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Patent Club Convergence Among Nations

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PATENT CLUB CONVERGENCE AMONG NATIONS

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INTRODUCTION

Innovation-related international organs, and primarily the World Trade Organization (WTO), the World Intellectual Property Organization (WIPO) and the United Nations Conference on Trade and Development (UNCTAD), traditionally have been under performed in offering a comprehensive innovation policy for all countries, particularly for developing countries. This issue has been highlighted both before and throughout the establishment of the WTO and the TRIPS Agreement. It was therefore only natural that upon its adoption, TRIPS merely consisted of a flat intellectual property "one-size-fits-all" policy for all WTO-members. In so doing, it implicitly corresponded with an earlier exemplary "Pax-American" World Bank-led neoclassical economic growth approach. Similarly, it should not come as a surprise that the WIPO remains to this day inconsistent in its preferred theoretical setting for innovation-led growth, as witnessed in the organization's archetypical Development Agenda adopted in October 2007, after years of deliberations.

As such, only few issue-based coalitions emerged over innovation-led growth or intellectual property-related policies.[1] The exception to the above finding, of course, is the existence of two structural alternatives that remain outside the scope of this article. The first is the loose compilation of civil society groups and movements, including numerous governments and individuals converging over broad egalitarian principles promoted by iconic movements, such as the Access to Knowledge (A2K) or the broad reaching Open Source movement. The second alternative to such issue-based coalitions is a plethora of overly generalized regional coalition blocs, such as the African Group or the European Union. These all-purpose regional blocs fail, however, to account for a more accurate delineation of cherry-picked countries converging over issue-based innovation-led growth or intellectual property-related policies.

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1. *See* Peter K. Yu, *Building Intellectual Property Coalitions for Development*, *in* IMPLEMENTING THE WORLD INTELLECTUAL PROPERTY ORGANIZATION'S DEVELOPMENT AGENDA 79, 81–86 (Jeremy de Beer ed., 2009) [hereinafter Yu 2009]; John S. Odell & Susan K. Sell, *Reframing the Issue: the WTO Coalition on Intellectual Property and Public Health*, 2001, *in* NEGOTIATING TRADE: DEVELOPING COUNTRIES IN THE WTO AND NAFTA 85, 104 (John S. Odell ed., 2006) (discussing the coalition of developing countries for the 2001 Doha Declaration on the WTO Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) and Public Health); Peter Drahos, *Developing Countries and International Intellectual Property Standards-Setting*, 5 J. WORLD INTELL. PROP. 765, 784 (2002) (suggesting that India, Brazil, Nigeria, and China could form a "*Developing Country Quad*" - a leading working group on key negotiations); Gunnar Sjostedt, *Negotiating the Uruguay Round of the General Agreement on Tariffs and Trade*, *in* INTERNATIONAL MULTILATERAL NEGOTIATION: APPROACHES TO THE MANAGEMENT OF COMPLEXITY 44, 44–54 (I. William Zartman ed., 1994) (explaining coalition strategies leading to the negotiation of the TRIPS agreement during the Uruguay Round).

Nonetheless, *de facto* heterogeneity among countries over other economic-related growth policies is commonly witnessed in a variety of WTO coalitions. In particular, country coalitions are increasingly becoming the informal preferred response of developing countries to imbalances in power at the WTO. In response to the few under-theorized innovation and intellectual property-related coalitions, this article offers a unique clustering analysis. It does so within the framework of endogenous growth theory, measuring optimal convergence by country coalitions into multiple innovation-based growth equilibria rather than through a single "one-size-fits-all" theoretical setting. The measurement is based on countries' patent propensity rates as proxy for their domestic innovation rates. Convergence literature herein contributes a seminal analytical insight, codenamed *club convergence*.[2] As the term suggests, *club convergence* is the hypothesis whereby only countries that are similar in their structural characteristics and which have similar initial conditions will converge with one another.

Thus, one potential innovation-led growth hypothesis could be that richer OECD countries may shape one convergence club, the developing countries an additional club, and the underdeveloped yet another. Alternatively, different club convergence groupings may be telling of how countries and groups thereof converge—or ought to—over innovation-led growth and related intellectual property policies.

Part I offers a positive theoretical framework based on endogenous growth theory and convergence analysis, briefly introduced above. Part II follows with a supporting empirical model, which serves as a unique statistical model, while contributing to a regional convergence club understanding of endogenous growth theory. The model carries out cluster analyses for sixty-six innovating countries at two different points during the 1996–2011 time period, namely at the beginning and end of the period, as well as measuring performance throughout the entire period. That is, it functions in order to detect groups of countries that were similar in their patent propensity rates as proxy for their domestic innovation rates. The model delineates two large patent propensity-gaps and convergence patterns within the world economy. The first gap refers to the great distance that separates the middle group of "*followers*" from the stronger "*leaders*" in terms of patent propensity capabilities. The second gap similarly refers to the impressive gap that separates the weaker "*marginalized*" from the *followers*

2. *See, e.g.*, Fabio Canova & Albert Marcet, *The Poor Stay Poor: Non-Convergence Across Countries and Regions*, 2 (London Ctr. for Econ. Pol'y Res., Discussion Paper No. 1265, 1995), *available at* http://ssrn.com/abstract=289497; Oded Galor, *Convergence? Inferences from Theoretical Models*, 106 ECONOMIC JOURNAL 1056, 1056 (1996).

clubs.

Part III then follows with numerous theoretical ramifications of the findings of Parts I and II. These ramifications relate to the need for additional corroborating research intended to explain remaining discrepancies regarding shifts and reversals in rates of regional convergence. Thus far, there is a lack of evidence for the slowness or nonexistence of inner club convergence, especially in advanced economies, but also in emerging ones.

I. PATENT CLUB CONVERGENCE: THE POSITIVE FRAMEWORK

A. Convergence Over Innovation-led Growth

Evidence increasingly shows that developing countries differ not only in their propensity to attract Foreign Direct Investment (FDI), trade, and technology, but also in their abilities to innovate.[3] Moreover, much evidence increasingly foretells how developing countries differ in their ability to make use of intellectual property rights as a tool for fostering domestic innovation.[4] All of these startling pieces of evidence are found against the backdrop of a traditional World Bank-led inflexible North/South country group dichotomy,

3. *See* U.K COMM. ON INTELL. PROP. RTS., INTEGRATING INTELLECTUAL PROPERTY RIGHTS AND DEVELOPMENT POLICY 2 (2002) ("Thus developing countries are far from homogeneous, a fact which is self-evident but often forgotten. Not only do their scientific and technical capacities vary, but also their social and economic structures, and their inequalities of income and wealth."); *see also*, Daniel Benoliel & Bruno Salama, *Towards an Intellectual Property Bargaining Theory: The Post-WTO Era*, 32 U. PA. J. INT'L L. 265, 275–90 (2010) (analyzing the heterogeneity among developing countries, codenamed the "*Developing Inequality Principle*").

4. *See* José L. Groizard, *Technology Trade*, 45 J. DEV. STUD. 1526, 1539–40 (2009) (using panel data of eighty countries for the period 1970–1995, while finding that FDI is higher for countries with stronger IPRs). On the other hand, the author shows a negative relationship between IPR and human capital indicators that exist in tandem. Earlier findings are similarly ambiguous. While some works generally find a positive effect, Walter G. Park in his article *Do intellectual property rights stimulate R&D and productivity growth? Evidence from cross-national and manufacturing industries data*, Intellectual Property and Innovation in the Knowledge-Based Economy, Industry Canada, Ottawa, 1 vol. 9 (2005) and Sunil Kanwar & Robert Evenson, *Does Intellectual Property Protection Spur Technological Change?* 55 OXFORD ECON. PAPERS 235, 258–59 (2003), others explain that lower IPR can facilitate imitation, while on the other hand, innovation in developing countries increases in proportion to greater IPR protection. Yongmin Chen & Thitima Puttitanun, *Intellectual Property Rights and Innovation in Developing Countries* 78 J. DEV. ECON. 474, 474 (2005). *See also* Rod Falvey et al., *Intellectual Property Rights and Economic Growth* 10 REV. DEV. ECON. 700, 703, 712 (2006) (using panel data of seventy-nine countries and four sub-periods: 1975–1979, 1980–1984, 1985–1989, and 1990–1994, the authors find evidence of a positive effect between IPR and economic growth for both low and high-income countries, but not for middle-income countries. According to the latter, 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 FDI from high-income countries without negatively affecting the national industry based on imitation).

or some variation thereof.[5] Such an innovation policy setting continually highlights the asymmetries between Northern countries, which are deemed to generate innovative products and technologies, and Southern countries, which are generally thought to consume them.[6] Surely, some international organs did not make a clear theoretical choice on the matter. WIPO or UNCTAD traditionally have failed in adopting a proper innovation policy for developing countries in particular. This challenge has been especially evident before and throughout the establishment of the WTO and the TRIPS Agreement.[7] It was, therefore, only natural that upon its adoption, TRIPS merely consisted of a flat intellectual property policy for all WTO-members, corresponding with an earlier World Bank-led "Pax-American" neoclassical economic growth model.[8]

It should not have come as a surprise, therefore, that WIPO remains to this day inconsistent on this matter, as witnessed in the organization's archetypical Development Agenda adopted in October 2007 after years of deliberations.[9]

A convenient way to distinguish the two views is to ask: are poor economies catching up with those already innovatively advanced, and thus

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5. CARLOS M. CORREA, INTELLECTUAL PROPERTY RIGHTS, THE WTO AND DEVELOPING COUNTRIES: THE TRIPS AGREEMENT AND POLICY OPTIONS 5–6 (2000) (describing the asymmetrical distribution of technological innovation and consumption between Northern and Southern countries); Paul Krugman, *A Model of Technology Transfer, and the World Distribution of Income*, 87 J. POL. ECON. 253, 253–58 (1979) (analyzing the TRIPS Agreement via the innovating North and non-innovating South)*; see also* discussion *infra* part I.C..

6. Krugman, *supra* note 5, at 254–55.

7. *See* World Intellectual Property Organization, http://www.wipo.int [hereinafter WIPO] (providing official surveys); *see also* the United Nations Department of Economic and Social Affairs, http://www.un.org/en/development/desa/index.html [hereinafter UN DESA]. For theoretical and empirical studies, *see* Helge E. Grundmann, *Foreign Patent Monopolies in Developing Countries: An Empirical Analysis*, 12 J. DEVELOPMENTAL STUD. 186 (1976); Jorge M. Katz, *Patents, the Paris Convention and Less Developed Countries*, 24–27 (Yale Univ. Econ. Growth Center, Discussion Paper No. 190, Nov. 1973); Douglas F. Greer, *The Case against Patent Systems in Less-Developed Countries*, 8 J. INT'L L. & ECON. 223 (1973); Constantine Vaitsos, *Patents Revisited: Their Function in Developing Countries*, 9 J. DEVELOPMENTAL STUD. 71, 89–90 (1972).

8. Benoliel & Salama, *supra* note 3, at 278; WIPO National Seminar on Intellectual Property, *The International Protection of Industrial Property: From the Paris Convention to the TRIPS Agreement*, WIPO/IP/CAI/1/03/2, 16 (Feb. 17, 2003) (by Michael Blakeney).

9. World Intell. Prop. Org., *The 45 Adopted Recommendations under the WIPO Development Agenda*, at ¶ 45 (2007), *available at* http://www.wipo.int/ip-development/en/agenda/recommendations.html [hereinafter Adopted Recommendations] ("To approach intellectual property enforcement in the context of broader societal interests and especially development-oriented concerns, with a view that 'the protection and enforcement of intellectual property rights should contribute to the promotion of technological innovation and to the transfer and dissemination of technology . . . .'"). Thus both neoclassical economics' "technological transfer" and competing endogenous contextual "societal interests" preside in tandem, implying much theoretical inconsistency towards the matter regarding innovation-led growth. *See* discussion *infra* part I.C..

richer? Or, instead, are they caught in some innovation-related poverty trap?[10]

These two Capitalist Space Economy questions traditionally have been dominated by two opposing views as to the expected long-run trajectories of regional development.[11] The first of the two views, whereby poor economies incipiently catch up with those already richer, rooted in neoclassical equilibrium economics, holds that, provided there are no central barriers to the function of market processes, in an integrated national economy there are strong pressures leading to the general *convergence* of regional income-related indicators over time. Regional discrepancies can only be a short-term state. That is the case, since such disparities will instigate self-correcting movements in prices, wages, capital, and labor, thereby restoring the tendency towards regional convergence.

The convergence hypothesis, whereby poor economies might "catch up," has generated a huge body of empirical literature which thus far has barely addressed innovation or intellectual property-related economic growth by developing countries.[12] Instead, the most popular examples covered in the literature include:

> [C]onvergence [in] incomes between rich and poor parts of the European Union; [convergence] in plant and firm size in industries; in economic activity across different regions (states, provinces, districts, or cities) within the same country; in asset returns and inflation rates across countries in a common trade area; in political attitudes across different groups; and in wages across industries, professions, and geographical regions.[13]

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10. Compare: Danny T. Quah, *Empirics for Economic Growth and Convergence* 1 (Center for Econ. Performance, Discussion Paper No. 253, 1995) (posing a similar question broadly concerning economic growth).

11. Ron Martin & Peter Sunley, *Slow Convergence? The New Endogenous Growth Theory and Regional Development*, 74 ECON. GEOGRAPHY, 201, 201 (1998). Earlier accounts of convergence among countries or country groups have mostly attributed to the understanding of convergence over salaries, GDP and other macroeconomic income-related indications. Little accounts for convergence over domestic technological creation as considered herein. *See*, Dan Ben-David, *Convergence Clubs and Subsistence Economies*, 55 J. OF DEV. ECON.155, 166–67 (1998).

12. Jérôme Vandenbussche et al., *Growth, Distance to Frontier and Composition of Human Capital*, 11 J. ECON. GROWTH 97, 121–22 (2006) (using a panel of nineteen OECD countries between 1960 and 2000, while using an endogenous growth model, authors show how as a country increasingly experiences economic growth, it relies more and more on innovation); *see*, EMMANUEL HASSAN, ET AL., INTELLECTUAL PROPERTY AND DEVELOPING COUNTRIES: A REVIEW OF THE LITERATURE, 17 (2010 (providing additional general discussion of the argument); *see also* discussion, *infra* Part III.

13. Quah, *supra* note 11, at 1. For the extended list of methodological examples, *see also* Ben-David, *supra* note 11, at 167; STILIANOS ALEXIADIS, CONVERGENCE CLUBS AND SPATIAL

The convergence hypothesis on per capita income convergence has uncovered a profound and possibly inspiring empirical finding for innovation-led growth analysis as well. It found through geographically disaggregating poor and rich economies, such as within German reunification or the effects of regional redistribution within individual countries and across the European Union, that all appear to be converging towards each other at a steady, consistent rate of two percent per year.[14]

In the meantime, convergence literature saw another convergence regression. Codenamed *club convergence*,[15] as the term suggests, is the hypothesis whereby only countries that are similar in their structural characteristics, and which have sufficiently similar initial conditions, will inter-converge to one another. Thus, one potential innovation-led growth hypothesis could be that richer OECD countries may form one convergence club, developing countries will form another, and the underdeveloped yet another. Alternatively, different club convergence groupings may show how countries and groups thereof converge (or ought to) over innovation-led growth.

To illustrate one seminal income-related club convergence finding, numerous economists now negate that there is substantive convergence

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EXTERNALITIES: MODEL AND APPLICATIONS OF REGIONAL CONVERGENCE IN EUROPE (2013); Jonathan Eaton & Zvi Eckstein, *Cities and Growth: Theory and Evidence from France and Japan* 1–40 (Nat'l Bureau of Econ. Research, Working Paper No. 4612, 1994); Joan-María Esteban & Ray Debraj, *On the Measurement of Polarization*, 62 ECONOMETRICA 819 (1994); Joep Konings, Gross Job Flows and Wage Determination in the UK: Evidence from Firm-Level Data (1994) (unpublished PhD thesis, LSE, London); Reinout Koopmans & Ana R. Lamo, *Cross-Sectional Firm Dynamics: Theory and Empirical Results from the Chemical Sector* (Cen. For Econ. Performance, Working paper No. 229 (1994); Danny Quah, Regional *Convergence Clusters across Europe* (Cen. For Econ. Performance, Discussion Paper No. 274, 1994); Danny Quah, *One Business Cycle and One Trend from (Many) Many Disaggregates* (Cen. For Econ. Pol'y Res., Discussion Paper No. 873, 1994); Martin & Sunley, *supra* note 11, at 210 (citing David M. Gould & Roy J. Ruffin, *What determines economic growth?*, FED. BANK DALLAS ECON. REV. 25 (1993); Robert J. Barro & Xavier Sala-i-Martin, *Convergence across States and Regions*, 1 BROOKINGS PAPERS ON ECON. ACTIVITY 107 (1991) [hereinafter *Convergence across*]). For two of the earliest and most influential statements of this view, *see* GEORGE H. BORTS & JEROME L. STEIN, ECONOMIC GROWTH IN A FREE MARKET (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 3, 3–5 (1965) (analyzing the evolution of regional income differences in advanced industrial countries).

14. Xavier X. Sala-i-Martin, *The Classical Approach to Convergence Analysis*, 106 ECON. J. 1019, 1028 (1996); Martin Larch, *Regional Cross-Section Growth Dynamics in the European Community*, (European Inst., London School of Economics and Political Science, 1994); Danny Quah, *Empirical Cross-Section Dynamics in Economic Growth* (European Econ. Rev., Discussion Paper No. 154, 1993).

15. Canova & Marcet, *supra* note 2; Oded Galor, *Convergence? Inferences from Theoretical Models*, 106 ECON. J. 1056, 1056 (1996).

between these three abovementioned clubs.[16] They further predict how the broad inequalities between the different country groupings or clubs may persist or even increase in years to come such that the cross-country income distribution remains polarized.[17]

Club Convergence theory may, therefore, be attributed to the second approach, known as *regional divergence*. In such cases, poor countries are due to remain caught in a model poverty trap. Put differently, there would be no necessary reason why regional growth based on either innovation or other growth-related indicators should uphold convergence, even over the long run. On the contrary, regional divergence may be said to be the most likely outcome. As a case in point, models of regional growth advanced by writers such as Perroux,[18] followed by Myrdal,[19] and Kaldor[20] indeed predict that regional incomes will tend to diverge. If left to their own devices, we are told, market forces would become spatially disequilibrating, and economies of scale and agglomeration would then lead to the collective concentration of capital, labor, and output in certain regions at the expense of others. Uneven regional development was thus found to be self-correcting, yet only within convergence clubs and not among them.

A remaining seminal theoretical reformulation is known as *conditional convergence*.[21] Because convergence is conditional on the different structural characteristics of each economy, for instance, its preferences, technologies, rate of population growth, or government policy, different structural characteristics imply that different countries will have varying steady-state relative incomes or innovative capacity. Hence, the prediction is that the growth of an economy will be a function of the fracture that divides it from its own stable state.[22] To test for conditional convergence, therefore, it is necessary to hold the state of each economy as a constant as well.

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16. Galor, *supra* note 15, at 1065–66.

17. *Id.*

18. François Perroux, *Economic Space: Theory and Applications*, 64 Q. J. ECON., 89 (1950) [hereinafter *Economic Space*]; François Perroux, *Note sur law Notion des Poles du Croissance* [Note on the Notion of a Growth Pole], 8 ECONOMIE APPLIQUEE 307 (1955).

19. GUNNAR MYRDAL, ECONOMIC THEORY AND UNDER-DEVELOPED REGIONS (1957).

20. *The Case for Regional Policies*, *in* THE ESSENTIAL KALDOR, 311 (F. Targetti & A.P. Thirlwall eds., 1989) [hereinafter *Case for Regional Policies*]; *The Role of Increasing Returns, Technical Progress and Cumulative Causation in the Theory of International Trade and Economic Growth*, *in* THE ESSENTIAL KALDOR, *supra* note 20, at 327.

21. *See* Martin & Sunley, *supra* note 11, at 207–08; Sala-i-Martin, *supra* note 14, at 1026–27; Robert J. Barro & Xavier X. Sala-i-Martin, *Convergence*, 100 J, OF POL. ECON. 223 (1992); N. Gregory Markiw et al., *A Contribution to the Empirics of Economic Growth*, 107 Q. J. ECON. 407 (1992).

22. *See generally* Martin & Sunley, *supra* note 11, at 206–07.

B. Coalitions and Convergence Clubs

Heterogeneity among countries over their economic growth is commonly witnessed in a plethora of coalitions.[23] In the absence of information asymmetries and transaction costs convergence clubs and coalitions thereof should efficiently correlate. In reality, country coalitions indeed are rapidly "becom[ing] the *de facto* preferred response of developing countries to imbalances in power [at the] WTO."[24] Such coalitions consequently impact trade governance and WTO-related institutional reforms.[25] To date, of the 112 WTO Members who define themselves as "developing countries," ninety-nine are members of one or more developing country groups or coalitions.[26]

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23. Sonia E. Rolland, *Developing Country Coalitions at the WTO: In Search of Legal Support*, 48 HARV. INT'L L.J. 483, 483 (2007).

24. Vicente Paolo B. Yu III, *Unity in Diversity: Governance Adaptation in Multilateral Trade Institutions Through South-South Coalition-building* 1-68, 28 (South Centre, Research Paper No. 17, 2008); *see also* AMRITA NARLIKAR, INTERNATIONAL TRADE AND DEVELOPING COUNTRIES: BARGAINING COALITIONS IN THE GATT AND WTO (2003) [hereinafter NARLIKAR, INTERNATIONAL TRADE) (offering an historical typology of developing country coalitions in the GATT and WTO); Rolland, *supra* note 23, at 483 (emphasizing that developing country-led coalitions are beginning to change the WTO's dynamics); NEGOTIATING TRADE: DEVELOPING COUNTRIES IN THE WTO AND NAFTA (J. Odell, ed., 2006); Jerome Prieur & Omar R. Serrano, *Coalitions of Developing Countries in the WTO: Why Regionalism Matters?* (2006), *available at* http://graduateinstitute.ch/files/live/sites/iheid/files/sites/political_science/shared/political_science/3458/Developing_20Countries_20Coalitions_20in_20the_20WTO_20vrai.pdf; Constantine Michalopoulos, *The Participation of the Developing Countries in the WTO*, INSTITUTE FOR AGRICULTURE AND TRADE POLICY (March 6, 2000) http://www.iatp.org/documents/participation-of-the-developing-countries-in-the-wto-the-0. *See also* Yu 2009, *supra* note 1, at 84; Odell & Sell, *supra* note 1, at 104; Drahos, *supra* note 1, at 780; Sjostedt, *supra* note 1 for an explanation of concerns over intellectual property-related coalitions.

During the early years of the WTO, there were initial attempts at bringing together an overarching group of developing countries (similar to the G-77 in UNCTAD), but these attempts were later abandoned as it became clear that differing interests and institutional capacities posed ever greater challenges to such a grouping. Michalopoulos, *supra* note 24.

In the pre-WTO era, developing country-led coalitions in the GATT received only limited academic attention and were largely considered ineffective. Amrita Narlikar, *Bargaining over the Doha Development Agenda: Coalitions in the World Trade Organization* 2 (Serie LATN Papers, No. 34, 2005) [hereinafter Narlikar, *Doha Development Agenda*] ("Developing countries, even while operating in coalitions, had stood on the sidelines in the GATT, choosing to free-ride on the concessions that were exchanged"). Narlikar adds that this neglect lay partly in the fact that coalitions in the GATT were informal and harder to trace. *Id.*; *Thematic Studies from a Ford Foundation Project*, *in* 1 DEVELOPING COUNTRIES AND THE GLOBAL TRADING SYSTEM (John Whalley ed., 1989); DEVELOPING COUNTRIES IN WORLD TRADE: POLICIES AND BARGAINING STRATEGIES (Diana Tussie & David Glover eds., 1993).

25. Mayur Patel, *New Faces in the Green Room: Developing Country Coalitions and Decision-Making in the WTO*, (Global Economic Governance Programme Working Paper No. 33, 2007); *see also* Faizel Ismail, *Reforming the World Trade Organization*, 10 WORLD ECON. 109 (2009); Debra P. Steger, *The Future of the WTO: The Case of Institutional Reform*, 12 J. INT'L ECON. L. 803 (2009).

26. Yu III, *supra* note 24, at 28.

For developing countries with small markets and limited diplomatic resources, coalitions prove repeatedly to be the only means at their disposal for advancing] their bargaining positions.[27] The joint defense of a negotiating position is likely to improve the legitimacy of a proposal in consensus-based and majoritarian institutions. This explains why even developed countries with large markets search for allies in the WTO.

It was during the run-up to and following the 1999 Seattle Ministerial Conference that novel types of coalitions led by developing countries started appearing—ranging from bloc-type groups such as the Like-Minded Group of the late 1990s,[28] to issue-based groups, such as the G-20 of the post-Cancun period. Otherwise, coalitions appeared as region-based groups,[29] such as the African Group, or as groups that shared certain development characteristics such as the Least-Developed Countries (LDCs).[30]

Moreover, region based groups, such as LDCs, remain central for coalition-based action by many developing countries. In the meantime, informal issue-based groups or coalitions, such as the G20, the G33 and the NAMA-11,[31] are also becoming a key means for group-based action by developing countries. Of the coalitions in place as of late 2009, some "[s]ixty-seven developing countries (or 58.77 percent of developing WTO Members) have joined one or more informal *issue-based* developing country coalitions" and "[s]ixty-one developing countries are [M]embers of a *regional* group (including 35 which are also members of one or more issued-based groups and 37 which are members of one or more common characteristic groups)."[32]

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27. NARLIKAR, INTERNATIONAL TRADE *supra* note 24, at 3.

28. *See* Amrita Narlikar & John Odell, *The Strict Distributive Strategy for a Bargaining Coalition: The Like Minded Group in the World Trade Organization*, *in* NEGOTIATING TRADE: DEVELOPING COUNTRIES IN THE WTO AND NAFTA, *supra* note 1, at 115–45 (discussing the genesis, negotiating strategy, and results of the Like-Minded Group.

29. Prieur & Serrano, *supra* note 24, at 5–7; SISULE F. MUSUNGU, SUSAN VILLANUEVA & ROXANA BLASETTI, UTILIZING TRIPS FLEXIBILITIES FOR PUBLIC HEALTH PROTECTION THROUGH SOUTH-SOUTH REGIONAL FRAMEWORKS xiv (2004) ("[a] regional approach to the use of TRIPS flexibilities will enable similarly situated countries to address their constraints jointly . . . ."). Further, the authors offer two models of regional cooperation over IP-related policies, namely (a) coordination, yet non-harmonization, has most commonly been adopted among the RECs in Latin America and the Caribbean region, and (b) harmonization without coordination as is mostly witnessed in Africa in the form of OAPI and ARIPO. *Id.*, at 50–55. *See* Yu 2009, *supra* note 1, at 90, (explaining "[r]egional or pro-development fora are particularly effective means for coordinating efforts by less developed countries in the areas of public health, IP, and international trade.").

30. Prieur & Serrano, *supra* note 24, at 5–7.

31. A group of eleven developing countries working toward strengthening NAMA. See Faizel Ismail, Reforming the World Trade Organization: Developing Countries in the Doha Round, Chapter 3: G20 and the NAMA 11: Developing Countries in the Doha Round 31-57 (2009).

32. Yu III, *supra* note 24, at 28 (emphasis added).

These coalition building efforts surely play a role in the backdrop of much United States-led opposition. Since the failure of the fifth WTO Ministerial Conference in Cancún (Cancún Ministerial) in 2003, most noticeably, the United States has largely engaged in a divide-and-conquer strategy intended to marginalize coalition building by developing countries. The United States henceforth has rewarded countries that were willing to work with it, while undermining efforts by Brazil, India, and other G20 members to establish a united negotiating front for less developed countries.[33]

The G20 is the most important example of a coalition of developing countries developed during the pre-negotiation phase in the GATT.[34] "The G20 . . . is composed only of developing countries (later referred to as the "G20+) . . . . [and] [t]his coalition of developing countries appeared just before the WTO Cancun summit, attempting to block the joint US/EC proposals."[35] In so doing, it favored negotiating with developed countries over the issue of the inclusion of services in the agenda of the Uruguay Round. "This group eventually merged with the G-9,[36] a group of nine developed countries, to form the "*Café au Lait*" group, from which negotiating proposals eventually emerged that 'provided the basis for the *Punta del Este* declaration and the commencement of the Uruguay Round.'"[37]

The example of the G20 is telling for an additional reason. It foretells how even in the midst of changes in the exact list of countries converging, club convergence remains intact based on its exemplary core members. To illustrate, as membership in the G20 coalition has changed at various points, it

33. Yu 2009, *supra* note 1, at 83–84; *see also* Peter K. Yu, *The Middle Intellectual Property Powers*, 18 (Drake Univ. Legal Stud. Res. Paper Series, Research Paper No. 12–28); Robert B. Zoellick, *America will not wait*, ACADEMIC CONSORTIUM ON INTERNATIONAL TRADE (Sept. 21, 2003) http://www.fordschool.umich.edu/rsie/acit/TopicsDocuments/Zoellick030921.pdf ("As WTO members ponder the future, the US will not wait: we will move towards free trade with can-do countries."). In tandem, domestic U.S. private entities threaten or use of unilateral sanctions, as part of their coalition with Europe, and Japan at the industry level. *See, e.g.*, Ruth L. Okediji, *Public Welfare and the Role of the WTO: Reconsidering the TRIPS Agreement*, 17 EMORY INT'L L. REV. 819, 844–46 (2003) (referring to the case of the pharmaceutical industry); SUSAN SELL, PRIVATE POWER, AND PUBLIC LAW: THE GLOBALIZATION OF INTELLECTUAL PROPERTY RIGHTS (2003).

34. Composed of Bangladesh, Chile, Colombia, Ivory Coast, Hong Kong (China), Indonesia, Jamaica, Korea, Malaysia, Mexico, Pakistan, Philippines, Romania, Singapore, Sri Lanka, Thailand, Turkey, Uruguay, Zambia, and Zaire (now DR Congo). *The 128 Countries that had signed GATT by 1994*, WORLD TRADE ORGANIZATION (2014), http://wto.org/english/thewto_e/gattmem_e.htm.

35. Prieur & Serrano, *supra* note 24, at 8 (noting in a footnote that the G20+ includes "Argentina, Bolivia, Brazil, Chile, China, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Guatemala, India, Mexico, Pakistan, Paraguay, Peru, Philippines, South Africa, Thailand and Venezuela. With the addition of Egypt and Kenya, the group acquired the name of the G22.").

36. Composed of Australia, Austria, Canada, Finland, Iceland, New Zealand, Norway, Sweden, and Switzerland.

37. Yu III, *supra* note 24, at 26 (citation omitted).

has consisted of a core group of countries, in this case called the G3+3.[38] This group consists of the three biggest members: Brazil, China, and India. In addition, three important middle powers preside: Chile, South Africa, and Argentina.[39]

In reality, not all coalitions have prevailed. A case in point is the establishment of the G-10 created during the pre-negotiation phase of the Uruguay Round from 1982–1986.[40] The coalition, led by Brazil and India, opposed the launch of a new trade round, and was even more vocal in its opposition to the inclusion of services in any trade negotiations within the GATT.[41] For the purposes of this article, it should be added that the G-10 was equally opposed to the inclusion of the Agreement on trade-related aspects of intellectual property rights (TRIPS) or the Agreement on Trade-Related Investment Measures (TRIMS). It further refused to make a compromise on any of these issues until its demands of standstill and rollback of non-tariff barriers were met. The group was successful only in a limited way.[42]

An additional few, under-theorized WTO member issue-based coalitions also continuously emerge over innovation-led growth and intellectual property-related policies.[43] Among them are the "*Joint proposal (in intellectual property)*" Coalition,[44] sponsoring a proposal calling for the establishment of a Geographic Indications (GI) database and register,[45] and its

38. Prieur & Serrano, *supra* note 24, at 8.

39. *Id.*

40. Yu III, *supra* note 24, at 26 (adding that the coalition of G-10 countries included Argentina, Brazil, Cuba, Egypt, India, Nicaragua, Nigeria, Peru, Tanzania, and Yugoslavia).

41. *Id.* (citing Sylvia Ostry, *The Uruguay Round North-South Grand Bargain: Implications for Future Negotiations*, *in* THE POLITICAL ECONOMY OF INTERNATIONAL TRADE LAW, 285–86 (Daniel M. Kennedy & James D. Southwick eds., 2002).

42. Narlikar, *Doha Development Agenda*, *supra* note 24, at 6 ("Amidst this grand-standing, the coalition also refused to engage with any other coalitions, and turned down overtures from other developing countries to engage in shared research initiatives or draft joint proposals.").

43. There still remains the alternative analytical framework of a plethora of present day loose gatherings of civil society groups and movements, including governments and individuals converging on egalitarian principles of justice, freedom, and economic development. These notably include the Access to Knowledge movement, the Open Source movement, etc. *See* Jack Balkin, *What is Access to Knowledge?*, BALKANIZATION (Apr. 21, 2006), http://balkin.blogspot.co.il/2006/04/what-is-access-to-knowledge.html; R.E. Wyllys, *Overview of the Open-Source Movement*, UNIV. TEX. AUSTIN GRADUATE SCH. LIBR. & INFO. SCI. (2001), https://www.ischool.utexas.edu/~l38613dw/readings/OpenSourceOverview.html (commenting on the open source movement).

44. A group of 20 WTO members including Argentina, Australia, Canada, Chile, Costa Rica, Dominican Rep., Ecuador, El Salvador, Guatemala, Honduras, Israel, Japan, Korea, Mexico, New Zealand, Nicaragua, Paraguay, Chinese Taipei, South Africa, U.S. *Groups in the WTO*, WORLD TRADE ORG. (July 1, 2013), http://www.wto.org/english/tratop_e/dda_e/negotiating_groups_e.pdf.

45. *Id.*

neighbor the *W52* coalition,[46] sponsoring a proposal for "*modalities*" in negotiations on geographical indications. Other than these and only a handful of similar examples, countries infrequently join efforts over innovation-led growth and TRIPS-related concerns merely as part of their overly generalized regional groupings. Such are the forty-two *African Group* members,[47] the thirty-one *Asian developing members*,[48] the twenty-eight European Union (EU) members,[49] and, of course, the world's fifty poorest countries, codenamed the *Least-developed countries (*LDC*s)*.[50] These countries group themselves, as discussed, notwithstanding their possibly contradicting innovation-led economic growth interests as well as their innovation capabilities. As archetypical bloc-type coalitions, the latter regional country alignment could now be replaced by more issue-based coalitions over innovation-led growth and intellectual property-related policies.

Bargaining coalitions, one will recall, are modeled along two ends of a spectrum. On the one end there are bloc-type coalitions, and on the other issue-based ones.[51] The differences between the two are twofold, which also explains why innovation and intellectual property-related policy coalitions could at least in theory be more effectual.[52] First, bloc-type coalitions bind member countries through "a set of ideas and an identity that go beyond the immediately instrumental; . . . [issue-based coalitions], as the name suggests, are bound together by a more focused and instrumental aim[,]" instead of an overly generalized developmental aim.[53]

A second reason in support of a transition to issue-based coalitions over innovation and intellectual property-related policies follows. Blocs such as the EU or LDCs usually unite like-minded countries.[54] On the other hand, "[i]ssue-based coalitions . . . often dissipate after the specific goal is achieved. Bloc-type coalitions successfully address the problem of minimal external weight . . . , but [they] also run the risk of fragmentation as they lack internal coherence."[55] Another distinction is that "issue-specific coalitions enjoy internal coherence, but are difficult to sustain when large diversified

46. A group of 109 WTO members. "The list includes as groups: the EU, ACP and African Group." *Id.*

47. *Groups in the TRIPS Negotiations*, WORLD TRADE ORG. (2014), http://www.wto.org/english/tratop_e/trips_e/trips_groups_e.htm.

48. *Id.*

49. *Id.*

50. *Id.*

51. Narlikar, *Doha Development Agenda*, *supra* note 24, at 6.

52. *Id.*

53. *Id.*

54. *Id.*

55. *Id.*

economies with multiple sectoral interest groups are involved . . . ."[56] Again, such coalitions, if focused on innovation-led growth and intellectual property, could have better chances of enduring—at least theoretically. In short, developing country-led coalitions over innovation-led growth or intellectual property-related policies are especially prone to integration. These countries thus should prefer issue-based coalitions, as opposed to bloc-based ones.[57] Equally, such coalitions arguably should not be overly specific, or they may share the risk of disintegration by competing interests.[58]

C. Growth Theory and Convergence Over Innovation-led Growth

One more preliminary concern remains, namely, what is the proper theoretical setting for issue-based coalitions? In the broader context of growth theory, endogenous growth theory and the new growth empirics naturally prevail. This is so much the case that growth theory prefers multiple economic growth equilibria by numerous country groups or clusters[59] over a single international equilibrium of neoclassical economic growth setting.[60]

Recent discussion, as explained thus far, has focused mostly on long-term convergence in per capita income and output indicators between countries. Again, focusing on innovation-led economic growth, this article offers cluster analysis based on yearly data from 1996–2011 for sixty-six countries.[61] It evaluates the linkage between national innovation as measured through the

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56. *Id.*

57. *See* Hamilton & Whalley, *Coalitions in the Uruguay Round*, 125 WELTWIRTSCHAFTLICHES ARCHIV, 547, 556–57 (1989); Narlikar, *Doha Development Agenda*, *supra* note 24, at 6.

58. Narlikar, *Doha Development Agenda*, *supra* note 24, at 6.

59. "[T]he assumption of [endogenous growth holds that] diminishing returns to capital implicit in the neoclassical production function [(measuring income-based indicators among countries), leads to] the prediction that the rate of return to capital (and therefore its growth rate) is very large when the stock of capital is small and *vice versa*. Sala-i-Martin, *supra* note 14, at 1025; *see also* Danny T. Quah, supra note 10, at 1.

60. This mainly empirical debate has promoted the development of endogenous growth theory, which seeks to move beyond conventional neoclassical theory by treating as endogenous those factors—particularly technological change and human capital— demoted as exogenous by neoclassical growth models. *Id.*

61. A review of the dataset shows that an alphabetical list of the 66 countries with sufficient statistical validity: Argentina, Armenia, Australia, Austria, Azerbaijan, Belarus, Belgium, Brazil, Bulgaria, Burkina Faso, Canada, China, Colombia, Costa Rica, Czech Republic, Denmark, Ecuador, Egypt, Finland, France, Germany, Greece, Hungary, Iceland, India, Israel, Italy, Japan, Kazakhstan, Kuwait, Kyrgyzstan, Latvia, Lithuania, Madagascar, Malaysia, Mexico, Mongolia, the Netherlands, New Zealand, Norway, Pakistan, Panama, Poland, Portugal, Republic of Korea, Republic of Moldova, Romania, Russian Federation, Serbia, Singapore, Slovakia, Slovenia, South Africa, Spain, Sri Lanka, Sweden, Thailand, The former Yugoslav Republic of Macedonia, Trinidad and Tobago, Tunisia, Turkey, Ukraine, United Kingdom of Great Britain and Northern Ireland, United States of America, Uruguay, and Zambia.

rate of *issued* United States Patent and Trademark Office (USPTO) patents listed by Inventor Country (ICN) or United States Inventor State (IS) search categories as proxy for state-of-the-art-technology. At the same time, it accounts for a formulation of the sum and rate of supply of R&D, as measured by countries' Gross Domestic Expenditure on R&D (GERD). The rate between both, known also as the "*Patent Propensity rate*," prefigures the clusters therein. The statistical analysis has only recently been made possible with the publication of highly detailed R&D-related datasets by the UNESCO Institute for Statistics in 2011 covering all countries in full or in part.

This article contributes to the critique of the WTO's TRIPS agreement as well as the WIPO's systematic evasion of intellectual property-related policy delineations between distinct country groups and clusters thereof.[62] The TRIPS Agreement notably consists merely of an almost flat intellectual property and related-innovation policy for all WTO-members.[63] Against that backdrop, TRIPS casted international intellectual property protection as a central pillar for both short- and long-run economic growth, effectively ignoring country group differences over innovation-led growth and related intellectual property policies.

This argument stood for two long-run neoclassic exogenous economic incentives offered by developed nations.[64] 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 developing

62. While overriding country group classifications, WIPO's policy is defined flatly towards all non-LDCs members. The WIPO 2007 Development Agenda serves as a case in point. To illustrate, Recommendation 1 ("WIPO technical assistance shall be, *inter alia*, development-oriented, demand-driven and transparent, taking into account the priorities and the special needs of developing countries, especially LDCs, as well as the different levels of development of Member States") and Recommendation 15 ("Norm-setting activities shall. . .take into account different levels of development"). In one context referring to WIPO's labeled 'Technical assistance,' Recommendation 1 acknowledges the need for its implementation to be as country-specific and context-sensitive ("design, delivery mechanisms and evaluation processes of technical assistance programs should be country specific ") *Id*.

For Theoretical and empirical studies, *see* Grundmann, *supra* note 7; Katz, *supra* note 7; Greer, *supra* note 8; *Vaitsos*, *supra* note 7.

63. *See* Benoliel & Salama, *supra* note 3, at 278; Blakeney, *supra* note 8.

64. *See*, *e.g.*, CAROLYN DEERE, THE IMPLEMENTATION GAME: THE TRIPS AGREEMENT AND THE GLOBAL POLITICS OF INTELLECTUAL PROPERTY REFORM IN DEVELOPING COUNTRIES 5, 51 (Oxford University Press, 2009); Peter K. Yu, *Toward 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) (relying on additional sources therein); *See also* Christine Thelen, *Carrots and Sticks: Evaluating the Tools for Securing Successful TRIPs Implementation*, 24 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).

countries as a whole.[65] The second incentive assured agricultural trade.[66] These incentives, backed by supportive agreements, were pivotal for the final acquiescence of developing countries to the TRIPS agreement.[67] Both incentives also adhered implicitly to Solow's neoclassical growth model, formulated earlier on by economists Cass,[68] and Koopmans,[69] and earlier contributors.[70]

More specifically, there still remains a predicament regarding the first technological incentive of technology transfer.[71] Initially, it was meant to act as a force for convergence, because of the "*advantage of backwardness*" conferred on technological laggards, as was initially put by Harvard University economist Alexander in 1962.[72] Later in his work, he offered a pioneering idea which was called into action by neoclassical economists and policy makers such as in the WTO's TRIPS example.

As Gerschenkon explained, "*technology gaps*" between technologically-edged (mostly developed) economies and laggard developing countries provide the latter with immense opportunities for economic growth.[73] Since Gerschenkon, just about every theory of international income differences that

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65. 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); *see also* CORREA, *supra* note 5, at 18 (focusing on developing countries' concerns over increasing technological transfer as a means of economic growth); *see* also Christine Thelen, *supra* note 64, at 528–29 (showing broader long-run economic growth concerns by developing countries).

66. Helfer, *supra* note 65, at 22; *see also* 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).

67. Helfer, *supra* note 65, at 22; *see also* Clete D. Johnson, *supra* note 66.

68. David Cass, *Optimum Growth in an Aggregative Model of Capital Accumulation*, 32 REV. ECON. STUD. 233 (1965).

69. Tjalling Koopmans, *On the Concept of Optimal Economic Growth*, *in* STUDY WEEK ON THE ECONOMETRIC APPROACH TO DEVELOPMENT PLANNING 225 (Pontificia Academia Scientiarvm 1965).

70. *See* Frank P. Ramsey, *A Mathematical Theory of Saving*, 38 ECON. J. 543 (1928); Robert M. Solow, *A Contribution to the Theory of Economic Growth*, 70 Q. J. ECON. 65 (1956); Trevor W. Swan, *Economic Growth and Capital Accumulation*, 32 ECONOMIC RECORD 334 (1956).

71. The WIPO Development Agenda of 2007 noticeably illustrates the organization's general yet implicit inclination towards neoclassical economics-related policies, with technology transfer being its archetypical example. *See Adopted Recommendations*, *supra* note 9, at Cluster C: 28 ("To explore supportive intellectual property -related policies and measures Member States, especially developed countries, could adopt for promoting transfer and dissemination of technology to developing countries."); *see also*, *id.*, at Cluster C: 31 ("To undertake initiatives agreed by Member States, which contribute to transfer of technology to developing countries, such as requesting WIPO to facilitate better access to publicly available patent information.").

72. *See* ALEXANDER GERSCHENKON, *Economic Backwardness in Historical Perspective*, *in* ECONOMIC BACKWARDNESS IN HISTORICAL PERSPECTIVE: A BOOK OF ESSAYS 6–11 (1962).

73. *Id*. at 8–9.

has taken technology transfer into account has implied that all countries share the same long-run growth rate.[74]

The convergence, and lack thereof, over patent propensity by countries worldwide, as proxy for their domestic innovation, corroborates the critique of these neoclassical economics growth theoreticians. That critique, of course, being over the difficulty of these theoreticians in explaining how growth rates by poor countries remained significantly lower than the rest of the world for almost two centuries.[75] In sum, this article bears witness to three innovation-based economic growth clusters that traverse both the developed and developing countries' alignments and may necessitate innovation-led growth and related international intellectual property policy adaptations.

II. THE MODEL

A. Methodology

The model adheres to five methodological principles. At the outset, the analysis adheres to a formal statistical inference method to estimate the effect and associated statistical significance of the two hypotheses below. The statistical comparison over patent propensity rates between all sixty-six innovating countries is modeled as follows. The number of patents corresponding to each pair (year, country) depends on the country, the year, the GERD invested (during the third previous year per Issued Patents in a three year average delay at the United States Patent and Trademark Office (USPTO)), and the type.[76]

In the econometric model appropriate for present panel data, the dependent variable is the expected value of the yearly number of issued patents.[77] The explanatory variables include country, GERD (as offset), year,

74. *See, e.g.*, Susanto Basu & David N. Weil, Appropriate Technology and Growth, 113 Q. J. ECON. 1025 (1998) (applying this notion to rich countries on the technological edge); Daron Acemoglu & Fabrizio Zilibotti, Productivity Differences, 116 Q. J. ECON.563 (2001); Stephen L. Parente & Edward C. Prescott, *Technology Adoption and Growth*, (Nat'l Bureau of Econ. Res., Working Paper No. 3733, 1991) (applying the notion for countries in which technology transfer can be blocked by local special interests); Stephen L. Parente & Edward C. Prescott, *Monopoly Rights: A Barrier to Riches*, 89 AM. ECON. REV.1216 (1999); Daron Acemoglu et al., *Distance to Frontier, Selection and Economic Growth*, 4 J. EUR. ECON. ASS'N. 37 (2002) (referring to countries with institutions that do not permit full advantage to be taken of technology transfer.).

75. Peter Howitt & David Mayer-Foulkes, *R&D, Implementation and Stagnation: A Schumpeterian Theory of Convergence Clubs*, 37 J. OF MONEY, CREDIT AND BANKING, 147, 149 (2005).

76. The type effect is statistically assumed to be changing throughout time.

77. 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

and type, changing throughout time. The 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.

The following panel data counting method relates to the choice of a patent category search with the USPTO dataset. It is pursued twofold. Firstly, as previously stated, the model analyzes USPTO Issued Patents. It does so as issued patents effectively serve as proxy for R&D-related state-of-the-art quality output assurance, which the model uniquely incorporates. To explain, patent series are by nature subject to a substantial bias, with most patents generating low or no value and only a few patents being associated with high economic and financial value. Thus far, patent statistics studies have rarely tested thoroughly the quality sensitivity of the results of their patent count methodology or their data source.[78] The qualitative methodological improvement herein counts archetypical state-of-the-art technology that has successfully culminated as issued patents, instead of the mere filing of related patent applications. This methodological choice is related to a concern over the possibility that a quantity of innovative activity does not begin or otherwise conclude the patenting process.[79] 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 patent statistics to measure patent applications as an indication of quality innovation.[80]

Another approach within the patent statistics literature has partly met this qualitative challenge. The approach proffers that instead of seeking to make inferences about the propensity to patent by estimating the patent production function, data must be collected based on directly asking firms about the

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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 2 outcomes. *See* JOSEPH M. HILBE, NEGATIVE BINOMIAL REGRESSION 81–84 (2007).

78. *See* ORGANISATION FOR ECON. CO-OPERATION & DEVELOPMENT., OECD Science, Technology and Industry Scoreboard 2011 (2011), *available at* http://www.oecd-ilibrary.org/science-and-technology/oecd-science-technology-and-industry-scoreboard-2011_sti_scoreboard-2011-en; Jérôme Danguy, Gaétan de Rassenfosse & Bruno van Pottelsberghe de la Potterie, *The R&D - Patent relationship: An industry perspective* (ECARES, Working Paper 2010-038, 2010) *available at* https://dipot.ulb.ac.be/dspace/bitstream/2013/73257/1/2010-038-DANGUY_DERASSENFOSSE_VANPOTTELSBERGHE-therd.pdf.

79. Bronwyn H. Hall et al., *The NBER Patent Citations Data File: Lessons, Insights and Methodological Tools* 6 (Nat'l Bureau of Econ. Res., Working Paper No. 8498, 2001).

80. Patent statistics literature has irregularly considered this limitation. The earliest, most important contribution begins with Professor Zvi Griliches' article titled "Patent Statistics as Economic Indicators: A Survey. Zvi Griliches, *Patent Statistics as Economic Indicators: A Survey*, 28 J. ECON. LITERATURE 1661 (1990); *See also* Daniele Archibugi & Mario Pianta, *Measuring Technological Change through Patents and Innovation Surveys*, 16 TECHNOVATION 451 (1996).

fraction of innovations they generally patent.[81] This approach allows for the assembly of a calculate 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*. The first is the method whereby patent propensity rates could be measured as the percentage of innovations for which a patent application is filed.[82] Yet in the case of developing countries in particular, often too many patent applications do not lead to patent issuance, neither nationally or at the USPTO level. This study, therefore, corresponds with the above mentioned methodological definition of the propensity to patent as the percentage of patentable inventions that are in fact patented.[83]

A second patent panel data counting method and challenge, relating to the particularities of the USPTO dataset, follows. It maintains that patents are analyzed by the USPTO Inventor Country (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.[84] The ICN search category indicates the inventiveness of the local laboratories and labor force of a given country. This second counting method has never been used in earlier methods of determining propensity to patent research, and enjoys three important advantages in comparison to all of the above mentioned methods of accounting for patent applications or other quantitative variations. Firstly, it replaces the "Patent Affiliate" or "Owner" alternative USPTO search categories, which mostly represent patenting activity by multi-national

81. Kleinknecht, Van Montfort and 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. Alfred Kleinknecht, Kees Van Montfort & Erik Brouwer, *The Non-trivial Choice Between Innovation Indicators*, 11 ECON. INNOVATION & NEW TECH., 109, 113–14, 117 (2002) (analyzing five 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).

82. Wesley M. Cohen et al., *Protecting Their Intellectual Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patent (or Not)* 16–24 (Nat'l Bureau of Econ. Research, Working Paper No. 7552, 2000); *see also* Anthony Arundel & Isabelle Kabla, *What Percentage of Innovations Are Patented? Empirical Estimates for European Firms*, 27 RES. POL'Y 127 (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 ANNALES D'ÉCONOMIE ET DE STATISTIQUE [ANNALS ECON. STAT.] 289 (1998); Edward Deering Mansfield, *Patents and Innovation: An Empirical Study*, MGMT. SCI. 32, 173–181 (1986).

83. *Id.*

84. *Tips on Fielded Searching*, U.S. PATENT & TRADEMARK OFFICE, http://patft.uspto.gov/netahtml/PTO/help/helpflds.htm (last visited May 13, 2014).

enterprises originating in advanced economies.[85] Secondly, the measurement of the ICN or IS search categories operate to minimize transaction costs associated with domestic patenting by developing countries.

Thirdly, an additional methodological advantage with the ICN search category choice concerns co-invention measurement. In such cases, at least one of the inventors belonging to an emerging economy may be foreign and possibly belong to an advanced economy nationality.[86] Indeed, the solution presented through the ICN search category may account for either sole or co-inventions. All the same, USPTO co-inventions, at least from OECD nationalities, comprise roughly one percent of total inventions patented at the USPTO.[87]

With that said, there is need to account for the methodological choice whereby using the issued patent search category, this study focuses solely on USPTO patenting activity. The reason for not expanding this article beyond the USPTO onto the European or Japanese patent office is because they are undependable. To date, neither of the two other leading patent offices, the

85. ORGANISATION FOR ECON. CO-OPERATION & DEVELOPMENT, *OECD Patent Statistics Manual* (2009), *available at* http://browse.oecdbookshop.org/oecd/pdfs/free/9209021e.pdf [hereinafter *Statistics Manual*]; Anna Bergek & Maria Bruzelius, Patents with Inventors from Different Countries: Exploring Some Methodological Issues through a Case Study, Presented at the DRUID Conference, Copenhagen, 27-29 June, *available at* http://www2.druid.dk/conferences/viewpaper.php?id=2694&cf=18.

86. *Statistics Manual*, *supra* note 85.

87. The exact rates of co-inventorship in emerging economies is still unaccounted for. A seminal 2014 article by Jérôme Danguy, titled: *Globalization of Innovation Production: A Patent-Based Industry Analysis* (iCite Working Paper 009, 2014), provides important insight albeit limited mostly to OECD countries. Danguy's study is based on a panel dataset composed of 21 manufacturing industries covering the period (defined by the priority date of the patent filing) from 1980 to 2005. As he shows in 2005, only 2% of Priority filings (incorporating all the patents filed by the inventors (or applicants) based in a country, regardless of the patent office of application) (8% for EPO) were subject to international co-invention. Danguy adds that less than 5% represented cross-border ownership of innovation (18% for EPO); and only 1% of PF (2% for EPO) were subject to international co ownership. *Id*., at 10. Surely, as said the sample is mainly restricted to OECD countries representing about 90% of the worldwide patenting activities. Yet to be sure the sample considers international collaboration with all the countries in the PATSTAT database including emerging economies. *Id*., at fn. 12.

Two additional studies offer partial account for China and India. To begin with, Lee Branstetter, Guangwei Li and Francisco Veloso, in their article titled: *The Rise of International Co-invention, NBER*, (October 2013) (*available at* http://www.nber.org/chapters/c13028.pdf), Branstetter et al., empirically explain that India's and China's increase in U.S. patents are to a great extent driven by MNEs from advanced economies. Thus and in accordance with the present study illustration of relatively low patent propensity rates in emerging economies, Lee Branstetter et al., conclude that simply counting Chinese or Indian patent grants per their patent propensity significantly exaggerates their overall national innovative activity. A second study on China follows. *See*, Jennifer Chen, Show-Ling Jang, and Chiao-Hui Chang, *The Patterns and Propensity for International Co-invention: The Case of China*, 94 SCIENTOMETRICS 481 (2013).

European (EPO) nor the Japanese (JPO), which, when including the USPTO, are jointly referred to as the Triadic Patent family (consolidated to eliminate double counting of patents filed at different offices),[88] offer equivalent Inventor Country Nationality (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 also twofold. The first is that countries, especially in the developing world, do not have the same patentability criteria.[89] A second reason is that such countries may differ substantively over their national grant rates.[90] Both these methodological partialities are mostly solved by USPTO-based patenting statistics based on the ICN search category whereby issued patents are sampled.

Indeed, the probable importance of a future designed uniformed Triadic Inventor Country Nationality search category certainly would support the fact that most R&D-related activity is concentrated in these geo-political regions.[91] Yet, on the other hand, a mitigating finding in support of this study's USPTO-based analysis holds that on average only between ten and 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.[92]

A third methodological principle follows. It employs a calculation method according to which 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 United States Dollars by 2005 constant prices.[93] This calculation of competing national rates by currency

88. *See Statistics Manual*, *supra* note 85.

89. *See, e.g.*, CARLOS M. CORREA, INTELLECTUAL PROPERTY RIGHTS, THE WTO AND DEVELOPING COUNTRIES: THE TRIPS AGREEMENT AND POLICY OPTIONS 51 (Zed Books 2000); PETER DRAHOS, THE GLOBAL GOVERNANCE OF KNOWLEDGE: PATENT OFFICES AND THEIR CLIENTS XIV (Cambridge University Press 2010) ("we do not know much about how developing country patent offices administer the standard of patentability that arrive in their countries through various treaty processes.").

90. *See, e.g.*, Dominique Guellec and Bruno van Pottelsberghe de la Potterie, The Impact of Public R&D Expenditure on Business R&D, OECD Science, Technology and Industry Working Papers 2000/4, OECD Publishing (2000) 8, 9.

91. Jacques Gaillard, *Measuring R&D in Developing Countries: Main Characteristics and Implications for the Frascati Manual*, 15 SCIENCE, IN TECHNOLOGY & SOCIETY 77, 81 (2010).

92. G. de Rassenfosse, J. Danguy and B. van Pottelsberghe de la Potterie, *supra* note 78, at 13; *Statistics Manual*, *supra* note 85.

93. *Glossary - 63 terms for science & technology*, UNITED NATIONS EDUC., SCIENTIFIC & CULTURAL ORG. (last visited May 25, 2014), http://glossary.uis.unesco.org/glossary/map/terms/177 [hereinafter *Glossary*]. As the UNESCO report explains, this methodology was adapted from the Franscati Manual. ORGANISATION FOR ECON. CO-OPERATION & DEV., COMPENDIUM OF PATENT STATISTICS, FRASCATI MANUAL: PROPOSED STANDARD PRACTICE FOR SURVEYS ON RESEARCH AND EXPERIMENTAL DEVELOPMENT § 423 (6th. ed. 2002) [hereinafter FRASCATI MANUAL].

conversion into United States Dollars largely eliminates the differences in price levels among countries and country groups.[94]

Moreover, when expenditure on Gross National Product (GNP) for different national price indices is converted into a common currency by means of the PPP per 2005 constant prices, it is in effect expressed at the same set of national prices so that comparisons 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 energizing and advanced country group classifications.[95]

This study abides by a fourth methodological principle. Based on the dataset generated, the study has thus far used two competing clustering methods, which gave nearly, but not exactly, the same clustering results. First to be used was a K-means method, which produced a plot within the group's sum of squares by number of clusters extracted to help determine the appropriate number of clusters. The result of this method was that no clear conclusion was found for sixty-six innovating countries used for the model. The analysis then used the Ward's Hierarchical Clustering test with a Euclidean distance matrix. The latter test indicated a three cluster solution according to the K-means: an appropriate scattered plot matched by a two Dendogram chart detailing country participations in the three convergence clubs for both the first and last year in the time series, namely 1996 and 2011, respectively.

A fifth methodology applies. Accordingly, statistical imputation is used 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 the fifteen years between 1996 and 2010 with missing values. In a few country cases, no reliable imputation is possible, since the range of time for which data is available is too narrow, such as in the case of the GERD date from the Philippines. Whenever imputation methodology is statistically permissible, the following rules are appropriate: firstly, 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. Secondly, 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. Thirdly, if there is missing data between two data points, the study uses an interpolation between the two data points.

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94. Glossary, *supra* note 93.

95. *Id.*

As a whole, the methodology used in the model adheres to the conceptualization and critique put forth by two constituting OECD statistical manuals. The first is the OECD Frascati Manual (2002) on R&D & GERD-related statistics.[96] The second manual is the OECD/Eurostat Oslo Manual (2005) on innovation-related statistics.[97] In principle, both jointly lay emphasis on the need to move beyond normative posturing by stakeholders, role players and policy makers and toward empirical observations. The OECD's Frascati Manual certainly is the *de facto* standard for the internationally comparable measurement of R&D & GERD of OECD member states and associated observer states for the last fifty years.[98] It is funneled by two additional, noticeable OECD manuals. The first of two is the United Nations Educational, Scientific and Cultural Organization (UNESCO) Technical Paper No. 5, titled: *Measuring R&D: Challenges Faced by Developing Countries* from 2010.[99] This manual provides guidance on a number of methodological challenges that are relevant to developing countries and which may have not been elaborated clearly enough in the Frascati Manual. The second of two is the *OECD's Patent Statistics Manual of 2009*,[100] which provides users and producers of patent statistics with basic guidelines used herein for compiling and analyzing such data. Both manuals confirm the Frascati Manual as the most widely accepted international standard practice for R&D & GERD-related surveys.[101]

B. Findings

1. The Null Hypothesis (H0): Patent Propensity Clusters

The null hypothesis, *H*0, represents this article's main argument whereby countries worldwide converge into numerous convergence clubs over their propensity to patent as proxy for their domestic innovation.[102]

The *first* finding described in Tables 1–3 below leads to the identification of three innovation convergence clubs with markedly different levels of

96. FRASCATI MANUAL, *supra* note 93.

97. ORGANISATION FOR ECON. CO-OPERATION & DEV., OSLO MANUAL: PROPOSED GUIDELINES FOR COLLECTING AND INTERPRETING TECHNOLOGICAL INNOVATION DATA (3rd ed. 2005).

98. UNITED NATIONS EDUC., SCIENTIFIC & CULTURAL ORG., MEASURING R&D: CHALLENGES FACED BY DEVELOPING COUNTRIES 11 (2010) [hereinafter MEASURING R&D].

99. *Id.*

100. *Statistics Manual*, *supra* note 85.

101. MEASURING R&D, *supra* note 98. This article adheres to these methodologies while entailing a series of statistical analysis using Statistical Analysis System (SAS) software.

102. This null hypothesis sets the default assumption thereof, either because it is believed to be true or because it is to be used as a basis for argument, but has not been proved.

propensity to patent rates. Table 1 refers to the first point of measurement, labeled "first time," in which the Ward Hierarchical Clustering analysis scaled as log ratio of Patents per GERD over scaled GERD has been accounted for. Table 1 indicates the existence of two large patent propensity-gaps in the world economy: the first refers to the great distance that separates the middle group of "*followers*" from the stronger "*leaders*" in terms of patent propensity capabilities; the second similarly refers to the impressive gap that separates the weaker "*marginalized*" from the *followers* clubs.

Convergence among the *leaders*, which has received the most attention in the literature, is indeed more prevalent than within the intermediate *followers* range. Tables 2 and 3, titled "*Country Clusters Dendogram*" at "first time" and "last time," respectively, further show alongside Table 4 below (whereby *leaders* are labeled as Cluster 3 colored in blue), that the cluster of *leaders* in 1996 includes merely twenty countries out of which only seventeen OECD countries are accounted for and two emerging economies, namely Thailand and Malaysia, were included. As of 1996, the latter fifty percent of OECDs initially converged with the *followers* convergence club—that is, while slicing OCDC advanced countries into two noteworthy halves over what remains an unaccounted for OECD patent propensity divide. By 2011 Bulgaria, Hungary, and Norway join in.

For the *followers* convergence club alongside Table 4 below (whereby *followers* are labeled as Cluster 2 colored in green), the findings questions the depiction of the twenty-four Emerging Economies listed by the IMF as of 16 July 2012,[103] as the inclusive intermediary innovative country group classification. Notably, by 2011 a mere three out of twenty-four of the Emerging Economies, namely Lithuania, Latvia, and Romania, were made part of the *followers* cluster. Alongside this minority of Emerging Economies, numerous other less-developing countries, namely Armenia, Azerbaijan, Kyrgystan, and Moldova, maintain both leadership within developing countries as well as potential intermediacy between the *leaders* and *marginalized* convergence clubs—within the *followers* cluster.[104]

What remains significant throughout the time series between 1996 and 2011 is that none of the four BRIC economies—Brazil, Russia, India, and China—belonged to the *followers* cluster. Instead, these four iconic political leaders of the developing world and the twenty-four Emerging Economies therein belonged to the third and less innovative *marginalized* cluster (labeled

103. INT'L. MONETARY FUND, World Economic Outlook Update: New Setbacks, Further Policy Action Needed (16 July 2012), at http://www.imf.org/external /data.htm, at 4 & fn. 3 (listing emerging economies) [hereinafter IMF].

104. The Followers cluster further included four advanced economies: Greece, Slovakia, Slovenia, and Iceland. *See infra* Table 4.

as Cluster 1 and colored in red in Tables 1–3). That is the case given their surprisingly low propensity to patent rates as proxy for their domestic innovation rates, notwithstanding their leadership within the G-20 and other developing countries-led WTO coalitions over the TRIPS Agreement, as has been explained.

For the *marginalized* country group, alongside Table 4 below, the findings show numerous competing findings. Firstly, a majority of accounted for Emerging Economies belonged by 2011 to the marginalized cluster. These included the four BRIC countries, as well as Ukraine, Pakistan, Argentina, Turkey, Mexico, South Africa, and Poland. Moreover, alongside the IMFs Less Developing Country group classification, numerous other developing countries joined by 2011 and noticeably sub-Saharan Burkina Faso, Egypt, and Sri Lanka. Lastly, among the *marginalized* group, by 2011, numerous OECDs were to be found. These included Spain, Portugal, and the Czech Republic.[105] Albeit empirically distinct per the propensity to patent breakdown, the characteristics of these clubs partly resemble those of the triad "*innovation*," "*imitation*," and "*stagnation*" groups identified following Aghion, Howitt, and Mayer-Foulkes' model and the deriving empirical findings by Fulvio Castellacci, offering broad technology-propensity results of a three cluster analysis.[106]

For the *leaders* convergence club, the findings suggest that even among the thirty-four OECD countries or the analogous thirty two Advanced Economies listed by the IMF as of 16 July 2012,[107] convergence over patent propensity is not apparent. In other words, there is evidence of club convergence even *within* the economies of the OECD. Resembling Canova's 2004 findings on the club convergence over income rate-related economic growth, this article shows that the initially-categorized *follower* countries in the OECD diverge from the initially remaining twenty *leader* countries. The latter are those which form the exclusive and enduring convergence club

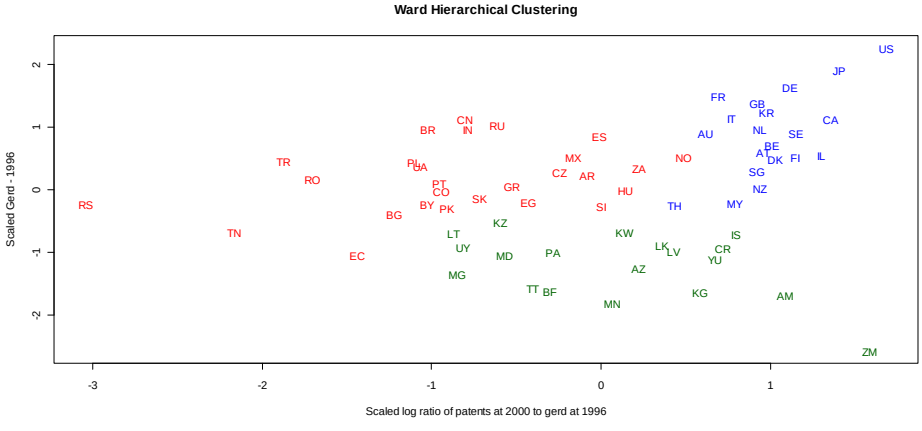
105. Cyprus, Malta, Ireland, Switzerland, and Luxemburg, which are OECD countries, were not accounted for in this study for lack of consistent GERD-related statistics on their behalf. Partial measurements did indicate, however, that Cyprus and Malta were close to belonging formally to the *marginalized* cluster.

106. Fulvio Castellacci, *Convergence and Divergence among Technology Clubs* 25 (Danish Research Unit for Indus. Dynamics, 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."); *see also* Philippe Aghion et al., *The Effect of Financial Development on Convergence: Theory and Evidence*, 120 Q. J. ECON. 173, 173 (2005) (presenting evidence whereby "any country with more than some critical level of financial development will converge to the growth rate of the world technology frontier, and that all other countries will have a strictly lower long-run growth rate").

107. IMF, *supra* note 103, at fn. 4.

throughout the entire period.[108] This article thus contradicts findings on income-related economic growth, especially following Barro's work. In his 1991 publication, he argues that over a nearly forty-year period (1950–1988) convergence was restricted to OECD countries, while it was almost absent between the OECD and the less developed countries.[109]

Table 1: Scattered Plot by Country Clusters at First Time 1996/2000 Offering Ward Hierarchical Clustering (Scaled Log Ratio of Patent/GERD Per Scaled GERD)



108. Fabio Canova, *Testing for Convergence Clubs in Income Per Capita: A Predictive Density Approach*, 45 INT'L ECON. REV. 49, 49 (2004); *see also* Sala-i-Martin, *supra* note 14, at 1029.

109. Robert J. Barro, *Economic Growth in a Cross Section of Countries*, 106 Q. J. ECON., 407, 420 (1991); *see also* Sala-i-Martin, *supra* note 14; Steve Dowrick & Norman Gemmell, *Industrialization, Catching Up and Economic Growth: A Comparative Study Across the World's Capitalist Countries*, 101 ECON. J. 263 (1991); Steve Dowrick & Duc-Tho Nguyen, *OECD Comparative Economic Growth 1950-85: Catch Up and Convergence*, 79 AM. ECON. REV. 1010 (1989).

Table 2: Country Clusters Dendogram at First Time 1996/2000

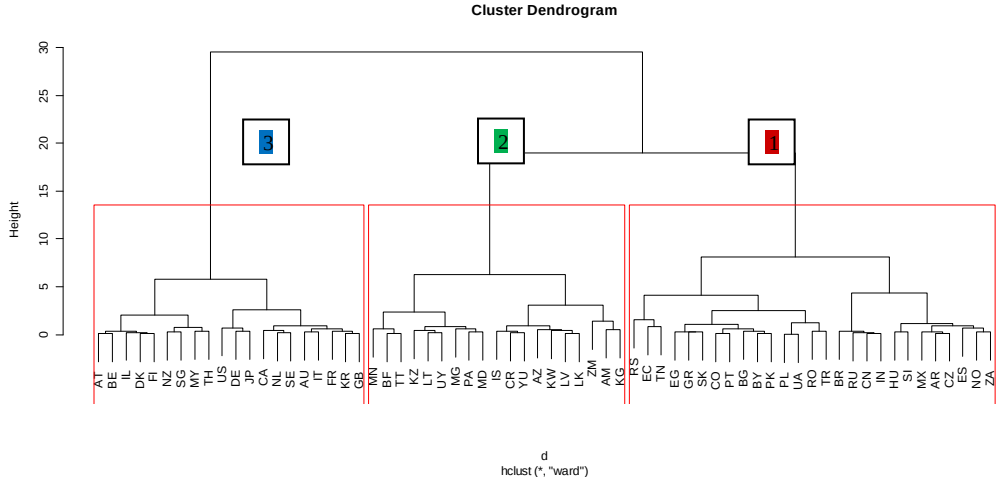


Table 3: Country Clusters Dendogram at End Time 2007/2011

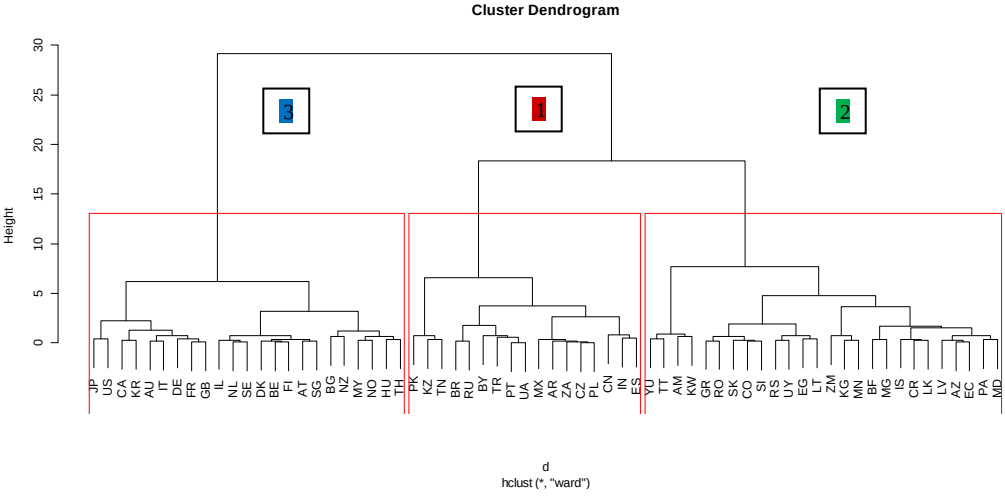


Table 4: List of Countries/Cluster Transitions between First time-End Time

Obs	Country Name	Country Code	Cluster Transition	Cluster 1996	Cluster 2011
1	Argentina	AR	11	1	1
2	Brazil	BR	11	1	1
3	Belarus	BY	11	1	1
4	China	CN	11	1	1
5	Czech Rep.	CZ	11	1	1
6	Spain	ES	11	1	1
7	India	IN	11	1	1
8	Mexico	MX	11	1	1
9	Pakistan	PK	11	1	1
10	Poland	PL	11	1	1
11	Portugal	PT	11	1	1
12	Russian F.	RU	11	1	1
13	Tunisia	TN	11	1	1
14	Turkey	TR	11	1	1
15	Ukraine	UA	11	1	1
16	S. Africa	ZA	11	1	1
17	Colombia	CO	12	1	2
18	Ecuador	EC	12	1	2
19	Egypt	EG	12	1	2
20	Greece	GR	12	1	2
21	Romania	RO	12	1	2
22	Serbia	RS	12	1	2
23	Slovenia	SI	12	1	2
24	Slovakia	SK	12	1	2
25	Bulgaria	BG	13	1	3
26	Hungary	HU	13	1	3
27	Norway	NO	13	1	3
28	Armenia	AM	22	2	2
29	Azerbaijan	AZ	22	2	2
30	Burkina F.	BF	22	2	2
31	Costa Rica	CR	22	2	2
32	Iceland	IS	22	2	2
33	Kyrgyzstan	KG	22	2	2

34	Kuwait	KW	22	2	2
35	Sri Lanka	LK	22	2	2
36	Lithuania	LT	22	2	2
37	Latvia	LV	22	2	2
38	Moldova	MD	22	2	2
39	Madagascar	MG	22	2	2
40	Mongolia	MN	22	2	2
41	Panama	PA	22	2	2
42	Trinidad T.	TT	22	2	2
43	Uruguay	UY	22	2	2
44	F. Yugoslav	YU	22	2	2
45	Zambia	ZM	22	2	2
46	Austria	AT	33	3	3
47	Australia	AU	33	3	3
48	Belgium	BE	33	3	3
49	Canada	CA	33	3	3
50	Germany	DE	33	3	3
51	Denmark	DK	33	3	3
52	Finland	FI	33	3	3
53	France	FR	33	3	3
54	United Kin.	GB	33	3	3
55	Israel	IL	33	3	3
56	Italy	IT	33	3	3
57	Japan	JP	33	3	3
58	Rep. Korea	KR	33	3	3
59	Malaysia	MY	33	3	3
60	Netherlands	NL	33	3	3
61	New Zealand	NZ	33	3	3
62	Sweden	SE	33	3	3
63	Singapore	SG	33	3	3
64	Thailand	TH	33	3	3
65	United St.	US	33	3	3

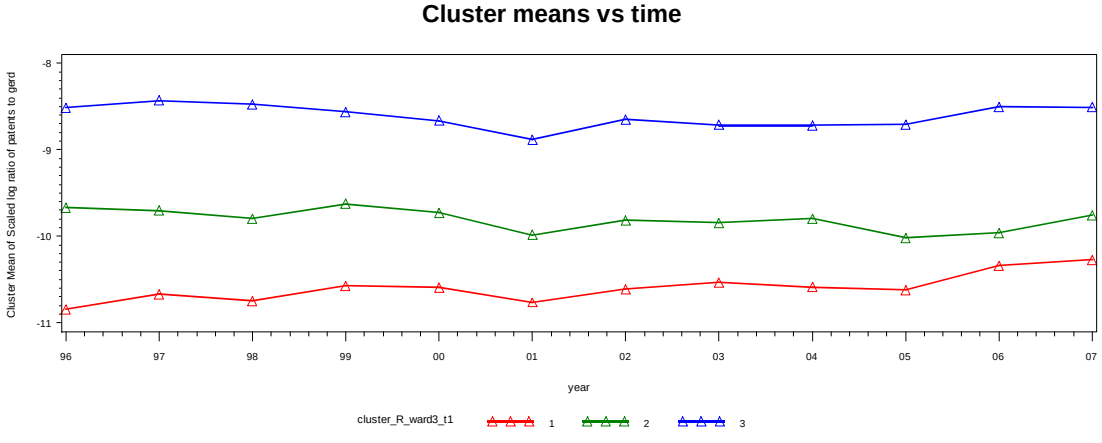
2. The First Hypothesis (H1): Inter-Cluster Convergence

The *H1* hypothesis follows. Table 5 confirms the assumption according to which a narrowing of the overall spectrum with both the *followers* and especially the *marginalized* cluster occurs. It shows a mild upward convergence on behalf of both the *followers* and *marginalized* towards the *leaders*. This transition is accounted for by each of the cluster's means of

scaled log ratio of patents to GERD as they change over time. It shows a relatively stable pattern regarding the means, with a consistently high mean corresponding to *leaders* and lower means correlating with the other two clusters. The final relative position as of 2011 of the three means changed, however, compared with their initial position. What is mostly evident is that towards the end of the period, the *marginalized* mean approaches the other two over their propensity to patent rates as proxy of their domestic innovation rates.

This finding contradicts recurring "catch-up" theories in the literature and the emblematic Chang's *Kicking Away the Ladder* warning against the widening of the model north-south innovation gap presumably fostered by the TRIPS agreement.[110] Indeed, the highest incidence of overall inter-cluster convergence is not on behalf of the *leaders* convergence club; rather, it is among the world's *marginalized* one.

Table 5: Cluster Means vs. Time



(Scaled Log Ratio of Patent/GERD Per Cluster)

110. HA-JOON CHANG, KICKING AWAY THE LADDER: POLICIES AND INSTITUTIONS FOR ECONOMIC DEVELOPMENT IN HISTORICAL PERSPECTIVE 67 (2002) (arguing that today's productivity gap between developed and developing countries is wider than the one in earlier times); CHRISTOPHER MAY, THE INFORMATION SOCIETY: A SKEPTICAL VIEW (2002) (discussing a possible growth in the gap since the enactment of the TRIPS agreement); *see generally* Carlota Perez & Luc L. Soete, *Catching-Up in Technology: Entry Barriers and Windows of Opportunity*, *in* TECHNICAL CHANGE AND ECONOMIC THEORY, (Giovanni Dosi ed., 1988) (discussing related "catch-up" literature).

3. The Second Hypothesis (H2): Intra-Cluster Convergence

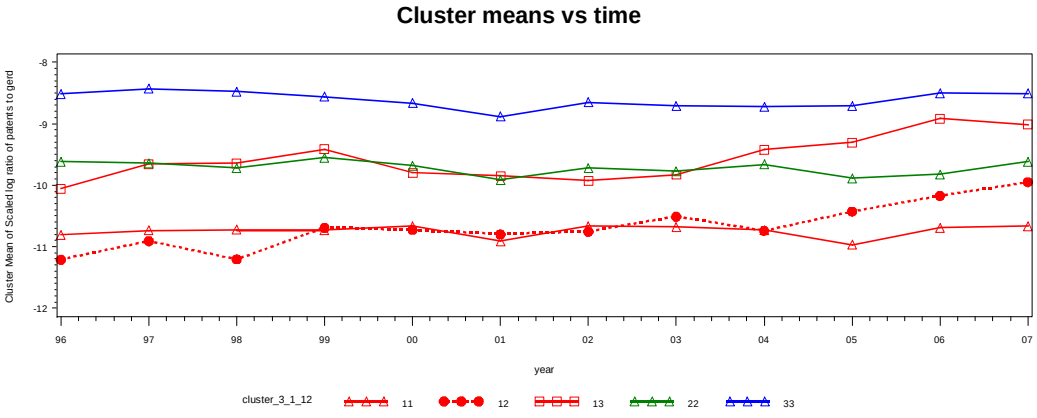
The *H2* hypothesis brings the article's findings to an important competing finding. The finding of Table 6 below is thus twofold: to begin with, it foretells how numerous countries that initially started as *marginalized* have moved and changed their position to *followers*. In contrast, however, Table 6 shows that with the exception of one country, Kazakhstan, countries that were *followers* or *leaders* did not regress in their convergence club ranking between 1996 and 2011. In other words, the aggregated propensity to patent worldwide advances slowly yet positively.

In the final analysis in Table 4 above, the article defines five groups of countries which account for intra-cluster convergences. These include those that were initially in cluster 1 (*Marginalized* cluster based on initial period as of 1996) and that remained in the second clustering period as of 2011 (labeled 11). A second group were those that were initially in cluster 1 and moved by 2011 to cluster 2 (the *followers* cluster based on initial period as of 1996, labeled 12). A third group, depicted in Table 4 above, are of those that were initially in cluster 1 and moved by 2011 to cluster 3 (the *leaders* cluster based on initial period as of 1996, labeled 13). A fourth group of countries are those that were initially in cluster 2 and that remained there as of 2011 (labeled 22). The fifth and last group described in Table 4 above is of those that were initially in cluster 3 and those that stayed there by 2011 (labeled 33).

As the combination of Tables 5 and 6 depicts, there has been a noteworthy upward convergence transition from twenty-seven *marginalized* countries in 1996, to sixteen in 2011; and from 41 percent of countries to 26 percent of them by 2011. This sharp decrease foretells the transformation of eight countries to *followers* by 2011, including Colombia, Ecuador, Egypt, Greece, Romania, Serbia, Slovenia, and Slovakia. In addition, three countries noticeably made full transition from being part of the *marginalized* cluster into the *leaders* cluster (cluster 3 labeled 13 above) –Bulgaria, Hungary and Norway.

This finding depicts Ben David's *upward convergence*, a case of lesser club members—*followers* and *marginalized*—catching up with advanced members, or *leaders*, herein. These findings correspond with recent analyses focused almost exclusively on income-related indications of endogenous growth theory. They indicate that unlike orthodox neoclassical models, as shown by Martin and Sunley, regional convergence rates are much slower on the whole.

Table 6: Five Cluster Means vs. Time



(Scaled Log Ratio of Pat/GERD Per Cluster)

III. THEORETICAL RAMIFICATIONS

The core empirical findings above moderately correspond with *catch-up* literature concerning the pulling of other countries through a technology "catch-up" effect. In a recently published, seminal article by Harvard University economist Jérôme Vandenbussche and others, the authors assess that the strength of this "catch-up" effect on the developing countries' frontier in fact decreases with the level of domestic technological creation.[111] As a result, it is presumed that technology creation by domestic firms becomes progressively more important as a country moves closer to the technology frontier whereby technology diffusion and absorption decline—or in other words, as catching up possibly translates into increasingly smaller technological improvement protected through incremental patenting activity.[112]

Yet, thus far, this endogenous growth analysis has remained overwhelmingly theoretical. Its validation in our case indeed is acute mostly at the regional level.[113] As the evidence suggests, the key factors stressed by endogenous growth theory, namely guaranteeing increasing returns, human capital and domestic technology creation, develop unevenly and could be differentiated locally and regionally[114] However, as stated above, earlier

111. Vandenbussche, *supra* note 12, at 104–06; *see* Hassan, *supra* note 13, at 17 (providing additional general discussion of the argument.).

112. Hassan, *supra* note 12, at 17. The present paper leaves the latter argument concerning incremental patenting outside of its scope.

113. Martin & Sunley, *supra* note 11, at 220.

114. Martin & Sunley, *supra*, note 11, at 220.

accounts of endogenous growth theory's relationship to club convergence between country groups, to be sure, have mostly contributed to the understanding of archetypical club convergence over salaries, GDP and other macroeconomic income-related indications.[115]

It is unclear why endogenous convergence between country groups or clubs over domestic state-of-the-art-technology creation exists. Similarly, not much is known about how the latter is achieved.[116] Moreover, very little is conceptually attributed to explaining how technological creation of country group clusters is determined.[117]

In fact, the only certain findings of this article concerning club convergence negate regional divergence between advanced and emerging economies. In other words, this article demonstrates slow regional convergence of innovation, especially by developing countries which are not emerging economies towards advanced ones, measured through patent propensity rates.[118] Table 4 above shows how in fact sixty-one percent of all accounted for Emerging Economy countries remained in the *marginalized* cluster for the period 1996–2011.[119]

Notwithstanding the present empirical absence concerning the exact growth model, it being exogenous or endogenous, this article indicates that market forces potentially have failed in disequilibrating the *leaders* convergence club in their relative country group's progression towards a patent propensity which characterizes two-thirds of advanced economies, as explained above. These highly-innovative countries continuously converged throughout the measured time series period. Moreover, in certain analogies to income-based growth, findings correspond with Baumol and Wolff's

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115. Dan Ben-David, *Convergence Clubs and Diverging Economies* 1 (CEPR Discussion Paper, 1997) (concluding that "income gaps have increased within most possible groupings of countries in the world. Where 'convergence clubs' tend to be more prevalent is at the two ends of the income spectrum.").

116. *See* Martin & Sunley, *supra* note 11, at 210 (citing Gould & Ruffin, *supra* note 13; *Convergence across*, *supra* note 13). Such diffusion of technology requires accordingly that lagging emerging economies would have appropriate infrastructure or conditions to adopt or absorb technological innovations. ALEXIADIS, *supra* note 13, at 61, Sec. 4.5 (for a supportive economic model). For two of the earliest and most influential statements of this view, *see* BORTS & STEIN, *supra* note 13 (offering a classic study of regional development in the United States); Williamson, *supra* note 13 (analyzing the evolution of regional income differences in advanced industrial countries).

117. *See* ALEXIADIS, *supra* note 13, at 61 & Sec. 4.5 (for a supportive economic model).

118. *But see* Martin & Sunley, *supra* note 11, at 201 ("predict[ing] that regional incomes will tend to diverge, because market forces, if left to their own devices, are spatially disequilibrating.") (citing *Economic Space*, *supra* note 18; Perroux, *supra* note 18; MYRDAL, *supra* note 19; *Case for Regional Policies*, *supra* note 20) (providing comparable income-related findings).

119. These were the four BRICs (Brazil, Russia, India and China), as well as Argentina, South Africa, Turkey, Poland, Ukraine, Pakistan, and Mexico. *See supra* Table 4.

utilization of data from seventy-two countries demonstrating that middle income countries (seventeen out of seventy-two countries in the sample), mostly corresponding to the *marginalized* cluster (particularly emerging economies beginning in the mid-1990s), have grown the fastest.[120]

Finally, one has to entertain the possibility that in the long run, comparable patent propensity rates as proxy of domestic innovation rates by advanced and emerging economies may uphold club divergence. Such divergence may exist instead of convergence due to possible deep international incompatibilities in economic integration.

CONCLUSION

Accounting for sixty-six innovating countries worldwide over the time series period between 1996 and 2011, the article offers three empirical findings. The first one leads towards the identification of three domestic innovation-related convergence clubs with markedly different levels of propensity to patent rates. It shows two large patent propensity-gaps in the world economy: the first refers to the great distance that separates the middle group of "*followers*" from the stronger "*leaders*" in terms of patent propensity capabilities; the second similarly refers to the impressive gap that separates the weaker "*marginalized*" from the *followers* clubs.

Furthermore, the first finding offers numerous insights. To begin with, the *leaders* cluster included in 1996 merely twenty countries including only seventeen OECD countries out of thirty-two. With the joining of Norway as of 2011, the latter fifty percent of OECDs defined the *followers* convergence club as a stable yet inflexible group of twenty one highly innovative OECD countries (alongside non-OECD Bulgaria and Hungary to join the *leaders* cluster by 2011). That is, while effectively slicing OCDC advanced countries into two halves over what remains an unaccounted for OECD patent propensity-related innovation divide.

As for the *followers* convergence club, the first finding further questions the depiction of the twenty-four emerging economies listed by the IMF, as of 16 July 2012, as the ultimate intermediary innovative country group classification. What remains significant throughout the time series is that none of the four BRIC economies, namely Brazil, Russia, India, and China

120. *See* William J. Baumol & Edward N. Wolff, *Productivity Growth, Convergence, and Welfare: Reply*, 78 AM. ECON. REV. 1155, 1156–57 (1988) (contrasting with the trajectory for the *marginalized* convergence club herein, and while using an income-related growth analysis, Baumol further upholds that the poorest countries have diverged from the others); *see also* Hollis Chenery & Moshe Syrquin, *Typical Patterns of Transformation*, *in* INDUSTRIALIZATION AND GROWTH: A COMPARATIVE STUDY 37 (Hollis Chenery, Sherman Robinson & Moshe Syrquin, eds., 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).

belonged to the *followers* cluster. Instead, these four rising political leaders within the developing world, and the twenty-four Emerging Economies therein, belonged to the third and less innovative *marginalized* cluster.

The article upholds a second finding concerning convergence between the three abovementioned convergence clubs. It adheres to the finding by which convergence among *leaders*, which have received the most attention in the literature, is indeed more prevalent than it is within the intermediate *followers* range. Yet the highest incidence of convergence towards the overall the global patent propensity mean is not done on behalf of the *leaders* convergence club; rather, it is done by the weaker *marginalized* one.

The third finding follows; it foretells how numerous countries that initially began as *marginalized* have moved and changed their position to *followers*. In contrast, however, it shows that except for Kazakhstan, countries that were *followers* or *leaders* did not regress in their convergence club ranking by 2011. In other words, the aggregated propensity to patent worldwide advances slowly yet positively. This finding depicts Ben David's upward convergence, a case of lesser club members—*followers* and mostly *marginalized*—catching up with advanced members, referred to herein as *leaders*.

These findings correspond with recent analyses focused almost exclusively on endogenous growth theory income-related indications. They suggest that unlike orthodox neoclassical models, as shown by Martin and Sunley, regional convergence rates are also much slower on the whole.

Lastly, this article's analysis implies numerous theoretical ramifications, primarily relating to the need for further explanation of the remaining intricacies in accounting for shifts and reversals in rates of regional convergence. Such discrepancies arise from the fact that there remains little to account for the slowness or nonexistence of inner (codenamed, intra-) club convergence, especially in advanced economies, but also in emerging ones. In terms of economic outcomes, it also remains unclear how a selection of a few countries in Latin America, coastal Africa, and the former Soviet bloc have dropped out of the *marginalized* convergence club as it is at least as impressive as it is unclear how a selection of countries have progressed from the *followers* one onto the *leaders* one. Finally, the article's findings beg further explanation of how, given that only half of OECD countries are members of the *leaders* convergence club, it remains small yet stable.