt and Grossman and Helpman were particularly effective in utilizing the increasing returns to scale of innovations to explain persistent global growth of output per capita over the recent two centuries. *See* Philippe Aghion & Peter Howitt, *A Model of Growth Through Creative Destruction*, 60(2) ECONOMETRICA 323, 327–29 (1992); GENE GROSSMAN & ELHANAN HELPMAN, INNOVATION AND GROWTH IN THE GLOBAL ECONOMY 1–6 (1991). For critics of Romer's endogenous growth model, see Paul Segerstrom, *Endogenous Growth Without Scale Effects*, 88(5) AM. ECON. REV. 1290, 1292–95 (1998) (arguing that data does not support the claim that the rate of growth increases with the scale of the economy because patent statistics have been roughly constant even though R&D employment as an endogenous growth indication has risen sharply between the 1970s–2000s and because a steady increase in R&D efforts has not led to any upward trend in U.S. economic growth rates); Charles Jones, *Time Series Tests of Endogenous Growth Models*, 110(2) Q. J. ECON. 495, 501–02 (1995) (developing an alternative model explaining why economic growth has not

technological change, particularly through research (and development) expenditures, is *sine qua non* as it lies at the heart of economic growth theory.[23] The empirics of patent propensity rates across countries analyzed in this Article thus flow naturally from the central role given to the measurement of R&D in relation with patenting itself.

Growth theory traditionally has gone through another innovation-related growth transformation. Until the recent expansion of exogenous growth theory, policy makers adhered implicitly to innovation-based economic growth as a *linear* process of technological development or innovation.[24] The model of innovation classifies research activities and establishes a connection between basic and applied research and eventually commercial activities.[25] It was perceived that "[d]eveloping countries were deemed to be at an earlier stage than the more advanced economies along the linear path of historical [economic] progress."[26] Such archetypical linearity was said to equally foster

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accelerated in spite of substantial increase in R&D efforts).

[23] Romer, *Endogenous Technological Change*, *supra* note 16, at S72.

[24] *See* STEPS CENTRE, *supra* note 2; *Data and Statistics*, INT'L MONETARY FUND (2012), http://www.imf.org/external/data.htm. *See generally* UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT, WORLD INVESTMENT REPORT (2005) (analyzing ways to close the archetypical 'Technology gap' between countries with respect to innovation). In reference to the role of internationalization of R&D in closing the 'Technology gap' the report further reads: "Large gaps [in this area] prevail between countries—gaps that limit the ability of many of them to take part in the global networks of knowledge creation and diffusion. Addressing these gaps is a major development challenge; it is also essential to ensure that the internationalization of R&D by TNCs benefits larger parts of the world." *Id.* at 100. For a historical account of the linear theory of innovation, see Godin, *supra* note 2, at 639–41 (adding that historically the linear model is not an actual scientific model of innovation or intellectual progress but rather a variety of actors such as scientists seeking funding and economists advising government agencies, which have constructed the linear model of innovation to classify research activities and to establish a connection between basic and applied research and eventually commercial activities).

[25] *See* Godin, *supra* note 2, at 639, 657.

[26] ORG. FOR ECON. CO-OPERATION & DEV., *supra* note 3, at 40 (for a broader contextual discussion). *See generally* Rostow, *supra* note 3, at 4 (offering a limited production function for growth whereas "It is possible to identify all

growth across countries by means of translation of R&D supply into "better" innovations based on a single economic equilibrium.

The linear theory indicated that technology is most efficiently acquired through assimilation of the existing backlog of knowledge by developing countries through investment in R&D-enhancing policies. Studying international aspects of the process of economic growth through innovation and learning, Harvard University economist Alexander Gerschenkon in 1962 offered a pioneering idea which was called into action. As Gerschenkon explained, "technology gaps" between technologically edged economies by mostly developed economies and laggard developing countries provide developing countries immense opportunities for economic growth.[27] It was not until the late 1970s that the technology gap standpoint was revived, leading to the so-called "technology gap" theory within modern innovation theory literature. In this later intellectual stage, the literature widely explored the catching-up process by lagging countries.[28] Yet, as Carolta Perez and L. Soete remarked,[29] catching-up was again perceived linearly to be a "question of relative speed in a race along a fixed track,"[30] where technology was perceived as a "cumulative unidirectional process."[31]

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societies, in their economic dimensions, as lying within one of five categories: the traditional society, the preconditions for take-off, the take-off, the drive to maturity, and the age of high mass-consumption"); Gerschenkon, *supra* note 3 (introducing his theory of "Economics Backwardness"—a country undergoing industrialization will have a different experience depending on its degree of economics backwardness when industrialization begins—as a reaction to uniform stages theories such as Rostow's).

[27] *See* Gerschenkon, *supra* note 3.

[28] *See* JOHN CORNWALL, MODERN CAPITALISM: ITS GROWTH AND TRANSFORMATION (1977); Moses Abramovitz, *Rapid Growth Potential and its Realization: the Experience of Capitalist Economics in the Postwar Period*, *in* 1 ECONOMIC GROWTH AND RESOURCES 191 (E. Malinvaud ed., 1979).

[29] *See* Carlota Perez & L. Luc Soete, *Catching-Up in Technology: Entry Barriers and Windows of Opportunity*, *in* TECHNICAL CHANGE AND ECONOMIC THEORY 458 (G. Dosi, ed., 1988).

[30] *Id.* at 460.

[31] *Id.*

The idea of linear—or equal country treating—economic growth through technology continually prevailed riding a mounting gale of equal country policy recommendations. The original Sussex Manifesto,[32] most notably, alongside many research contributions originated by scholars also from developing countries, led to a stream of problematic policy recommendations. The recommendations were naturally directed at closing the widening technology gap by promoting scientific and technological outputs while reemphasizing the weight of scientific R&D.[33] The policy recommendations further called for the adoption of technical manpower, incentivizing scientific publications, and the promotion of patenting of state-of-the-art technology *per se*, as proxy for innovation itself.[34] So much so, that until this day, most of what is typically labeled in international intellectual property law as "innovation policy" continues to focus on improving R&D intensity as the chief growth related indicator. This innovation policy is moderately based on Romer's endogenous growth theory while implicitly adhering to a linear growth model for all countries.

B. *Of Patenting as Linear Innovation*

Numerous international intellectual property instruments emphasizing patent-related policies adhere to the idea of linear innovation. These models draw a parallel to the creation of the United Nations' innovation policy-related organs, notably the WTO's signing of the TRIPS Agreement and the innovation-related policy by the WHO. It similarly draws parallel to the recent policy initiatives by the WIPO, and more broadly the Washington Consensus' macroeconomic reform package promoted

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[32] *See generally* HANS WOLFGANG SINGER, *The Sussex Manifesto: Science and Technology for Developing Countries during the Second Development Decade*, *in* I.D.S. REPRINTS NO. 101, (Institute of Development Studies 1974) (1970).

[33] *See* GREGORY TASSEY, THE ECONOMICS OF R&D POLICY 54–55, 226 (1997); *see generally* Patel, *supra* note 15; Jeffrey L. Furman, Michael E. Porter & Scott Stern, *The Determinants of National Innovative Capacity*, 31 RES. POL'Y 899, 900 (2002).

[34] *See* Tassey, *supra* note 33.

for crisis-wracked developing countries by the IMF, World Bank, and the United States Treasury Department, as will be discussed herein.

UN organs and WIPO and the United Nations Conference on Trade and Development ("UNCTAD") have systematically fallen short in devoting substantial attention to innovation-policy differences between developing and developed countries, before the establishment of the WTO and TRIPS.[35] It was, therefore, only natural that upon its adoption, the TRIPS Agreement merely consisted of a flat intellectual property policy for all WTO-members, corresponding with a neoclassical economic growth modeling.[36]

In essence, from the standpoint of developing countries, mandatory adoption of TRIPS standards created two related exogenous costs towards the developed world: the cost of reduced access to new technologies and knowledge and the cost of higher

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[35] Particularly, the failing New International Economic Order was a set of proposals put forward during the 1970s by numerous developing countries through UNCTAD to promote their interests by improving their terms of trade based on technology transfer (per technological goods) mostly. The term was derived from the Declaration for the Establishment of a New International Economic Order, adopted by the United Nations General Assembly in 1974, and referred to a wide range of trade, financial, commodity, and debt-related issues. *See* Resolution, U.N. General Assembly, *Declaration for the Establishment of a New International Economic Order*, U.N. DOC. A/RES/S-6/3201 (1974).

For theoretical and empirical studies, see generally Helge E. Grundmann, *Foreign Patent Monopolies in Developing Countries: An Empirical Analysis*, 12 J. DEV. STUD. 186 (1976); J. Katz, *Patents, The Paris Convention and Less Developed Countries* 24–27 (Yale Univ. Econ. Growth Center, Discussion Paper No. 190, 1973); Douglas F. Greer, *The Case Against Patent Systems in Less-Developed Countries*, 8 J. INT'L L. & ECON. 223, 225 (1973). UNCTAD has changed course afterwards. *See infra* n. 154–56 and accompanying text.

[36] *See* Daniel Benoliel & Bruno Salama, *Towards an Intellectual Property Bargaining Theory: The Post-WTO Era*, 32 U. PA. J. INT'L L. 265, 278 (2010); MICHAEL BLAKENEY, THE INTERNATIONAL PROTECTION OF INDUSTRIAL PROPERTY: FROM THE PARIS CONVENTION TO THE TRIPS AGREEMENT 16 (2003), *available at* http://www.wipo.int/export/sites/www/arab/en/meetings/2003/ip_cai_1/pdf/wipo_ip_cai_1_03_2.pdf.

royalty payments.[37] Against that backdrop, TRIPS held up international intellectual property protection as a central pillar for both short and long-run economic growth, effectively ignoring country group differences. This argument stood for two long-run neoclassic exogenous economic incentives offered by developed nations.[38] The first incentive promised to undertake positive efforts in the area of technology transfer—it being an archetypical form of a reflexive innovation policy towards the developing countries as the transferees.[39] The second incentive assured agricultural trade.[40] These incentives, backed by supportive agreements, were pivotal for the final acquiescence of developing countries to the TRIPS agreement.[41] Both incentives also implicitly adhered to Solow's neoclassical growth model, formulated earlier by economists

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[37] *See* Christopher S. Gibson, *Globalization and the Technology Standards Game: Balancing Concerns of Protectionism and Intellectual Property in International Standards*, 22 BERKELEY TECH. L.J. 1403, 1406 (2007).

[38] *See, e.g.*, Carolyn Deere, *Developing Countries in the Global IP System*, *in* THE IMPLEMENTATION GAME: THE TRIPS AGREEMENT AND THE GLOBAL POLITICS OF INTELLECTUAL PROPERTY REFORM IN DEVELOPING COUNTRIES 34, 51 (2009); Peter Yu, *Towards a Nonzero-Sum Approach to Resolving Global Intellectual Property Disputes: What We Can Learn from Mediators, Business Strategists, and International Relations Theorists*, 70 U. CIN. L. REV. 569, 635 (2001). *Cf.* Christine Thelen, *Carrots and Sticks: Evaluating the Tools for Securing Successful TRIPs Implementation*, XXIV TEMP. J. SCI. TECH. & ENVTL. L. 519, 528–33 (2006) (discussing four incentive mechanisms tailored for developing countries within TRIPS, namely creating short and long-term economic growth, technical assistance and additional time to become compliant).

[39] *See* Laurence R. Helfer, *Regime Shifting: The TRIPS Agreement and New Dynamics of International Intellectual Property Lawmaking*, 29 YALE J. INT'L L. 1, 2 (2004); CARLOS M. CORREA, INTELLECTUAL PROPERTY RIGHTS, THE WTO AND DEVELOPING COUNTRIES: THE TRIPS AGREEMENT AND POLICY OPTIONS 18 (2000) (focusing on developing country's concern for increasing technological transfer as means of economic growth). For broader long-run economic growth concerns by developing countries, see also Thelen, *supra* note 38, at 528–29.

[40] *See* Helfer, *supra* note 39, at 22; Clete D. Johnson, *A Barren Harvest for the Developing World? Presidential "Trade Promotion Authority" and the Unfulfilled Promise of Agriculture Negotiations in the Doha Round*, 32 GA. J. INT'L & COMP. L. 437, 464–65 (2004).

[41] Johnson, *supra* note 40, at 467–68.

David Cass,[42] and Tjalling Koopmans, as explained.[43] Neither the incentives nor the TRIPS Agreement at large incorporated substantive efforts to differentiate between country clusters nor otherwise consider a non linear underlying innovation theory.

Notwithstanding its deep-rooted innovation implications, TRIPS was predominantly accepted as a trade-related compromise.[44] Rooted in dependency theories of development whereby developing countries were flatly perceived to be dependent on developed ones, freer trade was said to immiserate countries of the "periphery."[45] TRIPS' trade-related stand may further have explained its exogenous economic stand all together.

The acceptance of TRIPS reflected the unequal, yet flat, bargaining power between developed and the group of developing countries in its entirety. The bargaining between developed and developing countries permitted developed countries to receive stronger protection for intellectual property rights as well as a

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[42] Cass, *supra* note 19.

[43] Koopmans, *supra* note 20, at 226–28.

[44] *See* JAYASHREE WATAL, INTELLECTUAL PROPERTY RIGHTS IN THE WTO AND DEVELOPING COUNTRIES 20 (2001) (explaining how developed countries agreed to phase out their quotas under the ATC (Agreement on Textiles and Clothing) on the most sensitive items of textiles and clothing in exchange for developing countries' acceptance to the phasing-in of product patents for pharmaceuticals which they perceived as the most important patent-related good). *See also* Frederick M. Abbott, *The WTO TRIPS Agreement and Global Economic Development*, *in* PUBLIC POLICY AND GLOBAL TECHNOLOGICAL INTEGRATION 39, 39–40 (Frederick M. Abbott & David J. Gerber eds., 1997); Deere, *supra* note 38, at 2; Charles S. Levy, *Implementing TRIPS—A Test of Political Will*, 31 LAW & POL'Y INT'L BUS. 789, 789–90 (2000) (describing TRIPS as a historical breakthrough even whereby minimal standards alone were set for international property rights concerning international trade).

[45] *See, e.g.*, Raul Prebisch, *International Trade and Payments in an Era of Coexistence: Commercial Policy in the Underdeveloped Countries*, 49 AM. ECON. REV. 251, 251–52 (1959) (offering examples of reasoning used by developing "periphery" countries fostering an aversion to increasing free trade). For a seminal Latin-American perspective, see FERNANDO HENRIQUE CARDOSO & ENZO FALETTO, DEPENDENCY AND DEVELOPMENT IN LATIN AMERICA 149–71 (Marjory Mattingly Uriquidi trans., University of California Press 1979) (depicting the tension between Latin American nationalist and populist political agendas and its impact on related international trade policies).

reduction in restrictions against foreign direct investment.[46] Less developed countries, in return, obtained lower tariffs on textiles and agriculture and protection against unilateral sanctions.[47]

In short, given its unique mixture of exogenous economical trade rules and fairly flat international intellectual property concepts, TRIPS never adhered to an endogenous economic growth model. TRIPS did not adhere to any particular innovation policy, but did adhere to one that was implicitly linear.

This rather implicit linear innovation inclination eluded developed countries and also developing countries. The developing countries instead mostly adhered to "inherent asymmetries and imbalances" as a trading constraint. That is, within the WTO's trading system and the Uruguay Round Agreements, including TRIPS, such a confrontational approach was almost certainly constituted at the Fourth WTO Ministerial Conference at Doha Qatar in 2001.[48] History, henceforth, recalls the resilient standoff by the Group of 77 and China per trading issues thereof.[49] Doha, nonetheless, should also be recalled as their reactive innovation policy slip.

The TRIPS Agreement (a neoclassical economic growth modeling corresponding with an implicit linear "one size fits all" international intellectual property approach) adds two particularly narrow exceptions as described in Table 1 (See below). Article 65 of the TRIPS Agreement provides less developed and transitional

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[46] *See* Watal, *supra* note 44, at 20; *see also* Abbott, *supra* note 44, at 39–40, 42.

[47] *See* Watal, *supra* note 44, at 20–22 (describing the sanctions imposed until the broad inauguration of the TRIPS agreement by the United States and other developed countries via the mandatory settlement process).

[48] *See* World Trade Organization, Declaration of the Group of 77 and China on the Fourth WTO Ministerial Conference at Doha, Qatar, WT/L/424 (Oct. 22, 2001), *available at* http://www.wto.org/english/thewto_e/minist_e/min01_e/proposals_e/wt_l_424.pdf.

[49] *See* Inge Govaere & Paul Demaret, *The TRIPS Agreement: A Response to Global Regulatory Competition or an Exercise in Global Regulatory Coercion?*, *in* REGULATORY COMPETITION AND ECONOMIC INTEGRATION: COMPARATIVE PERSPECTIVES 364, 368–69 (Daniel C. Esty & Damien Geradin eds., 2001).

countries with a five-year transitional period.[50] Article 66 more notably provides least developed countries ("LDCs") with an eleven-year transitional period.[51] Such pretentious egalitarian dialectic was seen, however, merely as a means to create "a sound and viable technological base" in these countries.[52] Article 66 thus limits taking-only technological transfer, in favor of a disputed dependency development theory.[53] Surely, both the Less-Developing Countries cluster and the Emerging Economies were ignored. Instead, an implied linear innovation theory presided.

Table 1: Agreement on Trade-Related Aspects of Intellectual Property Rights, 1994 (TRIPS) Patent-Related Policy

Developing Countries (162)			**Developed Countries** (32)
Least Developing Countries (LDCs) (TRIPS & IMF/WB)	**Less-Developing Countries** (IMF/WB)	**Emerging Economies** (24) (IMF/WB)	
Angola	Ecuador	China	
DR Congo	Columbia	India	
	Nigeria	Russian Federation	
	Egypt	Brazil	
	Azerbaijian	South Africa	

An examination of the actions of WHO offers an analogous following innovation policy blunder; In particular, the reliance on R&D as a motor of innovation of pharmaceuticals. In an analogous manner to the bargaining situation assumed by the UN

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[50] Agreement on Trade-Related Aspects of Intellectual Property Rights art. 65(1)–(3), Marrakesh Agreement Establishing the World Trade Organization, Annex 1C, 1869 U.N.T.S. 299 (Apr. 15, 1994), *available at* http://www.wto.org/english/docs_e/legal_e/27-trips.pdf.

[51] *Id.* at art. 66(1); Benoliel & Salama, *supra* note 36, at 360.

[52] Agreement on Trade-Related Aspects of Intellectual Property Rights, *supra* note 50, art. 66(2) (requiring developed countries to provide commercial incentives to encourage transfer of technology to least developed countries).

[53] *Id.*

in creating TRIPS, WHO similarly failed to adhere to a separate innovation policy given the underdeveloped world's fairly puzzling innovation activity characteristics.[54] For example, as of May 24, 2008, the World Health Assembly ("WHA"), the decision-making body for the WHO, released a document entitled "Global Strategy and Plan of Action on Public Health, Innovation and Intellectual Property."[55] In the report, WHO Member States suggest implementing strategies to promote R&D for diseases endemic in developing countries.[56] An Intergovernmental Working Group ("IGWG") consisting of representatives from over twenty countries developed these strategies.[57] One stated aim of the action plan was to "explor[e] a range of incentive mechanisms . . . [and] address[] the de-linkage of the costs of research and development and the price of health products and methods."[58] Some of the proposed strategies include open source research, patent pools, and prizes.[59] Yet rather unsurprisingly, soon after, on January 21, 2009, the WHO released a policy document entitled "Proposed Time Frames and Estimated Funding Needs" to implement the WHO IGWG plan of action.[60] The total cost estimate to implement the WHO IGWG plan of action was said to be $2.064 billion dollars, with a proposed time frame from 2009 to 2015.[61] Similarly to TRIPS, however, TRIPS' implementation again assumed the

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[54] Sixty-First World Health Assembly [hereinafter WHA], World Health Organization [hereinafter WHO], *Global strategy and plan of action on public health, innovation and intellectual property*, at 1, WHA61.21, (May 24, 2008), *available at* http://www.who.int/gb/ebwha/pdf_files/A61/A61_R21-en.pdf; Exec. Bd. 124th Session, WHO, *Public health, innovation and intellectual property: global strategy and plan of action: Proposed time frames and estimated funding needs*, at 1, EB124/16 Add.2 (Jan. 21, 2009), *available at* http://www.who.int/gb/ebwha/pdf_files/EB124/B124_16Add2-en.pdf.

[55] WHO Exec. Bd., *supra* note 54; 2008 WHA Report, *supra* note 54.

[56] WHO, *supra* note 54, at 1, 6.

[57] *See* WHO, *Public health, innovation and intellectual property and trade; Expert Working Group on R&D Financing*, http://www.who.int/phi/R_Dfinancing/en (last visited September 22, 2013) [hereinafter Expert Working Group].

[58] 2008 WHA Report, *supra* note 54, at 5.

[59] *Id.* at 10, 14, 16–17.

[60] Exec. Bd. 124th Session, *supra* note 54, at 1.

[61] *Id.* at 1–2.

rather unattainable internationalized MNC-led R&D activity. That is, the plan adopted a flat intellectual property policy, with no adherence to the rather dreary innovation conditions in distinct developing countries and possibly developing country clusters.[62]

A third United Nations organ to manifest an implicit linear, and thus flat, innovation policy towards both developing and developed countries is assumed by WIPO. Throughout the 1990s, WIPO's Secretariat was sympathetic to policy goals promoting developing countries. Yet, as Professor Laurence Helfer foretold, this early witnessed inclination shifted to the General Agreement on Tariffs and Trade's ("GATT") market power-based policies. With the establishment of the WTO, this shift finally formalized to the benefit of intellectual property-based industries in the developed world, including public health, biosciences, and the genetic industrial sectors.[63] To date, WIPO interprets its legislative mandate as one of progressively promoting intellectual property rights, again, flatly. It does so while admitting, however, that little is known about how innovation takes place in lesser developed economies and what incentivizes it.[64] This attitude is exemplified in the organization's flat promotion of recent agreements on the electronic transmission of works protected by copyrights or related rights,[65] and in its ongoing negotiations concerning the harmonization of patent rights.[66] As Professors Keith Maskus and

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[62] *See generally* 2008 WHA Report, *supra* note 54, at 1; WHO Exec. Bd., *supra* note 54, at 1–2.

[63] *See* Helfer, *supra* note 39, at 3–4.

[64] WIPO Economics & Statistics Series, *World Intellectual Property Report—The Changing Face of Innovation* 26 (2001). For a critique of the Secretariat's interpretation of WIPO's mandate see Keith E. Maskus & Jerome H. Reichman, *The Globalization of Private Knowledge Goods and the Privatization of Global Public Goods*, 7 J. INT'L ECON. L. 279, 294 n.54 (2004) (citations omitted).

[65] *See generally* WIPO Copyright Treaty, Dec. 20, 1996, 2186 U.N.T.S. 121 WIPO Doc. CRNR/DC/94 (23 December 1996), WIPO Doc. CRNR/DC/95 (23 December 1996), *available at* http://www.wipo.int/treaties/en/ip/wct/summary_wct.html (noting that not even the TRIPS Agreement equivalent extensions for less developing countries are to be found at the Copyright Treaty of 1996).

[66] *See generally* WIPO Standing Committee on the Law of Patents, Tenth Session, *Draft Substantive Patent Law Treaty*, SCP/10/2, *available at*

Jerome Reichman conclude, whether WIPO's strategy actually benefits innovation (and to which countries those benefits flow) seems to count for little in implementing the mandate.[67]

Lastly, archetypical linear innovation-based economic growth policies ultimately were incorporated, albeit implicitly, into a wider macroeconomic setting. The IMF, the World Bank, and the United States Treasury Department created a standard macroeconomic reform package promoted for crisis-wracked developing countries. Economist John Williamson coined them jointly as the *Washington Consensus*.[68] For developing countries these policies encompassed standard "package deal" policies in areas like macroeconomic stabilization, economic opening with respect to both trade and R&D investment, and the expansion of market forces within the domestic economy.[69] As seminal as the Washington Consensus became, its neoclassical economic and protectionist approach towards innovation policy remained mostly uncorroborated. In retrospect, Joseph Stiglitz and others criticizing the policies' protectionist approach blamed Washington D.C. for stifling innovation or otherwise not foreseeing the policies' potential growth impact on developing countries.[70]

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http://www.wipo.int/edocs/mdocs/scp/en/scp_10/scp_10_2.pdf. For general background about the WIPO, Standing Committee on the Law of Patents can be found at http://www.wipo.int/patent-law/en/scp.htm.

[67] *See* Maskus & Reichman, *supra* note 64, at 294.

[68] John Williamson, *What Washington Means by Policy Reform*, *in* LATIN AMERICAN ADJUSTMENT: HOW MUCH HAS HAPPENED? 7, 7 (John Williamson, ed. 1990). *See generally* Dani Rodrik, *Goodbye Washington Consensus, Hello Washington Confusion? A Review of the World Bank's "Economic Growth in the 1990s: Learning from a Decade of Reform"*, 44 J. ECON. LITERATURE 973 (2006).

[69] *See generally* Williamson, *supra* note 68.

[70] *See, e.g.*, Joseph Stiglitz, Chief Economist, World Bank, *More Instruments and Broader Goals: Moving Toward the Post–Washington Consensus*, address at the 1998 WIDER Annual Lecture 17 (Jan. 7, 1998) (transcript available at http://time.dufe.edu.cn/wencong/washingtonconsensus/instrumentsbroadergoals.pdf) ("The usual argument—that protectionism itself stifled innovation—was somewhat confused. Governments could have created competition among domestic firms, which would have provided incentives to import new technology."); *see also* Wing Thye Woo, *Some Fundamental Inadequacies of*

Even to date no empirical findings strictly correlate the ultimate demise of Washington's growth policies with innovation-led economic growth or theoretical variances thereof. It is nonetheless disappointing that in the past fifty-seven years only six economies—Hong Kong, China, Japan, Korea, Malta, Singapore, and Taiwan, China—have made the growth transition from developing to developed economies notwithstanding their innovation policy stance.[71] Another elegy of this overly broad "catch up" growth narration—again largely non indicative of linear innovation policies *per se*—is evident through examination of developing countries that have had at least twenty-seven years of consecutive growth above seven percent since 1950. The World Bank's Growth Commission Report of 2008 found only thirteen economies that had achieved such high rates of growth.[72]

While subjecting the World Bank's ubiquitous invocation of rule of law-related policies to the trenchant critique of the Washington Consensus, scholars like Portuguese economist Alvaro Santos offered a distinct break in the World Bank's much criticized policy. He and others labeled it as a post-Washington Consensus

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the Washington Consensus: Misunderstanding the Poor by the Brightest, at 1 *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=622322 ("The Washington Consensus is too hooked upon trade-led growth to acknowledge that science-led growth is becoming even more important.").

[71] *See* World Bank, *Innovation Policy: A Guide for Developing Countries* (2010), at 43, *available at* https://openknowledge.worldbank.org/bitstream/handle/10986/2460/548930PUB0EPI11C10Dislosed061312010.pdf?sequence=1; *see also* World Bank Comm'n on Growth & Dev., *The Growth Report Strategies for Sustained Growth and Inclusive Development* (2008), at 111, *available at* http://www.ycsg.yale.edu/center/forms/growthReport.pdf (adding that the 10 largest developing countries "account for about 70 percent of developing countries' GDP," that industrialized countries' secular growth rate is approximately 2 percent per capita, and that "[s]ince 1960, only 6 countries have grown faster than 3 percent in per capita terms . . . .").

[72] The list of thirteen includes the six countries mentioned above that became developed countries—Hong Kong, China, Japan, Korea, Malta, Singapore, and Taiwan, China—plus seven others that are still developing: Botswana, Brazil, China, Indonesia, Malaysia, Oman, and Thailand. Except for Botswana and China, these nations have not sustained their rate of growth, thereby preventing these other developing countries from making the transition into developed ones. *See* World Bank, *supra* note 71.

development model thus marking the "fall of neoliberal thinking."[73]

C. *Towards Non Linear Innovation Patenting*

The height of the demise of the Washington Consensus by the mid-1990s came late in comparison with late 1970s key innovation theoretical findings.[74] By the mid-1990s economists such as David Mowery and Nathan Rosenberg had already predicted for over a decade the death of the neoclassical linear-model of innovation causality in technology and science or markets.[75] As Mowery and Rosenberg further explained in their 1991 Cambridge University Press monograph titled "Technology and the Pursuit of Economic Growth," the contributions of economics to the understanding of technology and economic growth have been constrained by the theoretical framework employed within neoclassical economies.[76] Innovation causation was to be replaced with the recognition that

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[73] Alvaro Santos, *The World Bank's Uses of the "Rule of Law" Promise in Economic Development*, *in* THE NEW LAW AND ECONOMIC DEVELOPMENT: A CRITICAL APPRAISAL 253, 267 (David M. Trubek & Alvaro Santos eds., 2006). Neoliberalism surely incorporates free markets, the liberalization of trade and finance, and a limited role for the state in the economic and social organization of society. *See* DAVID HARVEY, A BRIEF HISTORY OF NEOLIBERALISM 2–4 (2005); *see also* HA-JOON CHANG, GLOBALIZATION, ECONOMIC DEVELOPMENT AND THE ROLE OF THE STATE 47–50 (2003).

[74] *See, e.g.*, John Weeks & Howard Stein, *Washington Consensus*, *in* THE ELGAR COMPANION TO DEVELOPMENT STUDIES 676, 676 (David Alexander Clark ed., 2006) ("The Consensus reigned hegemonic in international development policy from the early 1980s to the mid-1990s, when it came under sustained attack.").

[75] *See, e.g.*, David Mowery and Nathan Rosenberg, *The Influence Of Market Demand Upon Innovation: A Critical Review of Some Recent Empirical Studies*, 8 RES. POL. 102, 103 (1979) (criticizing the imbalanced attention given to demand-side innovation policy considerations, the authors state, "Little consideration has been paid to the study, at a less aggregated level, of the specific innovative outputs of industries and firms, and the forces explaining differences among industries, firms and nations.").

[76] *See* DAVID C. MOWERY & NATHAN ROSENBERG, TECHNOLOGY AND THE PURSUIT OF ECONOMIC GROWTH 4 (1991) ("The neoclassical economic framework for the analysis of R&D and innovation says very little if anything about the institutional structure of the research systems of advanced industrial economies . . . ."); *see also id.* at 16, 96 (providing similar conclusion).

innovation—being endogenous and non linear—involved a complex and country specific mix of new knowledge and new demand, with the exact blend being technology, firm and time specific.[77]

The studies, especially the abovementioned Science Policy Research Unit's, were primarily concerned with determinants of success and failure in industrial innovation. These studies, therefore, were far less concerned with the determinants of the rate and direction of the innovative activity *per se*.[78]

A novel critique has originated from evolutionary economics and presently represents a departure from earlier neoclassical theories and assumptions.[79] The theory is based on the Schumpeterian vision of the economic world as a chain of disequilibria, plainly dynamic and evolutionary, but which regards invention as an endogenous process rather than an exogenous force acting on the economic scheme. As its two early advocates, Sidney Winter and Richard Nelson, theorized in their 1982 book titled "An Evolutionary Theory of Economic Change," critique over neoclassical economics linear growth causality over innovation justified an adapted new setting for innovation theory.[80]

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[77] *See generally* GERHARD MENSCH, STALEMATE IN TECHNOLOGY: INNOVATIONS OVERCOME THE DEPRESSION (1979) (criticizing linear innovation using the example of computers in the United Kingdom during the sixties while arguing linear representations of innovation processes thereof are poorly explained linearly); SCI. POL'Y RESEARCH UNIT, REPORT ON PROJECT SAPPHO 1971 (detailing a study of management of innovation in two science-based industries, chemicals and scientific instruments, identifying the factors which distinguish innovations that achieved commercial success). *But see* Slavo Radosevic and Esin Yoruk, *SAPPHO Revisited: Factors of Innovation Success in Knowledge-Intensive Enterprises in Central and Eastern Europe*, (DRUID Working Paper No. 12-11), *available at* http://www3.druid.dk/wp/20120011.pdf.

[78] The last straw for the linear model was its inability to explain how Japan could be so successful with technology despite lacking a world-class science base as opposed to British firms. *See generally* Dianna Hicks, T. Ishizuka, & S. Sweet, *Japanese Corporations, Scientific Research and Globalization*, 23 RES. POL'Y 4 (1994) (rejecting that Japanese companies are "free riders" on world science as their science draws most heavily on Japanese, not foreign sources).

[79] *See* Léger & Swaminathan, *supra* note 12.

[80] For a critique of neoclassical growth theory for being overly generalized as

Evolutionary economics models incorporated an interactive effect between variables, as opposed to the impact that any single variable might have, in explaining the process of innovation and diffusion. Arguably, the models may ultimately withstand the dynamic impact of innovation country clusters as opposed to a single or linear innovation model.

Notably, the United States government much later also admitted in its 2008 United States President's Council of Advisors on Science and Technology ("PCAST") report that there has been a growing need for a non or at least less-linear innovation theory and policy as a whole.[81] Recently, such findings have been evenly witnessed throughout the ever-growing literature on non-linear innovation causation within developing countries' scholarship.[82]

Following on the tails of non-linear innovation analysis, one distinct theory has started to transform into policy within the

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said, see generally Ricardo Hausmann, Dani Rodrik & Andrés Velasco, *Getting the Diagnosis Right: A New Approach to Economic Reform*, 43 FIN. & DEV. 12 (2006); Ricardo Hausman, Dani Rodrik & Andrés Velasco, *Growth Diagnostics*, *in* THE WASHINGTON CONSENSUS RECONSIDERED: TOWARDS A NEW GLOBAL GOVERNANCE (Narcís Serra & Joseph Stiglitz eds., 2008); Dani Rodrik, *The New Development Economics: We Shall Experiment, But How Shall We Learn?* 24–28 (Harvard University, John F. Kennedy School of Government Faculty Research Working Papers Series, Paper No. RWP08-055, 2008) (stating that new development economics have become country-specific).

[81] *See* PRESIDENT'S COUNCIL OF ADVISORS ON SCIENCE AND TECHNOLOGY, UNIVERSITY-PRIVATE SECTOR RESEARCH PARTNERSHIPS IN THE INNOVATION ECOSYSTEM 1–2, 7, 31 (2008) (acknowledging the shift from a linear innovation paradigm into a non-linear, or less linear one).

[82] *See, e.g.*, N.C. Varsakelis, *The Impact of Patent Protection, Economy Openness and National Culture on R&D Investment: A Cross-Country Empirical Investigation* 30 RES. POL. 1059 (2001) (finding national culture to be a determinant of R&D intensity, using a panel of developing and industrialized countries); *see generally* Oscar Alfranca & Wallace E. Huffman, *Aggregate Private R&D Investments in Agriculture: The Role of Incentives, Public Policies, and Institutions*, 52 ECON. DEV. & CULTURAL CHANGE 1, 1–22 (2003) (showing that private agricultural R&D investments in EU countries also respond to the quality of the institutional environment, with an emphasis on bureaucracy, enforcement of contracts and IP protection); UNESCO Institute for Statistics, *Measuring R&D: Challenges Faced by Developing Countries*, UIS/TD/10-08 (2008), *available at* http://www.uis.unesco.org/Library/Documents/tech%205-eng.pdf.

OECD and the EU: "National Systems of Innovation" theory.[83] This seminal theory explains how innovation and technology development are the results of a complex set of domestic relationships among various state institutions[84] including enterprises, universities, and government research institutes. Developed by the renowned Danish economist Bengt-Åke Lundvall, "National System of Innovation" was initially used by the canonic Chris Freeman to explain the rise developing countries. Freeman's initial case study focused on Japanese innovative firms in the 1970s and 1980s when Japan was still a developing country. As said, this theory soon gradually became a core policy concept of OECD and EU. As an archetypical non-linear as well as endogenous innovation-based economic growth theory it has shifted focus to concentrating on the formal R&D system and technical education thereof bearing a country-specific policy orientation.[85]

Substantive empirical corroboration of the non-linearity between countries and group of countries, with emphasis on the gap between advanced and developing countries could now be achieved. Such reaching has been made possible particularly with the completion of an unprecedented and monumental country panel

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[83] For major academic contributions, see generally LUNDVALL, *supra* note 4; R. R. NELSON, NATIONAL INNOVATION SYSTEMS: A COMPARATIVE ANALYSIS, (Oxford Univ. Press, 1993); PATEL & PAVITT, *supra* note 4; Freeman, *supra* note 4. For a general overview, see ORG. FOR ECON. CO-OPERATION & DEV., *supra* note 3, at 57 (adding that the elements of the National Innovation System theory ("NIS") have close similarities to structuralist views stressing that "development is neither linear nor sequential, but a unique process shaped by a specific histor[ical,]" cultural, and socioeconomic context).

[84] *See* LUNDVALL, *supra* note 4 (incorporating elements and relationships in the national system of innovation, which interact in the production, diffusion and use of new, and economically useful, knowledge).

[85] The dramatic breakthrough for the theory was a three-year work program known as the Technology-Economy Programme ("TEP") leading to the TEP Report. The theory was later carried through also in subsequent OECD policy studies, such as the 1994 Jobs Study and the policy recommendations, the 1996 Technology, Productivity and Job Creation report, and the 1998 Technology, Productivity and Job Creation: Best Policy Practices. *See* LYNN K. MYTELKA & KEITH SMITH, INNOVATION THEORY AND INNOVATION POLICY: BRIDGING THE GAP 12–17 (2001).

dataset by the United Nations Educational, Scientific, and Cultural Organization ("UNESCO") Institute for Statistics Monumental Science and Technology ("S&T") in 2011. Developing countries that previously have rarely reported on consolidated R&D growth indicators and related S&T statistics systems have enormously contributed towards a highly detailed standardized country panel datasets. This means that the country panel datasets can be used instead of previous lesser R&D-related datasets and/or lesser-developed S&T national statistics systems.[86]

III. THE MODEL

A. *Overview*

Developing countries led by Emerging Economies differ in their propensity to attract FDI, trade, and technology.[87] Arguably, they also differ in their overall abilities to innovate and make use of intellectual property protection. Surely, traditional approaches typically depart from the well-known North/South dichotomy, or some variation thereof.[88] The differences in the economics of developing countries highlight, in particular, innovation asymmetries between Northern countries, which are deemed to generate innovative products and technologies, and Southern countries, which are generally deemed to consume them.[89]

Surprisingly, out of 162 developing countries twenty-five account for about ninety percent of the Gross Domestic Product ("GDP") of the developing countries. All but one of these twenty-five were emerging economies.[90]

IMF has recently labeled exactly twenty-four such countries as "Emerging Economies."[91] These underdeveloped economies—and

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[86] *See also* UNESCO, *supra* note 82, at 12.

[87] *See generally* Benoliel & Salama, *supra* note 36, at 275–90 nn.25–90.

[88] *See* Paul Krugman, *A Model of Innovation, Technology Transfer, and the World Distribution of Income*, 87 J. POL. ECON. 253, 254–55 (1979).

[89] *See* CORREA, *supra* note 39, at 11.

[90] World Bank Comm'n on Growth & Dev., *supra* note 71 (adding that the ten largest developing countries account for about 70 percent of developing countries' GDP).

[91] As of July 16, 2012 Emerging Economies include: Mexico, Argentina,

they alone—are presently perceived as hotbeds of meaningful innovation within the developing world.[92]

Another comparable (albeit informal) country group classification is the Newly Industrialized Countries ("NICs") topping the list of developing countries by GDP.[93] Essentially, NICs differ from the remaining developing countries because they possess large and relatively diversified domestic economies. This fact awards them the status of being strategic and fast-growing markets in and with which multinational corporations typically cannot refrain from investing or trading.[94] Consequently, NICs

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Pakistan, Brazil, Peru, Bulgaria, Philippines, Chile, Poland, China, Romania, Estonia, Russia, Hungary, South Africa, India, Thailand, Indonesia, Turkey, Latvia, Ukraine, Lithuania, Venezuela, and Malaysia. *See* World Economic and Financial Surveys, *World Economic Outlook*, INTERNATIONAL MONETARY FUND (Apr. 2013), http://www.imf.org/external/pubs/ft/weo/2013/01/pdf/text.pdf.

[92] Grace Segran, *As innovation drives growth in emerging markets, western economies need to adapt*, INSEAD (Jan. 25, 2011), http://knowledge.insead.edu/innovation-emerging-markets-110112.cfm?vid=515; *see also* SUBHASH CHANDRA JAIN, EMERGING ECONOMIES AND THE TRANSFORMATION OF INTERNATIONAL BUSINESS 46 (2006) (stating that considerable attention has been devoted to the growing prominence of emerging nations in recent years and projecting the emerging markets of Brazil, Russia, India, and China as potential future leaders of the global economy). Similarly, in her book "The Rise of 'The Rest' " Amsden identifies twelve countries that have acquired considerable manufacturing experience: China, Indonesia, India, South Korea, Malaysia, Taiwan, Thailand, Argentina, Brazil, Chile, Mexico and Turkey. *See* ALICE H. AMSDEN, THE RISE OF "THE REST": CHALLENGES TO THE WEST FROM LATE-INDUSTRIALIZING ECONOMIES 15 (2001).

[93] For a comparable analysis of twenty-two Newly Industrialized Countries (NICs), compare with ANIS CHOWDHURY & IYANATUL ISLAM, THE NEWLY INDUSTRIALISING ECONOMIES OF EAST ASIA 4–5 (1997) (listing the twenty-two countries categorized as NIEs and their respective GDP savings ratio, GNP per capita, share of manufacturing percentage, and human development index as of 1988). *See also* NIGEL GRIMWADE, INTERNATIONAL TRADE: NEW PATTERNS OF TRADE, PRODUCTION AND INVESTMENT 240–44 (1989) (discussing the qualities of a Newly Industrializing Country and the twenty-seven countries that could qualify for such a status). Accordingly, NICs tend to be more advanced than other developing countries and less so than developed countries. There is no official or undisputed set of criteria to define an NIC, so each author sets a list of countries according to her own criteria and methods.

[94] Just consider, for instance, the fact that China already has the same number of mobile-phone users—five-hundred million—as all of Europe.. *See*

capture a disproportionally large portion of the foreign direct investment that flows to developing countries.[95] Only Brazil, Mexico, South Africa, China, India, Malaysia, Philippines, Thailand, and Turkey would be considered NICs by popular categorization methods.[96]

Back to the Emerging Economies' taxonomy, they arguably hold political power to improve access to the world's intellectual output and thus lead remaining developing countries.[97] Their macroeconomics facilitates their growing ability to challenge TRIPS to adapt towards developed countries. Given these characteristics, the Emerging Economies henceforth serve as the focal point of the empirical analysis herein.[98]

"[M]ost efforts have concentrated on understanding the process in industrialized advanced countries rather than in developing ones."[99] UNESCO statistical reporting concerning developing countries as of 2010,[100] however, is now offering alternative empirical headway. As the UNESCO report suggests, developing countries' innovation systems and associated R&D or Gross Domestic Expenditure on R&D ("GERD") measurement systems exhibit wide variety.[101] "This variety possibly encompasses an

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Technology in Emerging Economies: Of Internet Cafes and Power Cuts, THE ECONOMIST, February 9, 2008, http://www.economist.com/ node/10640716.

[95] In turn, the remaining developing countries receive proportionally much smaller shares of FDI. *See, e.g.*, Ilene Grabel, *Internaitonal Private Capital Flows and Developing Countries*, *in* RETHINKING DEVELOPMENT ECONOMICS, 327–28 (Ha-Joon Chang ed., 2003) ("FDI flows are . . . highly concentrated in roughly ten large, middle-income countries . . . China, Brazil, Mexico, Argentina, Malaysia, Poland, Chile, South Korea, Thailand, and Venezuela.").

[96] *See* DAVID WAUGH, GEOGRAPHY, AN INTEGRATED APPROACH 576 (2000) (explaining that Newly Industrialized Countries are those developing countries who achieved a considerable level of industrialization).

[97] Rochelle C. Dreyfuss, *The Role of India, China, Brazil and the Emerging Economies in Establishing Access Norms for Intellectual Property and Intellectual Property Lawmaking*, IILJ Working Paper 2009/5, 1, 3, *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1442785.

[98] *See id.* at 1.

[99] *See* Swaminathan, *supra* note 12, at 1.

[100] *See* UNESCO, *supra* note 82.

[101] *See id.* at 7.

uneven concentration of R&D performers as well as an unequal empirical capacity to measure R&D [or GERD]."[102]

Emerging Economies leading the developing world as hotbeds for state-of-the-art innovation do most of the innovative activity thereof. In conjunction with innovation by developed countries, this Article proposes a conceptual and empirical comparison between the two groups of the North-South divide. This section thus offers a comparison between the twenty-four Emerging Economies as the hallmark of innovative developing countries, with the thirty-two Advanced Economies listed by the IMF as of 16 July, 2012.[103]

The model attempts to approximate innovation of state-of-the-art technology by the two country groups alongside the developing-developed potential innovation divide. The proposed model corresponds with Ed Mansfield's definition of the propensity to patent as the percentage of patentable inventions that are in fact patented.[104] The propensity to patent is expressed in "per firm" terms. "Per firm" means the percentage of innovative firms in a sector that have applied for at least one patent over a defined time period.[105]

In the early 1980s, as Scherer argued, not much was known about the systematic nature of the propensity to patent.[106] Since

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[102] *Id.* at 13.

[103] *See* World Economic and Financial Surveys, *supra* note 91 (stating that as of July 16, 2012 Advanced Economies include: Australia, Austria, Belgium, Canada, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, South Korea, Luxemburg, Malta, Netherlands, New Zealand, Norway, Portugal, Singapore, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Taiwan, United Kingdom, and United States).

[104] *See* Mansfield, *supra* note 1; Dreyfuss, *supra* note 97.

[105] Isabelle Kabla, *The Patent as Indicator of Innovation*, 1 NAT'L INST. STAT. & ECON. STUD. 56–71 (1996). *But see* Georg Licht & Konrad Zoz, *Patents and R&D: An Econometric Investigation Using Applications for German, European, and US Patents by German Companies* 3–4 (Zentrum fur Europaische Wirtschaftsforschung, ZEW Discussion Paper No. 96-19, 1996) (offering empirical evidence whereby large firms enjoy a higher patent propensity rate than small firms).

[106] Frederick Scherer, *The Propensity to Patent*, 1 INT'L J. INDUS. ORG. 107,

then, a growing stream of research of patented inventions has analyzed the extent to which patents are a reliable indicator of innovative activity. Five recent studies have estimated that elasticity of patent propensity is generally found to be positively corroborating the results of the patent/GERD correlation.[107] All the studies, however, were based on surveys performed solely on cross-sectional or panel data at the firm or industry-level within the developed world.[108] Within these narrow parameters, largely avoiding country and country cluster analysis, the propensity to patent literature focused on the following indications: differences between industries,[109] the type of institution and the type of

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107–08 (1983) ("[T]he quantity and quality of industrial patenting may depend upon chance, how readily a technology lends itself to patent protection, and business decision-makers' varying perceptions of how much advantage they will derive from patent rights[.]").

[107] *See generally* Mansfield, *supra* note 1; C. T. TAYLOR & Z. A. SILBERSTON, THE ECONOMIC IMPACT OF THE PATENT SYSTEM—A STUDY OF THE BRITISH EXPERIENCE (1973); Wesley M. Cohen, Richard R. Nelson & John P. Walsh, *Protecting Their Intellectual Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patent (or Not)* (Nat'l Bureau Econ. Research, Working Paper No. 7552, 2000); Jérôme Danguy et al., *The R&D-Patent Relationship: An Industry Perspective* (ECARES Working Paper No. 2010-038, 2010); Emmanuel Duguet & Isabelle Kabla, *Appropriation Strategy and the Motivations to Use the Patent System: An Econometric Analysis at the Firm Level in French Manufacturing* (NAT'L INST. STAT. & ECON. STUD. Working Paper No. G 9717, 2010). To illustrate, the largest survey so far for the United States is a 1996 survey by Cohen, Nelson & Walsh, which offered preliminary patent propensity rates for innovations, weighted by R&D expenditures, for a survey of 1065 American research laboratories in manufacturing. They report that a patent application was made for 51.5% of product innovations and for 33.0% of process innovations between 1991 and 1993. *See* Wesley M. Cohen, R. Richard Nelson & John Walsh, *Appropriability Conditions and Why Firms Patent and Why They Do Not in the American Manufacturing Sector*, Paper presented to THE ORG. ECON. CO-OPERATION & DEV. CONFERENCE ON NEW S&T INDICATORS FOR THE KNOWLEDGE BASED ECONOMY (1996).

[108] *See* Danguy, *supra* note 107, at 2; Iiro Mäkinen, *The Propensity to Patent: An Empirical Analysis at the Innovation Level*, Paper presented to ETLA—RESEARCH INST. FIN. ECON. 2 (2007) *available at* http://www.epip.eu/conferences/epip02/files/MAKINEN_The_propensity_to_patent.pdf.

[109] *See, e.g.*, James Bessen & Robert M. Hunt, *An Empirical Look at Software Patents*, 16 J. ECON. & MGMT. STRATEGY 157, 171–73 (2007); Cohen, Nelson &

research,[110] or the indices of "patent rights" based on the "strength" of patent systems.[111] To a limited degree, diversity within the propensity to patent led also to macroeconomics-related analysis. This analysis again focused almost entirely on differences across developed countries.[112]

Walsh, *supra* note 107; Bronwyn H. Hall & Rosemarie Ham Ziedonis, *The Patent Paradox Revisited: An Empirical Study of Patenting in the U.S. Semiconductor Industry, 1979–1995*, 32 RAND J. ECON. 101, at 111–12.

[110] *See, e.g.*, Bruno van Pottelsberghe de la Potterie & Carine Peeters, *Introduction: Advanced Research Findings and Fields for Further Research in Economics and Management of Intellectual Property*, *in* APPLIED ECONOMETRICS ASS'N SERIES, ECON. AND MGMT. PERSPECTIVES ON INTELLECTUAL PROP. RIGHTS (2006); *see generally* Michele Cincera, *Firms' Productivity Growth and R&D Spillovers: An Analysis of Alternative Technological Proximity Measures*, 14 ECON. INNOVATION & NEW TECH. 657 (2005).

[111] Theoretical work emerged with Ginarte and Park in 1997, and the updated versions published by Park in 2008 for 110 countries. *See* Walter Park, *International Patent Protection: 1960–2005*, 37 RESEARCH POL'Y 761, 2 (2008). *See generally* Juan C. Ginarte & Walter Park, *Determinants of Patent Rights: A Cross-National Study*, 26 RESEARCH POL'Y 283 (1997) (computing an index of patent strength, also known as the IPI index, or intellectual property index). In 2002, Josh Lerner expanded this approach for 60 countries, defining "strong" patent systems as those that are essentially applicant friendly. *See* Josh Lerner, *Patent Protection and Innovation Over 150 Years* 4–6 (Nat'l Bureau Econ. Research Working Paper No. 8977, 2002) (examining the patent laws of a comprehensive number of countries from 1960 to 1990, considering five components of the laws, namely the duration of protection, extent of coverage, membership in international patent agreements, provisions for loss of protection, and enforcement measures).

[112] *See* Jonathan Eaton, Samuel Kortum & Josh Lerner, *International Patenting and the European Patent Office: A Quantitative Assessment*, *in* PATENTS, INNOVATION AND ECONOMIC PERFORMANCE: ORG. ECON. CO-OPERATION & DEV. CONFERENCE PROCEEDINGS 27 (2004) (solely analyzing European patenting patterns by advanced economies). Laura Bottazzi and Giovanni Peri estimated the relationship between employment in R&D and generation of knowledge as measured by patent applications across OECD countries. *See* Laura Bottazzi & Giovanni Peri, *The International Dynamics of R&D and Innovation in the Short and in the Long Run* (Nat'l Bureau Econ. Research, Working Paper No. 11524, 2005). Jeffrey L. Furman, Michael E. Porter, and Scott Stern introduced a novel framework based on the concept of "national innovative capacity" as the ability of a country to produce and commercialize a flow of innovative technology over the long term. *See* Jeffrey

B. *Methodology*

The proposed model adheres to four methodological principles. At the outset, the analysis adheres to a formal statistical inference method to estimate the effect and the associated statistical significance of two hypotheses explained *infra* Part II.C.[113] The statistical comparison for patent propensity rates between the two groups of Advanced and Emerging Economies is modeled as follows. The number of patents corresponding to each pair (year, country) depends on the country, the year, and the GERD invested (during the third previous year per granted patents in a three year average delay at the United States Patent and Trademark Office ("USPTO")) and on the type.[114]

In the econometric model appropriate for present panel data, the dependent variable is the expected value of the yearly number of issued patents.[115] The explanatory variables include GERD (as offset), the country, the year, and the type, changing throughout time. This is expressed as interaction between the year and the group country classification (namely both Emerging Economies and Advanced Economies as the IMF classifies them). The

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L. Furman, Michael E. Porter & Scott Stern, *The Determinants of National Innovative Capacity*, 31 RESEARCH POL'Y 899 (2002). The survey uses a sample of seventeen OECD countries from 1973 through 1996. Few narrow exceptions for the focus on developed countries in examining patent propensity-related indications exist. *Id. See, e.g.*, David Matthew Waguespack, Jòhanna Kristìn Birnir & Jeff Schroeder, *Technological Development and Political Stability: Patenting in Latin America and the Caribbean*, 34 RESEARCH POL'Y 1570, 1572 (2005) (accounting for political stability or lack thereof over the propensity to patent by Latin American countries).

[113] The data analyzed formally for all countries will have at least four values of GERD and GERD-related data. The range of the available years of data is seven years at least (maximal year minus minimal year is equal to or greater than seven).

[114] The type effect is statistically assumed to be changing throughout time.

[115] The statistical assumption is that the number is distributed as a negative binomial. The latter type of distribution is a distribution of discrete probability of the number of successes in a sequence of Bernoulli trials before a specified (non-random) number of failures (denoted r) occur. In statistical terms, a Bernoulli trial is each repetition of an experiment involving only two outcomes. *See* JOSEPH M. HILBE, NEGATIVE BINOMIAL REGRESSION 185–87 (Diana Gillooly et al. eds., 2007).

longitudinal structure of the data (panel data) induces serial correlation between yearly observations corresponding to the same country, which were taken into account by the model.

A second principle follows. It adheres to a panel data counting method relates to the choice of a patent category search with the USPTO dataset. The model analyzes the USPTO granted patents. Thus, the model recognizes that issued patents, as opposed to patent applications, effectively serve as a proxy for R&D-related state-of-the-art quality output assurance. This is important because patent series are, by nature, subject to a substantial bias, with most patents generating low or no value and a few patents being associated with high economic value. Presently, patent statistics studies rarely thoroughly test the quality sensitivity of the results of the patent count methodology or the data source.[116] The qualitative methodological improvement in the proposed model counts archetypical state-of-the-art technology, which has successfully culminated as issued patents, instead of the mere filing of related patent applications. This methodological choice addresses the concern whereby the quantative innovative activity does not begin or otherwise conclude the patenting process, but in patents being prosecuted and finally granted.[117] Surely, only state-of-the-art technology that completes the USPTO patenting process is accounted for as issued patents. It is, therefore, a limitation of present patent statistics methods to measure patent applications as an indication of quality innovation.[118]

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[116] *See* ORG. ECON. CO-OPERATION & DEV., OECD SCIENCE, TECHNOLOGY AND INDUSTRY SCOREBOARD 2011, 1, 7 (2011); Danguy et al., *supra* note 107.

[117] *See, e.g.*, Bronwyn H. Hall, Adam B. Jaffe & Manuel Trajtenberg, *The NBER Patent Citations Data File: Lessons, Insights and Methodological Tools* 4 (Nat'l Bureau Econ. Research Working Paper No. 8498, 2001) (presenting main trends in U.S. patenting over the last 30 years, including a variety of original measures constructed with citation data).

[118] Patent statistics literature has irregularly considered this limitation. The earliest, most important contribution begins with Zvi Grilliches. *See* Zvi Grilliches, *Patent statistics as economic indicators: a survey*, 28 J. ECON. LITERATURE, 1661, 1696–97 (1990); *see also* Daniele Archibugi and Mario Pianta, *Measuring Technological Change Through Patents and Innovation Surveys*, 16 TECHNOVATION 451, 455 (1996) (offering an overview of recent

Another approach within the patent statistics literature has partly met this qualitative challenge. Instead of seeking to make inferences about the propensity to patent by estimating the patent production function, surveys have directly asked the firms about the fraction of innovations they generally patent.[119] This approach allows for the construction of a direct measure of the propensity to patent that is closely in line with the theoretical definition of the propensity to patent as the fraction of innovations that are accounted for as USPTO issued patents.

There are two additional methodological challenges concerning patent propensity measurement of developing countries *per se*. First, measuring patent propensity rates (as a proxy for innovation) by equivocating propensity to the number of patent applications filed poses a challenge.[120] With developing countries in particular, often many patent applications do not lead to patent issuance,

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research using innovation surveys and patent data as indicators of technological activity).

[119] Alfred Kleinknecht, Kees Van Montfort, and Erik Brouwer offer to replace patent/R&D rate analysis with measuring expenditure on innovation (including non-R&D-expenditure), sales of innovative products known which may be interpreted as an indicator of imitation, or otherwise innovation not introduced earlier by competitors, which may be interpreted as an indicator of "true" innovation. *See* Alfred Kleinknecht, Kees Van Montfort & Erik Brouwer, *The Non-Trivial Choice Between Innovation Indicators*, 11 ECON. INNOVATION & NEW TECH. 109, 113–14 (2002) (analyzing four alternative innovation indicators: R&D, patent applications, total innovation expenditure, and shares in sales taken by imitative and by innovative products measured in the Netherlands).

[120] *See, e.g.*, Anthony Arundel & Isabelle Kabla, *What Percentage of Innovations are Patented? Empirical Estimates for European Firms*, 27 RESEARCH POL'Y 127, 131 (1998); Emmanuel Duguet & Isabelle Kabla, *Appropriation Strategy and the Motivations to use the Patent System: An Econometric Analysis at the Firm Level in French Manufacturing*, 49/50 ANNALS ECON. & STAT. 289, 294 (1998); Mansfield, *supra* note 1, at 176 n.10 (adding neighboring methodological concerns, including the difficulty to estimate the proportion of patentable inventions that is disclosed and that unless the firm actually files, it may not be absolutely certain that a particular invention is patentable). Firms have become more disillusioned with the patent system and as they have devised other ways of protecting their technology thereby witnessing a lower propensity to patent between the late 1960s and early 1980s through the patents granted to U.S. inventors. *Id.* at 178–79

either nationally or at the USPTO level. The proposed method, therefore, corresponds with the above mentioned methodological definition of the propensity to patent as the percentage of patentable inventions that are, in fact, patented.[121]

A second patent panel data counting method and challenge relating to the particularities of the USPTO dataset follows. Patents are analyzed by the USPTO Inventor Country Nationality ("ICN") or United States Inventor State ("IS") search categories. These categories contain the country or state of residence of the inventor at the time of patent issue.[122] The ICN search category indicates the inventiveness of the local laboratories and labor force of a given country.

This counting method has never been used in earlier propensity to patent research and it enjoys three important advantages in comparison to all of the above mentioned methods of accounting for patent applications or other quantitative variations thereof. First, it replaces the "Patent Affiliate" or "Owner" alternative USPTO search categories, which mostly represent patenting activity by multi-national enterprises originating in advanced economies.[123] Second, the measurement of the ICN or IS search categories operate to minimize transaction costs associated with domestic patenting by developing countries. To illustrate, in the Mexican maize breeding industry, information, certification and enforcement costs were high enough to hamper the incentive effect

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[121] Mansfield, *supra* note 1, at 178–79.

[122] *Tips on Fielded Searching (Inventor Country (ICN))*, U.S. PATENT AND TRADEMARK OFFICE (2012), http://www.uspto.gov/patft/help/ helpflds.htm# Inventor_Country.

[123] ORG. FOR ECON. CO-OPERATION & DEV., PATENT STATISTICS MANUAL (2009) *available at* http://browse.oecdbookshop.org/oecd/pdfs/free/9209021e.pdf. *See generally* EMMANUEL HASSAN, OHID YAQUB & STEPHANIE DIEPEVEEN, INTELLECTUAL PROPERTY AND DEVELOPING COUNTRIES: A REVIEW OF THE LITERATURE (2010); Anna Bergek & Maria Bruzelius, *Patents with Inventors from Different Countries: Exploring Some Methodological Issues Through a Case Study*, Paper presented at the DRUID CONFERENCE ON DYNAMICS OF INDUSTRY AND INNOVATION: ORGANIZATIONS, NETWORKS AND SYSTEMS 6 (2005).

of intellectual property rights.[124] Similar conclusions were reached for a firm-level panel after the strengthening of intellectual property protection in Japan.[125] A following methodological advantage with the ICN search category choice concerns co-invention measurement. In some cases, at least one of the inventors on a patent belonging to an Emerging Economy may be foreign and may belong to an Advanced Economy nation.[126] The ICN search category solves this problem because it may account for either sole or co-inventions. All the same, USPTO co-inventions comprise roughly one percent of total inventions patented at the USPTO.[127]

With that said, there is need to account for the methodological choice whereby using the granted patent search category this study focuses solely at USPTO patenting activity. The reason for not expanding this article beyond the USPTO to the European or Japanese patent office is, however, undependable. To date, neither of the two other leading patent offices, namely the European and Japanese, which, including the USPTO, are jointly referred to as the "Triadic Patent family" (consolidated to eliminate double counting of patents filed at different offices)[128]—offer equivalent ICN search categories.

Furthermore, the rationales underlying the focus on USPTO-based patenting activity instead of the alternative aggregation of national patenting systems of both Advanced and Emerging Economies are twofold. The first reason is that countries, especially in the developing world, do not have the same

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[124] *See* Andréanne Léger, *Intellectual Property Rights in Mexico: Do They Play a Role?*, 33 WORLD DEV. 1865, 1875–76 (2005).

[125] Mariko Sakakibara & Lee Branstetter, *Do Stronger Patents Induce More Innovation? Evidence from the 1988 Japanese Patent Law Reforms*, 32 RAND J. OF ECON. 77, 77–100 (2001).

[126] OECD, *supra* note 123.

[127] Patel & Vega, *supra* note 15; Adam. B. Jaffe, Manuel Trajtenberg & Rebecca Henderson, *Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations*, 108 Q. J. OF ECON. 577, 577–98 (1993). *See generally* ORG. FOR ECON. CO-OPERATION AND DEV. COMPENDIUM OF PATENT STATISTICS, ECONOMIC ANALYSIS AND STATISTICS (2004).

[128] *See* OECD, *supra* note 123, at 71.

patentability criteria.[129] A second reason is that such countries may substantively differ in their national grant rates.[130] Both of these methodological partialities are mostly solved by USPTO-based patenting statistics based on the ICN search category whereby issued patents are sampled.

To be sure, the probable importance of future designed uniformed Triadic Inventor Country Nationality search category would support the fact whereby most R&D-related activity is concentrated in these geo-political regions.[131] Yet, in balance, a mitigating finding in support of this study's USPTO-based analysis holds that on average, only between ten to fifteen percent of patent priority filings become triadic patents in the first place whereas for the rest there is USPTO dominance for issued patents by foreign inventors.[132]

The proposed model also addresses the differences in price levels among countries and country groups.[133] The method employs a third methodological principle. It uses a calculation method whereby total domestic intramural expenditure on R&D during a given period by both Advanced and Emerging Economies country groups is expressed in Purchasing Power Parity ("PPP") United States Dollars by 2005 constant prices.[134] This serves as a calculation of competing national rates by currency conversion into United States Dollars. Then, expenditures on GNP for different national price indices are converted into a common currency by means of the PPP per 2005 constant prices; they are, in effect, expressed at the same set of national prices so that comparisons

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[129] *See* Dominique Guellec & Bruno van Pottelsberghe de la Potterie, *The Impact of Public R&D Expenditure on Business R&D* (OECD Science, Technology and Industry Working Papers, No. 2000/4, 2000).

[130] *Id.* at 8.

[131] Jacques Gaillard, *Measuring R&D in Developing Countries: Main Characteristics and Implications for the Frascati Manual*, 15(1) SCI. TECH. & SOC. 77, 81 (2010).

[132] Danguy et al., *supra* note 107.

[133] *Id.*

[134] United Nations Educational, Scientific and Cultural Organization (UNESCO) Glossary—63 Terms for Science & Technology, http://glossary.uis.unesco.org/glossary/map/terms/177 (last visited Oct. 2, 2013) (explaining this methodology was adapted from OECD (2002), Frascati Manual, § 423).

between countries reflect only differences in the volume of GERD-related goods and services purchased. This method thereby normalizes the patent propensity rate comparison between emerging and advanced country groups classifications.[135]

This study abides by a fourth methodological principle. Accordingly, the model uses statistical imputation to resolve patterns of patenting of GERD-related missingness for each year, country, and country group. Patent data at the USPTO website is available with no missing values for the entire sixteen years between 1996 and 2011. GERD-related data covers fifteen years between 1996 and 2010 with missing values. In some cases, no reliable imputation is possible because the range of time for which data is available is too narrow, such as with the case of the GERD date from the Philippines which has been deleted from the model presented in this Article. Whenever imputation methodology is statistically permissible, the following rules are used in calculating missing data. First, if there is missing data before the first available data point, the study uses the rule "first data carried before," thereby assigning the same value to all data points before the first available. Second, if there is missing data after the last available data point, the study uses the rule "last data carried over," thereby assigning the same value to all data points after the last one available. Third, if there is missing data between two data points, the study uses an interpolation between the two data points. The primary statistical analysis per the first two rules above showed that there were thirty-one countries (fifty-five percent) with full data, so that imputation was not required.

As a whole, the methodology used in the model adheres to the conceptualization and critique put forth by two OECD statistical manuals: the OECD Frascati Manual (2002) on R&D & GERD-related statistics[136] and the OECD/Eurostat Oslo Manual (2005) on

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[135] *Id.*

[136] *See generally* ORG. FOR ECON. CO-OPERATION & DEV., PROPOSED STANDARD PRACTICE FOR SURVEYS ON RESEARCH AND EXPERIMENTAL DEVELOPMENT: FRASCATI MANUAL 121 (defining GERD), 129–51 (giving basic definitions) (Org. for Econ. Co-operation and Dev. ed., 6th ed. 2002).

innovation-related statistics.[137] Both manuals put emphasis on the need to move beyond normative posturing by stakeholders, role players, and policy makers, to empirical observations. The OECD's Frascati Manual is the *de facto* standard for the internationally comparable measurement of R&D and GERD of OECD member states and associated observer states for the last fifty years.[138] The proposed model also adheres to two additional noticeable OECD manuals. The first of the two is the UNESCO Technical Paper No. 5, titled: Measuring R&D: Challenges Faced by Developing Countries (2010).[139] This manual provides guidance on a number of methodological challenges that are relevant to developing countries and which may not have been elaborated clearly enough in the Frascati Manual. Second is the OECD's Patent Statistics Manual of 2009,[140] which provides users and producers of patent statistics with basic guidelines used herein for compiling and analyzing such data. The latter manuals hold out the Frascati Manual as the most widely accepted international standard practice for R&D & GERD-related surveys.

C. *Findings*

1. *The North-South Patent Propensity Divide*

Two hypotheses were tested and the results supported both. The first of two hypotheses is that there is a significant yearly statistical difference (gap) in the patent propensity rates between emerging economies and advanced economies. This corroborates the notion that developing and developed countries are separated by a gap in an international propensity to patent.

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[137] *See generally* ORG. FOR ECON. CO-OPERATION & DEV. & EUROSTAT, OSLO MANUAL: GUIDELINES FOR COLLECTING AND INTERPRETING INNOVATION DATA 64–65 (Org. for Econ. Co-operation & Dev. ed., 3d ed. 2005) (offering breakdown by type of innovation activity).

[138] *See generally* Benoît Godin, *On the Origins of Bibliometrics*, 68 SCIENTOMETRICS 109 (2006) (offering a study on the history and present methods bibliometric measurement).

[139] *See* UNESCO, Measuring R&D: Challenges Faced by Developing Countries (UIS Technical Paper No. 5) (2010), *available at* http://www.uis.unesco.org/Library/Documents/tech%205-eng.pdf.

[140] *See* OECD, *supra* note 123.

The finding is shown with regard to the number of USPTO Issued Patents cataloging per national R&D expenditure measured as a percentage of GERD.[141] The finding upholds the argument that patent propensity rates by the two country clusters are comparatively non-linear instead of the linear rate promoted in neoclassical innovation literature and by organs of the United Nations as described.

Table 2 below offers a graphical illustration of two examples of yearly differences in country group classification in 1999 and 2011. As Table 2 shows, both examples uphold a significant clustered difference between Advanced Economies (colored in gray) and Emerging Economies (colored in white) concerning the patent propensity rates of their country members.

[141] *Id.* at 12.

Table 2: Patents/GERD ($100M)—Examples for 1999, 2011

Year 1999

Country	Pat/GERD ($100M)
Hong Kong	56.88
United States	46.02
Japan	33.07
Canada	29.23
Israel	28.40
Switzerland	28.31
Finland	25.69
Denmark	24.11
Sweden	21.14
Germany	21.03
Korea	20.29
Belgium	18.58
New Zealand	18.16
Netherlands	18.07
Austria	16.70
United Kingdom	14.72
France	12.97
Italy	12.75
Ireland	12.53
Singapore	12.46
Malaysia	12.21
Australia	11.76
Luxembourg	11.57
Thailand	11.37
Latvia	11.11
Iceland	10.50
Norway	9.27
South Africa	7.56
Hungary	6.72
Peru	5.25
Spain	4.94
Mexico	4.03
Argentina	4.00
Slovenia	3.78
Greece	3.20
Lithuania	3.14
Bulgaria	2.97
Slovakia	2.83
Russian Federation	2.49
Czech Republic	2.35
Poland	1.99
India	1.66
Brazil	1.46
Ukraine	1.34
Estonia	1.27
China	1.24
Portugal	1.09
Turkey	0.56
Pakistan	0.53
Romania	0.50
Cyprus	0.00
Malta	0.00

Year 2011

Country	Pat/GERD ($100M)
United States	41.58
Japan	35.65
Korea	32.28
Canada	30.26
Switzerland	29.96
Israel	25.96
Hong Kong	25.29
New Zealand	24.11
Netherlands	22.68
Germany	19.47
Belgium	19.12
Ireland	18.59
Denmark	18.44
Sweden	18.33
Finland	17.08
United Kingdom	16.68
Bulgaria	14.42
Singapore	14.42
France	14.33
Australia	14.29
Austria	14.00
Norway	13.50
Luxembourg	13.34
Malaysia	13.24
Italy	13.17
Malta	11.45
Thailand	10.66
Iceland	9.10
Hungary	8.10
India	7.85
Cyprus	7.68
Latvia	6.90
Slovakia	5.74
Greece	5.71
Estonia	4.65
China	4.50
Slovenia	4.39
Spain	4.27
Czech Republic	4.22
Peru	4.07
Romania	3.94
South Africa	3.76
Argentina	3.69
Mexico	3.58
Poland	3.56
Lithuania	2.52
Russian Federation	2.17
Ukraine	1.78
Brazil	1.65
Portugal	1.36
Turkey	1.29
Pakistan	0.54

Legend:

Advanced Economy
Emerging Economy

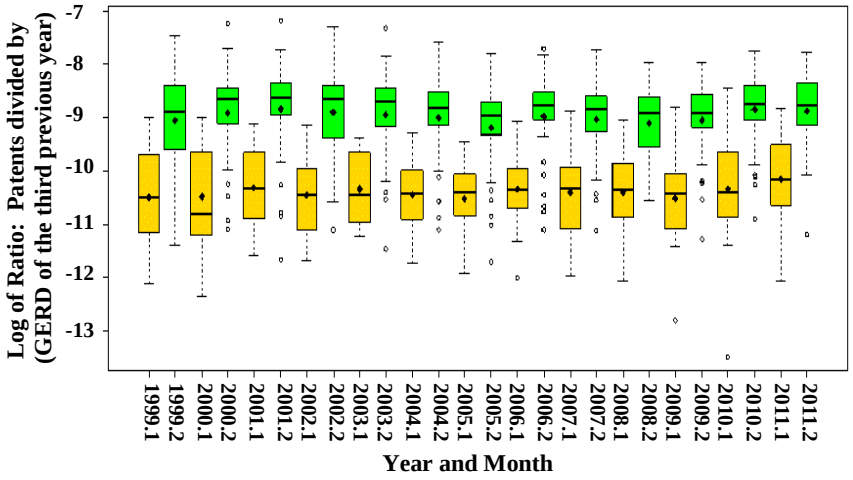
Table 3: Patents/GERD ($100M)—All Countries, All Years

'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11

Table 3 above further offers an aggregated summary for all years between 1999 and 2011. Tables 2 and 3 correspond to the statistical difference for every individual year thereof. The difference is further found to be highly significant for all thirteen years, with changes in its magnitude during the years.

For the preparation of Tables 2 and 3, boxplots were drawn for each country classification. Advanced Economies are displayed in yellow, and Emerging Economies are displayed in green. The final boxplot presented in Table 4 below displays the yearly log of the ratio per number of Patents/GERD (in $100 Million (U.S.)) to compare country classifications.

Table 4: Boxplots for Countries Classified as 1 vs. Countries Classified as 2



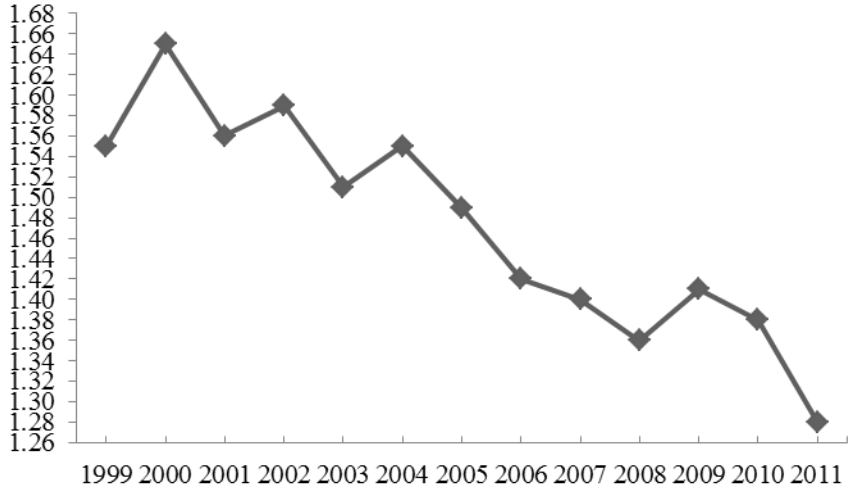
2. *Emerging Economies Upward Convergence*

The second hypothesis shows that the patent propensity rate gap between the two country clusters slowly, yet steadily decreases between 1996 and 2011. The difference was shown to be significantly smaller at the end of the time range compared with the beginning by a factor of 0.77. Table 5 and Graph 1 below show the estimated pattern of change in the gap, which systematically decreases over time. Table 5 below displays estimated values, conveniently marked in yellow (based on the fitted model) on the log Patents/GERD scale of the difference per year between the two classifications. Table 5 predicts a decline from -1.5509 in 1999 to -1.277 in 2011 as also shown in Graph 1 below.

Table 5: Estimated Yearly Differences of the Log Patents per GERD Between the Two Groups of Countries

Obs	Stmt No	Effect	Slice	Classification	_Classification	Estimate	StdErr	DF	TValue	Probt
1	1	Year* Classification	99	1	2	-1.5509	0.1283	65.58	-12.09	<.0001
2	1	Year* Classification	00	1	2	-1.6516	0.1360	82.44	-12.14	<.0001
3	1	Year* Classification	01	1	2	-1.5554	0.1241	16.48	-12.54	<.0001
4	1	Year* Classification	02	1	2	-1.5944	0.1227	27.23	-12.99	<.0001
5	1	Year* Classification	03	1	2	-1.5056	0.1177	21.86	-12.79	<.0001
6	1	Year* Classification	04	1	2	-1.5513	0.1173	51.63	-13.23	<.0001
7	1	Year* Classification	05	1	2	-1.4961	0.1189	37.66	-12.58	<.0001
8	1	Year* Classification	06	1	2	-1.4191	0.1183	52.60	-11.99	<.0001
9	1	Year* Classification	07	1	2	-1.3952	0.1170	58.93	-11.92	<.0001
10	1	Year* Classification	08	1	2	-1.3610	0.1115	35.58	-12.20	<.0001
11	1	Year* Classification	09	1	2	-1.4053	0.1148	141.60	-12.24	<.0001
12	1	Year* Classification	10	1	2	-1.3834	0.1127	38.55	-12.27	<.0001
13	1	Year* Classification	11	1	2	-1.2770	0.08972	3.183	-14.23	0.0005

Graph 1: Estimated Yearly Difference of the Log Patents per GERD Between the Two Groups of Countries



The empirical finding combined by Table 5 and Graph 1 follows the first hypothesis in validating the statistical gap between the two country-group classification based on their patent propensity rates. More specifically, it shows that the propensity to patent by the Emerging Economies cluster is slowly and steadily growing following a homogeneous marginal return of increase as compared to Advanced Economies.[142] This archetypical form of "upward convergence" is a case of poorer club members—the

[142] *But see* HA-JOON CHANG, KICKING AWAY THE LADDER: POLICIES AND INSTITUTIONS FOR ECONOMIC DEVELOPMENT IN HISTORICAL PERSPECTIVE 2 (2003) (arguing that TRIPS may increase the gap between the most technologically advanced and the least technologically advanced nations); CHRISTOPHER MAY, THE INFORMATION SOCIETY: A SCEPTICAL VIEW 2–3, 126–27 (2002) (debunking the role of the state in the midst of globalization of internationalized innovation and R&D). *See generally* Carlota Perez & Luc L. Soete, *Catching-Up in Technology: Entry Barriers and Windows of Opportunity*, *in* TECHNICAL CHANGE AND ECONOMIC THEORY 458 (1988).

cluster of Emerging Economies in this case—catching up to wealthier members—Advanced Economies herein.[143]

This basic empirical finding may correspond with "catch-up" literature concerning the pulling of other countries through a "catch-up" effect: In a recent seminal article, Harvard University economist Jérôme Vandenbussche and others state that the strength of this "catch-up" effect at the developing countries' frontier in fact decreases with the level of domestic technological creation.[144] As others have shown, as a result, technology creation by domestic firms may become progressively more important as a country moves closer to the technology frontier whereby technology diffusion and absorption declines. That is, catching up possibly translates into increasingly smaller technological improvement protected through incremental patenting activity.[145]

Thus far, endogenous growth economics has been rather poorly measured empirically. The empirical challenge is acute at the regional level.[146] As the evidence suggests, "the key factors stressed by endogenous growth theory—increasing returns, human capital, and technology—develop unevenly across the space economy and are locally and regionally differentiated."[147] Earlier accounts of endogenous growth theory's relation to club convergence between country groups have mostly been attributed to the understanding of archetypical club convergence over

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[143] *See, e.g.*, Dan Ben-David, *Convergence Clubs and Subsistence Economies*, 55 J. DEV. ECON. 155, 159 (1998).

[144] *See* Jérôme Vandenbussche, Philippe Aghion & Costas Meghir, *Growth, Distance to Frontier and Composition of Human Capital*, 11 J. ECON. GROWTH 97, 98 (2006) (using a panel of nineteen OECD countries to show how as a country gets closer to economic growth, it relies more and more on innovation); *see generally* HASSAN ET AL., *supra* note 8, at 17.

[145] *See* HASSAN ET AL., *supra* note 8, at 17. The latter argument concerning incremental patenting is outside the scope of this paper.

[146] *See* Ron Martin & Peter Sunley, *Slow Convergence? The New Endogenous Growth Theory and Regional Development*, 74 ECON. GEOGRAPHY 201, 220 (1988).

[147] *Id.*

salaries, GDP, and other macroeconomic income-related indications.[148]

Little accounts for endogenous convergence between country groups or clubs and domestic technological creation. Not much is known about how domestic technology creation is achieved through diffusion of technology through technological transfer from northern to southern country group clusters.[149] Moreover, very little is conceptually attributed to explaining how technological creation of country group clusters is determined.[150]

In fact, the only finding by this Article's second hypothesis concerning club convergence negates regional divergence between Advanced and Emerging Economies, showing the slow yet steady closure of this North-South patent propensity divide. In other words, slow regional convergence of innovation by Emerging Economies towards Advanced Economies measured through patent propensity rates is more telling than opposite regional divergence by the former country group.[151]

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[148] *Cf.*, Ben-David, *supra* note 143, at 169 (concluding that income gaps have increased within most possible groupings of countries in the world and that "convergence clubs" tend to be more prevalent at the two ends of the income spectrum).

[149] *See* Martin & Sunley, *supra* note 146, at 210 (citation omitted); STILIANOS ALEXIADIS, CONVERGENCE CLUBS AND SPATIAL EXTERNALITIES: MODELS AND APPLICATIONS OF REGIONAL CONVERGENCE IN EUROPE 61, 80–87 (Manfred M. Fischer et al. eds., 2013) (stating that such diffusion of technology requires that "technologically lagging economies have an infrastructure and appropriate conditions that will allow the effective adoption of new technology"); GEORGE H. BORTS & JEROME L. STEIN, ECONOMIC GROWTH IN A FREE MARKET 1 (1964) (offering a classic study of regional development in the United States); Jeffrey G. Williamson, *Regional Inequality and the Process of National Development: A Description of the Patterns*, 13 ECON. DEV. & CULTURAL CHANGE 1, 3–4 (1965) (analyzing the evolution of regional income differences in advanced industrial countries).

[150] *See* ALEXIADIS, *supra* note 149.

[151] *But see* Martin & Sunley, *supra* note 146, at 210 (referring to "the models of regional growth advanced by writers such as Perroux (1950, 1955), Myrdal (1957), and Kaldor (1970, 1981) [which] predict that regional incomes will tend to diverge, because market forces, if left to their own devices, are spatially disequilibrating.").

Some earlier work has been done on cross-sectional patent propensity, with practically no emphasis on regional country group comparisons. In the 1980s, Jan Fagerberg used cross-sectional and time-series data for only twenty-five industrial countries for the period 1960–1983. This rather limited sample included, in addition to nineteen OECD countries, only six of the most important industrial economies from the non-OECD area. Fagerberg's study thus served as an early significant, albeit partial, confirmation that there exists a close correlation between the level of economic development, measured as GDP per capita, and the level of technological development, measured through R&D or patent statistics.[152]

Notwithstanding the present empirical absence of data on the exact growth model, exogenous or endogenous, this Article indicates that market forces may have failed in disequilibrating Advanced Economies in their relative country group progression towards that patent propensity rate that characterizes advanced economies. This finding corresponds with William Baumol and Edward Wolff's utilization of data from seventy-two countries demonstrates that middle income countries—seventeen out of seventy-two countries in the sample, mostly corresponding to the emerging economies cluster—have grown the fastest.[153]

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[152] For equivalent "Technology Gap" literature, see Jan Fagerberg, *A Technology Gap Approach to why Growth Rates Differ*, 16 RES POL'Y 87, 87–89 (1987); Jan Fagerberg, *International Competitiveness*, 98 ECON J. 355, 364 (1988). *See generally* Jan Fagerberg, *Technology and International Differences in Growth Rates*, 32 J. ECON. LITERATURE 1147 (1994); Fulvio Castellacci, *Convergence and Divergence Among Technology Clubs*, (DRUID Working Paper No. 06-21 2006) (supporting the idea of the existence of clubs of countries characterized by different levels of technological development and different technological dynamics).

[153] *See* Williams J. Baumol & Edward N. Wolff, *Productivity Growth, Convergence, and Welfare: Reply*, 78 AM. ECON. REV. 1155, 1156 (1988) (finding that the poorest countries have diverged from other country groups). *See generally* HOLLIS CHENERY ET AL., INDUSTRIALIZATION AND GROWTH: A COMPARATIVE STUDY (1986) (combining time-series and cross-sectional data for several countries while finding divergence among the poorer countries and convergence among the relatively wealthier countries); THORKIL KRISTENSEN, DEVELOPMENT IN RICH AND POOR COUNTRIES (2d ed. 1982) (focusing on the

Additionally, the present Article's findings concerning patent propensity club convergence tentatively corresponds with the recent United Nations position on innovation regional convergence. In the 2005 UNCTAD World Investment Report, the authors warn of a widening technological gap between developing countries taking part in the "global innovation network" and those failing to do so in the developing world. The UNCTAD report is germane to this Article's finding concerning emerging economies, as it points out that developing nations, particularly in Asia, are becoming increasingly successful in attracting investment in R&D from multinational corporations. On balance, the UNCTAD's findings tentatively uphold that developing countries that are weak in R&D—presumably excluded from being Emerging Economies—need to adopt appropriate policies if they are to benefit from this trend.[154] For example, the UNCTAD report finds that more than sixty percent of the multinational corporations surveyed by UNCTAD plan to expand their research activities in China. For India, the figure was 29.5 percent.[155] In contrast, however, few such corporations plan to increase R&D in Africa or Latin America (except in Brazil, Mexico, Morocco and South Africa).[156] These important, yet incomplete, UNCTAD findings are more significant concerning possible club divergence between middle-income or Emerging Economies and weak developing countries in innovation. Yet, the findings also serve to demonstrate how through the measurement of FDI and the global investment in R&D with the intervention of multinational corporations preliminary indication of upward convergence from Emerging Economies to Advanced Economies is also accounted for.

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cross-section alone, grouped countries by their 1974 income levels and found a hump-shaped relationship between group's 1970–1979 growth rates and their income levels with the middle-income groups enjoying higher rates of growth than the wealthier and the poorer groups).

[154] UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT, WORLD INVESTMENT REPORT 40 (2005).

[155] *Id.* at 114.

[156] *Id.* at 147.

Finally, it should be noted that, in the long run, comparable patent propensity rates as a proxy of innovation activity between Advanced and Emerging Economies may uphold club divergence, instead of convergence, due to deep international incompatibilities in economic integration.

IV. CONCLUSION

This Article shows that countries converge to multiple equilibria rather than to a single one over their propensity to patent as proxy for innovation.[157] The divide over the propensity to patent between developed and developing countries, approximated through Advanced and Emerging Economies herein, may be explained by a complex set of micro and macroeconomic indicators. Future empirical analysis of the propensity to patent, the divide and the exact country convergence clubs is necessary. A full empirical account of the nooks and crannies of these phenomena should ultimately lead to a novel non-linear innovation theory and policy recommendations, including international intellectual property-related ones.

For now, as a broad policy concern, legislation set to make patenting easier either entices firms to patent a higher percentage of their innovations or even to invest more in innovation. Yet, even this basic proposition needs to be further solidified, because economists such as R. Falvey and others state that having strong intellectual property rights benefits both the richest and the poorest nations, but probably not middle-income countries, such as Emerging Economies.[158]

Such pro-patenting policies indeed carry complex implications that lie beyond the scope of this Article.[159] As Arundel and Kabla

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[157] *Cf.* Ben-David, *supra* note 143, at 158 (reaching an equivalently broad conclusion concerning club convergence between separate country groups over income-related indications).

[158] *See* Rod Falvey, Neil Foster & David Greenaway, *Intellectual Property Rights and Economic Growth*, 10 REV. DEV. ECON. 700, 700 (2006).

[159] *Cf.* Anthony Arundel & Isabelle Kabla, *What Percentage of Innovations Are Patented? Empirical Estimates for European Firms*, 27 RES. POL'Y 127, 128 (1998) (discussing numerous patent propensity methods).

further add, such policies made "for example, to reduce the cost of a patent application, could instead increase patent propensity rates in some sectors that currently have low rates while having little effect on firms or sectors where a majority of innovations are already patented."[160] These changes may otherwise lead to the empirically uncorroborated reduction in patent quality altogether in either advanced or emerging economies alike.[161]

The cluster analysis used by this Article may also give cautionary political-economic messages. For example, Professor Rochelle Dreyfuss explains that because Emerging Economies represent demand by intellectual property consumers as much as they do towards intellectual property creators, they may partner with under-represented least-developed countries.[162] With the completion of this empirical project, additional political-economic implications follow.

Finally, a word about the rule of law. The rule of law offered through the TRIPS agreement and other such WTO technologically-driven capitalist treaties is not the product of what Ha-Joon Chang referred to as an "innocent scholastic awakening."[163] Instead, the rule of law represents interest in law primarily as a response to the critique and failure of earlier World Bank-led neoliberal policies as with the deriving WTO-led exogenous growth policies upon their focus on technological transfer and foreign direct investment-related stance for innovation-based economic growth. As seen through the non-linear characteristics of the patent propensity innovative divide noted in this Article, although TRIPS requires the harmonization of

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[160] *Id.*

[161] *See* OECD, *supra* note 116 (offering a novel innovation index upholding that patent quality has declined steadily on an average of 20%); WIPO, *supra* note 162 (concluding that patent quality varies from country to country depending on national circumstances and level of development).

[162] Dreyfuss, *supra* note 97.

[163] *Cf.* Ha-Joon Chang, *Understanding the Relationship Between Institutions and Economic Development: Some Key Theoretical Issues*, 1, 4 (U.N. World Institute for Development Economics Research, Discussion Paper No. 2006/05, 2006) (offering skepticism concerning rule of law-related post-Washington consensus policies with emphasis on the role of the World Bank thereof).

intellectual property rights protection, such harmonization is neither clearly necessary nor sufficient for the South. The South's lower patent propensity rates measured by their relatively lower rates of state-of-the-art technology as USPTO granted patents evermore stands in contradiction to nowadays "one size fits all" innovation policy.