The article uncovers profound empirical and conceptual shortcomings concerning the "one-size-fits-all" innovation and intellectual property-related policies used internationally. These policies surely are funneled by the World Trade Organization (WTO) and the TRIPS Agreement or the World Intellectual Property Organization (WIPO)'s archetypical Development Agenda. The article offers a novel delineation of these policies vis-à-vis distinct country groups or "convergence clubs."

In so doing, the article offers a unique statistical model carrying out hierarchal cluster analyses for sixty-six innovating countries twice during the 1996-2011 time series period. The model detects country groups that are similar in their convergence patterns over patent propensity rates as proxy for their domestic innovation rates.

Moreover, the article suggests a more accurate demarcation of two large patent propensity gaps and the convergence patterns therein. The first such gap refers to the stable expanse that separates the middle group of 'followers' from the stronger 'leaders' in terms of patent propensity capabilities. The second similarly refers to the impressive yet steadily closing gap that separates the weaker 'marginalized' from the 'followers' clubs. Overall, the article's findings should lead to optimizing future WTO member coalitions among such groups or clubs.
INTRODUCTION

Innovation-related United Nations organs, and primarily the World Trade Organization (WTO), the World Intellectual Property Organization (WIPO) and the United Nations Conference on Trade and Development (UNCTAD), systematically have failed in dispensing sufficient attention to innovation policy delineation to all countries, and particularly among developing countries. This issue has been highlighted especially 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. 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

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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.

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 increasingly are 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' theory. 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, as the term suggests, 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 series 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 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

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in rates of regional convergence. Thus far, little accounts 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 growingly 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. 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. All of these startling pieces of evidence are found against the backdrop of a traditional World Bank-led inflexible North/South country group dichotomy, or some variation thereof. Such an innovation policy setting continually highlights the asymmetries between Northern

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4 See, Jose Groizard, Technology Trade, The Journal of Development Studies, Taylor and Francis Journals, vol. 45(9) 1526 (2009) (using panel data of 80 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, for example Park (2005) and Kanwar and Evenson (2003), generally find a positive effect, Chen and Puttitanun (2005) explain that lower IPR can facilitate imitation, while on the other hand, innovation in developing countries increases in proportion to greater IPR protection. Furthermore, see, Falvey, R., N. Foster and D. Greenaway, Intellectual property rights and innovation in developing countries, Review of Development Economics, 10(4), 700-19 (2006) (using panel data of 79 countries and four sub-periods: 1975-79, 1980-84, 1985-89 and 1990-94, 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. Id.; See, also, Falvey et al, 2009 (using panel data of 69 developed and developing countries over the period 1970–1999 the author shows that the IPR-R&D relationship depends on the level of development, the imitative ability and the market size of the importing country).

countries, which are deemed to generate innovative products and technologies, and Southern countries, which are generally thought to consume them.\(^6\)

Surely, some United Nation organs did not make a clear theoretical choice on the matter. WIPO or UNCTAD simply have failed systematically to dispense substantive attention to innovation policy delineation among developing countries, and all countries as a whole. This failure 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' neoliberal 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.\(^9\)

Over-simplifying drastically, a convenient way to distinguish the two views on innovation-led growth of developing countries is to ask, “Are poor economies catch up with those already innovatively advanced (and thus 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

\(^6\) See, id.

\(^7\) See, for official surveys, World Intellectual Property Organization (WIPO, 1985), and the United Nations Department of Economic and Social Affairs (UNCTAD, 1974). For theoretical and empirical studies, see Grundmann, Foreign Patent Monopolies in Developing Countries: An Empirical Analysis, 12 J. Dev'tl Stud. 186 (1976); J. Katz, Patents, the Paris Convention and Less Developed countries, Discussion Paper no. 190, at 24-27 (Yale Univ. Economic Growth Center, Nov. 1973); Greer, The Case against Patent Systems in Less-Developed Countries, 8 J. Int'l L. & Econ. 223 (1973); Vaitos, Patent revisited: Their function in developing countries, 9 J. Dev'tl Stud. 71, 89-90 (1972). UNCTAD has changed course afterwards. See discussion hereinafter.


\(^9\) See, e.g., WIPO, The 45 Adopted Recommendations under the WIPO Development Agenda, Cluster F: Other Issues (Recommendation 45: "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...."), at: http://www.wipo.int/ip-development/en/agenda/recommendations.html. 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.


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.\(^\text{12}\) Instead, the most popular examples covered in the literature include: convergence over 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.\(^\text{13}\)

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

\(^{12}\) See, J. Vandenbussche, P. Aghion and C. Meghir, Growth, Distance to Frontier and Composition of Human Capital, Journal of Economic Growth 11(2) 97 (2006) (Using a panel of 19 OECD countries between 1960 and 2000 while using an endogenous growth model authors show how as a country gets closer as a country increasingly experiences economic growth, it relies more and more on innovation), at 21-30. For additional general discussion of the argument See, Emmanuel Hassan, Ohid Yaqub and Stephanie Diepeveen, Intellectual Property and Developing Countries: A review of the literature, RAND Europe (2010), at 17. See also discussion in Part III, infra.


individual countries and across the European Union, that all appear to be converging towards each other at a steady, consistent rate of 2 percent per year.\textsuperscript{14}

In the meantime, convergence literature saw another convergence regression. Codenamed \textit{club convergence},\textsuperscript{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 between these three abovementioned clubs.\textsuperscript{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.\textsuperscript{17}

Club Convergence theory may therefore be attributed to the second approach, known as \textit{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 \textit{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,\textsuperscript{18} followed by Myrdal\textsuperscript{19} and Kaldor\textsuperscript{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.

\textsuperscript{16} Id.
\textsuperscript{17} Id.
\textsuperscript{19} G. Myrdal, Economic Theory and Under-Developed Regions (1957).
A remaining seminal theoretical reformulation is known as conditional convergence. 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. To test for conditional convergence, therefore, it is necessary to hold the state of each economy as a constant as well.

B) Coalitions and Convergence Clubs

Heterogeneity among countries over their economic growth is commonly witnessed in a plethora of coalitions. In the absence of information asymmetries and transaction costs convergence clubs and coalitions thereof should efficiently correlate. In reality, country coalitions indeed rapidly are becoming the de facto preferred response of developing countries to imbalances in power at the WTO.


22 See, generally, Ron Martin and Peter Sunley, supra note 11, at 207-208.


24 On the background for developing countries-led coalitions at the WTO and GATT, See the seminal work of Amrita Narlikar, International Trade and Developing Countries: Bargaining Coalitions in the GATT and WTO (2003) (offering an historical typology of developing country coalitions in the GATT and WTO). See, also, Vicente Paolo B. Yu III, Unity in Diversity: Governance Adaptation in Multilateral Trade Institutions Through South-South Coalition-building, Research papers 17 (South Centre, July 2008), at 28, 33-34; Sonia E. Rolland, supra note 23 (emphasizing that developing country-led coalitions are beginning to change the WTO's dynamics), at 483; Negotiating Trade: Developing Countries in the WTO and NAFTA (J. Odell, ed.) (Cambridge University Press, 2006); J. Priceur and O.R. Serrano, Coalitions of Developing Countries in the WTO: Why Regionalism Matters? (2006); Constantine Michalopoulos, The Participation of the Developing Countries in the WTO (1999), at 17 (same).

For literature concerning intellectual property-related coalitions, see also Peter K. Yu, Building Intellectual Property Coalitions for Development, supra note 1, at 84; John S. Odell and Susan K. Sell, Reframing the issue: the WTO coalition on intellectual property and public health, supra note 1, at 104; Peter Drahos, Developing Countries and International Intellectual Property Standards-Setting, supra note 1, at 780; Gunnar Sjostedt, Negotiating the Uruguay Round of the General Agreement on Tariffs and Trade, in International Multilateral Negotiation: Approaches to the Management of Complexity supra note 1.

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. See e.g. Constantine Michalopoulos, Id.

In the pre-WTO era, developing country-led coalitions in the GATT received only limited academic attention and were largely considered ineffective. See, Amrita Narlikar, Bargaining over the Doha Development Agenda: Coalitions in the World Trade Organization, Serie LATN Papers, № 34 (2005) ("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"), at 2. Narlikar adds
Such coalitions consequently impact trade governance and WTO-related institutional reforms.\textsuperscript{25} To date, of the 112 Members who define themselves as 'developing countries,' a remarkable group of 99 countries (or 87.61 percent) are Members of one or more developing country-only groups or coalitions.\textsuperscript{26}

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.\textsuperscript{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,\textsuperscript{28} to issue-based groups such as the G-20 of the post-Cancun period. Otherwise, coalitions appeared as region-based groups\textsuperscript{29} such as the African Group, or as groups that shared certain development characteristics such as the Least-Developed Countries (LDCs).\textsuperscript{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,\textsuperscript{31} are also becoming a


\textsuperscript{26} See, Vicente Paolo B. Yu III, supra note 24, at 28.

\textsuperscript{27} Amrita Narlikar, supra note 24, at 3.


\textsuperscript{29} Jerome Prieur and Omar R. 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 (South Center 2004) ("[a] regional approach to the use of TRIPS flexibilities will enable similarly situated countries to address their constraints jointly..."), at xiv. Musungu et al, 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. \textit{Id.}, at 50-55. For probable support of a regional-type coalition within the context of Intellectual Property, \textit{See} Peter K. Yu, supra note 1 (Regional 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), at 90.

\textsuperscript{30} Jerome Prieur and Omar R. Serrano, \textit{Id.}, at 34.

\textsuperscript{31} A group of eleven developing countries working toward strengthening NAMA. \textit{See}, Faizel Ismail, The G-20 and NAMA 11: The Role of Developing Countries in the WTO Doha Round (2007), at 11-14.
key means for group-based action by developing countries. Of the coalitions in place as of late 2009, some sixty-seven developing countries (or 58.77 percent of developing WTO Members) have joined one or more informal issue-based developing country coalitions and sixty-one developing countries are Members of a regional group.32

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+”).35 This coalition of developing countries appeared just before the WTO Cancun summit, attempting to block the joint US/EC proposals.36 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-9,37 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.38

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32 This figure includes thirty-five that are also Members of one or more issue-based groups, and thirty-seven that are Members of one or more common characteristic groups. See, Vicente Paolo B. Yu III, supra note 24, at 28.


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).

35 See, Jerome Prieur and Omar R. Serrano, supra note 24 (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), at 8.

36 See, Jerome Prieur and Omar R. Serrano, supra note 24, at 8.

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

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 has consisted of a core group of countries, in this case called the G3+3.\textsuperscript{39} This group consists of the three biggest members: Brazil, China, and India. In addition, three important middle powers preside: Chile, South Africa and Argentina.\textsuperscript{40}

In reality, not all coalitions have prevailed. To illustrate, during the pre-negotiation phase of the Uruguay Round from 1982-1986, a coalition of developing countries called the G-10 was formed.\textsuperscript{41} 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.\textsuperscript{42} 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 successes of the group were limited.\textsuperscript{43}

An additional few, under-theorized WTO member issue-based coalitions continuously emerge also over innovation-led growth and intellectual property-related policies.\textsuperscript{44} Among them are the 'Joint proposal (in intellectual property)' Coalition,\textsuperscript{45} sponsoring a proposal calling for the establishment of a Geographic Indications (GI) database and register,\textsuperscript{46} and its neighbor the W52 coalition.\textsuperscript{47}

\textsuperscript{39} See, Jerome Prieur and Omar R. Serrano, supra note 24, at 8.
\textsuperscript{40} Id.
\textsuperscript{41} See, Vicente Paolo B. Yu III, supra note 24 (adding that these included Argentina, Brazil, Cuba, Egypt, India, Nicaragua, Nigeria, Peru, Tanzania, and Yugoslavia), at 26.
\textsuperscript{42} Id.
\textsuperscript{44} Amrita Narlikar, supra note 24, at 6-7. Adding that 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. Id.
\textsuperscript{45} 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? (April 21, 2006), Balkanization, at: http://balkin.blogspot.co.il/2006/04/what-is-access-to-knowledge.html (on A2K) ; Gaëlle Krikorian and Amy Kapczynski, Access to Knowledge in the Age of Intellectual Property (eds.) (2010) (same); R.E. Wyllys, Overview of the Open-Source Movement., The University of Texas at Austin Graduate School of Library & Information Science (2000) (on the open source movement).
\textsuperscript{46} 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. See, Groups in the WTO (updated 2 March 2013), at http://www.wto.org/english/tratop_e/dda_e/negotiating_groups_e.pdf, at 6.
\textsuperscript{47} A group of 109 WTO members. The list includes as groups: the EU, ACP and African Group. See, Groups in the WTO, supra note 45, at 5.
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, the thirty-one Asian developing members, the twenty eight European Union (EU) members, and of course the world’s fifty poorest countries, codenamed the Least-developed countries (LDCs). 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. The two differ from each other in two significant ways, which also explain why innovation and intellectual property-related policy coalitions could at least in theory be more effectual. 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.

A second reason in support of a transition to issue-based coalitions over innovation and intellectual property-related policies follows. Blocs usually bring together like-minded countries such as EU’s or LDCs, which adopt joint positions across issues and over time. Issue-based coalitions, on the other hand, 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. In contrast, issue-specific coalitions enjoy internal coherence, yet they remain hard to carry on when large diversified economies with manifold sector interest groups are involved. 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

52 Id.
53 Id.
54 Id.
55 Id.
bloc-based ones.\textsuperscript{56} Equally, such coalitions arguably should not be overly specific, or they may share the risk of disintegration by competing interests.\textsuperscript{57}

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\textsuperscript{58} over a single international equilibrium of neoclassical economic growth setting.\textsuperscript{59}

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, the article offers cluster analysis based on yearly data from 1996-2011 for sixty-six countries.\textsuperscript{60} It evaluates the linkage between national innovation as measured through the rate of \textit{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

\textsuperscript{56} See, Colleen Hamilton and John Whalley, Coalitions in the Uruguay Round, Weltwirtschaftliches Archiv, 125 (3), 1989, at 547-56; Amrita Narlikar, supra note 24, at 5.

\textsuperscript{57} Id.

\textsuperscript{58} The assumption of endogenous growth holds that diminishing returns to capital, implicit in the neoclassical production function (measuring income-based indicators among countries), lead 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. See, Xavier X. Sala-i-Martin, supra note 14, at 1025; Danny T. Quah, supra note 10, at 1.

\textsuperscript{59} 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—denoted as exogenous by neoclassical growth models.

\textsuperscript{60} The alphabetical list of the 66 countries with sufficient statistical validity include: 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.
between distinct country groups and clusters thereof. The TRIPS Agreement notably consists merely of an almost flat intellectual property and related-innovation policy for all WTO-members. 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. 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 countries as a whole. The second incentive assured agricultural trade. These incentives, backed by supportive agreements, were pivotal for the final acquiescence of developing countries to the TRIPS agreement. Both incentives also adhered implicitly to Solow's neoclassical growth model, formulated earlier on by economists Cass, and Koopmans, and earlier contributors.

More specifically, there still remains a predicament regarding the first technological incentive of technology transfer. Initially, it was meant to act as a

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61 For official surveys, see: World Intellectual Property Organization (WIPO, 1985), supra note 7, and the United Nations Department of Economic and Social Affairs (UNCTAD, 1974), supra note 7. For theoretical and empirical studies, See Grundmann, supra note 7; J. Katz, supra note 7, at 24-27 (Yale Univ. Economic Growth Center, Nov. 1973); Greer, supra note 8; Vaitos, supra note 7, at 89-90.
62 See, Daniel Benoliel & Bruno Salama, supra note 3, at 278; Michael Blakeney, supra note 8, at 16.
64 Laurence R. Helfer, Regime Shifting: The TRIPS Agreement and New Dynamics of International Intellectual Property Lawmaking, 29 Yale J. Int'l L. 1, 2 (2004); Carlos M. Correa, supra note 5 (focusing on developing countries' concerns over increasing technological transfer as a means of economic growth), at 18; For broader long-run economic growth concerns by developing countries, see also Christine Thelen, Id., at 528-529.
66 Id.
68 Tjalling Koopmans, On the concept of optimal economic growth, in (Study Week on the) Econometric Approach to Development Planning, chapter 4, 225 (1965), at 226-228.
70 The WIPO Development Agenda of 2007 noticeably illustrates the organization’s general yet implicit inclination towards neoclassical economics-related policies, with technology transfer being
force for convergence, because of the “advantage of backwardness” conferred on technological laggards, as was initially put by Harvard University economist Alexander in 1962. 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. Since Gerschenkon, just about every theory of international income differences that has taken technology transfer into account has implied that all countries share the same long-run growth rate.

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. 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.

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72 Alexander Gerschenkon, id.


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.\(^{75}\)

In the econometric model appropriate for present panel data, the dependent variable is the expected value of the yearly number of issued patents.\(^{76}\) The explanatory variables include country, GERD (as offset), year, 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.\(^{77}\) 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.\(^{78}\) Surely, only state-of-the-art technology that completes the USPTO patenting process is accounted for as issued patents. It is

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\(^{75}\) The type effect is statistically assumed to be changing throughout time.

\(^{76}\) The statistical assumption is that the number is distributed as a Negative Binomial. The latter type of distribution is a distribution of discrete probability of the number of successes in a sequence of Bernoulli trials before a specified (non-random) number of failures (denoted r) occur. In statistical terms, a Bernoulli trial is each repetition of an experiment involving only 2 outcomes. See, Joseph M. Hilbe, Negative Binomial Regression (2007), at 185-187.


therefore a limitation of patent statistics to measure patent applications as an indication of quality innovation.  

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 fraction of innovations they generally patent. 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. 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.

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. 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.


80 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. See, Kleinknecht A., K. Van Montfort and, E. Brouwer, The Non-trivial Choice between Innovation Indicators. Economics of Innovation and New Technology, 11, 109–121 (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), at 113-114.


82 Edward Deering Mansfield, supra note 1, Id.

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 enterprises originating in advanced economies. 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. Indeed, the solution presented through the ICN search category may account for either sole or co-inventions. All the same, USPTO co-inventions comprise roughly one percent of total inventions patented at the USPTO.

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 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), offer equivalent Inventor Country Nationality (ICN) search categories.

Furthermore, the rationale 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. A second reason is that such countries may differ substantively over their national grant rates. Both these methodological partialities are mostly solved by USPTO-based patenting statistics based on the ICN search category whereby issued patents are sampled.

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89 Id.
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. Yet on the other hand, a mitigating finding in support of this study's USPTO-based analysis holds that on average only between ten to fifteen percent of patent priority filings become triadic patents in the first place, whereas for the rest there is USPTO dominance for issued patents by foreign inventors.

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. This calculation of competing national rates by currency conversion into United States Dollars largely eliminates the differences in price levels among countries and country groups.

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.

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 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.

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. The second manual is the OECD/Eurostat Oslo Manual (2005) on innovation-related statistics. 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. 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 (2010). 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, 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.

100 United Nations Educational, Scientific and Cultural Organization (UNESCO) (2010), Technical Paper No. 5, supra note 98, Id. This article adheres to these methodologies while entailing a series of statistical analysis using Statistical Analysis System (SAS) software.
B) Findings

1) The Null hypothesis (H₀): Patent Propensity Clusters

The null hypothesis, H₀, 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.¹⁰¹

The first finding described in Tables 1-3 below leads to the identification of three innovation convergence clubs with markedly different levels of 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 2012,¹⁰² 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, Kyrgyzstan and Moldova, maintain both leadership within developing countries as well as potential intermediacy between the leaders and marginalized convergence clubs - within the followers cluster.¹⁰³

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

¹⁰¹ 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.
¹⁰³ The Followers cluster further included four advanced economies: Greece, Slovakia, Slovenia and Iceland. See, Table 4, Infra.
less innovative *marginalized* cluster (labeled 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 IMF's 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.\(^{104}\)

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.\(^{105}\)

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,\(^{106}\) 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 throughout the entire period.\(^{107}\) 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

\(^{104}\) 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.

\(^{105}\) For later findings See, also, Fulvio Castellacci, Convergence and Divergence among Technology Clubs, DRUID Working Paper No. 06-21 1 (2006) (supporting the idea of the existence of clubs of countries characterized by different levels of technological development and different technological dynamics), at 1; P. Aghion, P. Howitt and D. Mayer-Foulkes, The Effect of Financial Development on Convergence: Theory and Evidence, The Quarterly Journal of Economics, MIT Press, vol. 120(1) 173 2005 January (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).


was restricted to OECD countries, while it was almost absent between the OECD and the less developed countries.\(^{108}\)

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)

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

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Table 3: Country Clusters Dendogram at End time
2007/2011
### Table 4: List of Countries/Cluster transitions between First time-End time

<table>
<thead>
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<th>Country name</th>
<th>Country Code</th>
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<th>cluster 2011</th>
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2) The First Hypothesis (H1): Inter-Cluster Convergence

The $H_1$ 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. 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)

<table>
<thead>
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<th>Cluster Mean of Scaled log ratio of patents to gerd</th>
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<tr>
<td>-11</td>
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<tr>
<td>0.02</td>
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<tr>
<td>0.06</td>
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<td>0.10</td>
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</table>

![Graph showing cluster means vs time](image)

3) The Second Hypothesis ($H_2$): Intra-Cluster Convergence

The $H_2$ 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. 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.

Yet thus far this endogenous growth analysis has remained overwhelmingly theoretical. Its validation in our case indeed is acute mostly at the regional level. 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. However, as stated above, earlier accounts of endogenous growth theory’s relationship to club convergence between country groups, to be sure, have mostly

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110 See, J. Vandenbussche, P. Aghion and C. Meghir, supra note 12 (using a panel of 19 OECD countries between 1960 and 2000 while using an endogenous growth model authors show how as a country gets closer to economic growth, it relies more and more on innovation), at 21-30. For additional general discussion of the argument, see, Emmanuel Hassan, Ohid Yaqub and Stephanie Diepeveen, supra note 13, at 17.

111 See, Emmanuel Hassan, Ohid Yaqub and Stephanie Diepeveen, Id., at 17. The present paper leaves the latter argument concerning incremental patenting outside the scope of this paper.

112 See, Ron Martin and Peter Sunley, supra note 11, at 220. See also discussion henceforth.

113 See, e.g., Ron Martin and Peter Sunley, Id.
contributed to the understanding of archetypical club convergence over salaries, GDP and other macroeconomic income-related indications.\textsuperscript{114}

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.\textsuperscript{115} Moreover, very little is conceptually attributed to explaining how technological creation of country group clusters is determined.\textsuperscript{116}

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.\textsuperscript{117} Table 4 above shows how in fact sixty-one percent of all accounted for Emerging Economy countries remained in the \textit{marginalized} cluster for the period 1996-2011.\textsuperscript{118}

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 \textit{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 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 \textit{marginalized} cluster (particularly emerging economies beginning in the mid-1990s), have grown the fastest.\textsuperscript{119}

\textsuperscript{114} See, e.g., Dan Ben-David, Convergence clubs and subsistence economies, Journal of Development Economics (1998 February), vol. 55(1), 155-171, 167 (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.").

\textsuperscript{115} See, Ron Martin and Peter Sunley, supra note 11, at 210, referring to D. Gould, and R. Ruffin, What determines economic growth? Federal Bank of Dallas Economic Review 2:25 - 40 (1993); R. J. Barro and X. Xavier X. Sala-i-Martin, 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. See, S. Alexiadis, Convergence Clubs and Spatial Externalities, Advances in Spatial Science (Springer-Verlag 2013), at 61 & Sec. 4.5 (for a supportive economic model). For two of the earliest and most influential statements of this view See, G. H. Borts and J. L. Stein, supra note13 (offering a classic study of regional development in the United States); J. G. Williamson, supra note 13 (analyzing the evolution of regional income differences in advanced industrial countries).

\textsuperscript{116} See, S. Alexiadis, Convergence Clubs and Spatial Externalities, Advances in Spatial Science (Springer-Verlag 2013), at 61 & Sec. 4.5 (for a supportive economic model).

\textsuperscript{117} But See, for comparable income-related findings, Ron Martin and Peter Sunley, supra note 11, at 210 (referring to the work of Perroux (1950, 1955), Myrdal (1957), and Kaldor (1970, 1981) predicting that regional incomes will tend to diverge, because market forces, if left to their own devices, are spatially disequilibrating).

\textsuperscript{118} These were the four BRICs (Brazil, Russia, India and China), as well as Argentina, South Africa, Turkey, Poland, Ukraine, Pakistan and Mexico. See, Table 4, above.

\textsuperscript{119} See, William J. Baumol and Edward N. Wolff, Productivity Growth, Convergence, and Welfare: Reply, The American Economic Review, Vol. 78(5) (1988), 1155 (Contrasting with the trajectory for the \textit{marginalized} convergence club herein, and while using an income-related growth analysis, Baumol further upholds that the poorest countries have diverged from the others). For earlier findings concerning income-based club convergence by middle-income countries, \textit{see} Hollis
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 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

Chenery and Moshe Syrquin, Typical Patterns of Transformation, in Hollis Chenery, Sherman Robinson and Moshe Syrquin, eds., Industrialization and Growth: A Comparative Study, Oxford: Oxford University Press (1986) (combining time-series and cross-sectional data for several countries while finding divergence among the poorer countries and convergence among the relatively wealthier countries); Thorkil Kristensen, Development in Rich and Poor Countries, New York: Praeger (1982) (focusing on the cross-section alone, grouped countries by their 1974 income levels and found a hump-shaped relationship between group’s 1970-79 growth rates and their income levels, with the middle-income groups enjoying higher rates of growth than the wealthier and the poorer groups).
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, the 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.