THE IMPACT OF INSTITUTIONS ON PATENT PROPENSITY ACROSS COUNTRIES

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By: Daniel Benoliel*

This article offers a novel critique of the impact of institutions on the propensity to patent across countries. Patenting policy is regularly known to carry deep-rooted institutional implications. Yet in the case of developing countries, the United Nations constructed only loose policy concerning the role of the government, the business sector or Multi-National Enterprises in promoting patenting activity. Based on an implicit 'hands off' inclination towards the business sector, this yet uncorroborated policy flatly equates developing countries with advanced ones. More particularly, in the case of the twenty four emerging economies which are spearheading the developing world as hotbeds for meaningful innovation, little thought has thus far been given to the former's institutional particularities in view of promoting patenting as proxy of domestic innovation.

This article argues that advanced economies and emerging economies - abridging the development divide, in fact diverge over the impact of their government and business sectors in fostering patent propensity. For emerging countries there seems to be a negative relationship between the performance of innovation activity by the business sector and these countries' propensity to patent as proxy for domestic innovation. Equally, for advanced economies there is a negative relationship between the performance of innovation activity by the government and the propensity to patent by these countries. This article ultimately calls for a fundamental policy reexamination of the role of institutions in giving incentives to patenting activity as a proxy for domestic innovation in emerging economies abridging the archetypical North-South divide.

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INTRODUCTION

This article offers core empirical and theoretical critique of the impact of institutions on the propensity to patent across countries. To date, innovation-based economic growth theory has emphasized how research and development (R&D) and particularly internationalized R&D should be promoted by Multi-National Enterprises (MNEs) worldwide.[1] Such R&D activity is also strongly connoted with a higher yield of patenting activity measured by comparable national patent propensity rates. Yet across the board, present day literature in support, merely focuses on advanced or developed countries. It is, thus, not surprising either that there are a large number of scientific studies on this occurrence evidently merging the experience mostly of advanced economies or that several of these studies show an increasing internationalization of innovative activity mainly R&D by MNEs in such countries.[2] In practice, numerous examples established the present over generalized impression that internationalized R&D and the propensity to patent in emerging economies is a leading institutional choice. Surely, many examples come to mind. Such are Motorola's first foreign owned R&D lab in China since 1993, India's R&D activities of General Electric in areas as diverse as aircraft engines, consumer durables and medical equipment, or the presence of pharmaceutical

* Assistant Professor, University of Haifa Faculty of Law. This paper was presented at the 2013 Israeli Intellectual Property Academic Association Annual Meeting. I wish to acknowledge comments and assistance I received from Susy Frankel, Lior Zemer, Reto Hilty, Assaf Jacob, Niva Elkin Koren and Uri Benoliel. For statistical support I wish to thank Pavel Goldstein as well as and Professor Ayala Cohen and Dr. Etti Dove of the Statistics Laboratory at the Faculty of Industrial Engineering and Management, the Technion - Israel Institute of Technology. I also wish to thank my research assistance David Hurtado for additional assistance. Any inaccuracies are my responsibility.

[1] Frieder Meyer-Krahmer and Guido Reger, New perspectives on the innovation strategies of multinational enterprises: lessons for technology policy in Europe, Research Policy. Vol. 28, 751-776 (1999).

[2] Organization for Economic Co-operation and Development (OECD), Compendium of Patent Statistics, Economic Analysis and Statistics Division of the OECD Directorate for Science, Technology and Industry (2004); Daniele Archibugi & Alberto Coco, The Globalization of Technology and the European Innovation System, IEEE Working Paper DT09/2001. No (2001); Parimal Patel and Modesto Vega, Patterns of internationalization of corporate technology: location vs. home country advantages, Research Policy. Vol. 28, No. 145-155 (1999); Alexander Gerybadze. & Guido Reger, Globalization of R&D: recent changes in the management of innovation in transnational corporations, Research Policy, Vol. 28, No. 2-3 (special issue) 251-274 (1999); Parimal Patel (1995), Localized Production of Technology for Global Markets, Cambridge Journal of Economics, Vol. 19(1), 141-154.

companies such as Astra-Zeneca, Eli Lilly, GlaxoSmithKline, Novartis, Pfizer and Sanofi-Aventis - all running clinical research activities in India.[3]

Not surprisingly, this has also been the general albeit mostly implicit policy of different United Nations organs in recent years. Noticeably, this view is to be found in the 2005 United Nations Millennium Project,[4] the view of the World Intellectual Property Organization,[5] and even the United Nations Economic Commission for Africa.[6]

Rooted in dependency theories of development whereby developing countries were flatly perceived to be dependent on developed ones, the Trade-Related Aspects of Intellectual Property (TRIPS) agreement implicit pledge for a 'freer trade' role leading for the business sector in fostering domestic innovation backed by patenting activity. So much so, as TRIPS primarily corresponded and still does with the World Bank and UNCTAD's labeling of technology transfer as a reactive form of innovation-based economic growth for developing countries.[7] And so, rather than promoting domestic innovation through local technological capacity, innovation was to be received and at most adapted.[8] The business sector henceforth was meant to foster technologically-based trade.

Yet a more careful look shows that the role of MNEs and the business sector at large in promoting an internationalized form of innovation in the developing world based on the United Nations' internationalized R&D view thereof, seem to have partially fallen short in meeting these high expectations.

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[3] See, UNCTAD, World Investment Report, New York and Geneva, United Nations (2005), at Overview at XXIV.

[4] United Nations Millennium Project, Innovation: Applying Knowledge in Development, London: Task Force on Science, Technology and Innovation, Earthscan (2005) ("*thriving private sector depends fundamentally on adequate infrastructure, human capital, and research and development... Through support for higher education and for research and development outlays, the government lays the groundwork for economic growth through technological advance*"), at 123.

[5] See World Intellectual Property Organization (WIPO), see Economic Aspects of Intellectual Property in Countries with Economies in Transition, Ver. 1, the Division for Certain Countries in Europe and Asia, WIPO (2012) (focusing on developing countries mostly while reemphasizing that R&D is the most important economic indicator on how effective the innovation process is), at 22. See, broadly also Recommendation no. 26 of the WIPO, 45 Adopted Recommendations under the WIPO Development Agenda (2007) ("To encourage Member States, especially developed countries, to urge their research and scientific institutions to enhance cooperation and exchange with research and development institutions in developing countries, especially LDCs"), *Id.*

[6] See United Nations Millennium Project (2005), Innovation: Applying Knowledge in Development, London: Task Force on Science, Technology and Innovation, Earthscan (Emphasizing the role of innovation and underlying investment needs as a basis for economic transformation).

But see critique, e.g., Rasigan Maharajh and Erika Kraemer-Mbula, Innovation Strategies in Developing Countries, In Innovation and the Development Agenda (Erika Kraemer-Mbula and Watu Wamae, Eds.) (2009), at 136; Andreanne Léger and Sushmita Swaminathan, Innovation Theories: Relevance and Implications for Developing Country Innovation, German Institute for Economic Research (DIW) Discussion paper 743 (November 2007).

[7] See, World Bank, Innovation Policy: A Guide for Developing Countries (2010), at 116; UNCTAD and ICTSD (International Centre for Trade and Sustainable Development), Intellectual Property Rights: Implications for Development, Intellectual Property Rights and Sustainable Development Series Policy Discussion Paper, ICTSD, Geneva (2003).

[8] *Id.*

In so arguing, the article draws a comparison between two country group classifications abridging the North-South divide. These are the International Monetary Fund's (IMF) the twenty-four Emerging economies leading the developing world with innovation activity and the thirty-two advanced economies.[9] The dataset reviewed in this article relates to the years between 1996-2011. The article analyzes statistical connections between the government and the business sector both domestically and from abroad with the propensity to patent as proxy for domestic innovation by both country groups.

It follows the institutional wisdom whereby any effective innovation strategy requires coordination of multiple layers of institutional policies.[10] Such is the concern over the role these institutional actors take in promoting patenting activity, upon their impact on domestic innovation across countries. It corresponds with Ed Mansfield's definition of the propensity to patent as the percentage of patentable inventions that are in fact patented.[11] The definition per firm-level stands for the percentage of innovative firms in a sector that have applied for at least one patent over a defined time period.[12]

The analysis departs conceptually from the neoclassical economic growth theory and present-day policy favoring MNEs-based R&D activity in an overall 'one-size-fits-all' innovative narration for both country groups and for developed and developing countries alike more broadly. In so doing the article's model analyzes two R&D-related variables, namely the *financing* and the *performance* of Gross

[9] As of 16 July 2012 Advanced Economies include: Australia, Austria, Belgium, Canada, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Japan, South Korea, Luxemburg, Malta, Netherlands, New Zealand, Norway, Portugal, Singapore, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Taiwan, United Kingdom, United States. See, International Monetary Fund (IMF) (2012) Data and Statistics, at: http://www.imf.org/external/data.htm, *Id.* Emerging Economies include: Mexico, Argentina, Pakistan, Brazil, Peru, Bulgaria, Philippines, Chile, Poland, China, Romania, Estonia, Russia, Hungary, South Africa, India, Thailand, Indonesia, Turkey, Latvia, Ukraine, Lithuania, Venezuela, Malaysia. See, International Monetary Fund, *Id.*

[10] See, Isabel Maria Bodas Freitas and Nick von Tunzelmann, Alignment of Innovation Policy Objectives: A Demand Side Perspective, DRUID Working Paper No. 13-02 (2008); Sanjaya Lall & Morris Teubal, Market-stimulating" technology policies in developing countries: A framework with examples from East Asia, World Development, Elsevier, vol. 26(8) 1369 (1998) (for the context of East Asia); B.A. Lundvall, and S. Borrás, The globalizing learning economy: Implications for innovation policies, Science Research Development, European Commission (1997). In developing countries, these layers of intervention need to be adjusted and coordinated so as alleviations of poverty. In his seminal book modeling the fastest growing markets among the billions of poor people at the bottom of the financial pyramid C. K. Prahalad models innovation through distributive justice policies that are also profitable, while adhering to the central role of institutions and governments in particular. C. K. Prahalad, The Fortune at the Bottom of the Pyramid: Eradicating Poverty through Profits (Philadelphia, PA: Wharton School Publishing 2005), at 81. 84. See also, Rasigan Maharajh and Erika Kraemer-Mbula, Innovation Strategies in Developing Countries, In Innovation and the Development Agenda (Erika Kraemer-Mbula and Watu Wamae, Eds.) (2009), at 142.

[11] See, Edward Deering Mansfield, Patents and innovation: an empirical study. Manage. Sci. 32, 173–181 (1986).

[12] Isabelle Kabla, The patent as indicator of innovation, INSEE Studies Econ. Stat. 1, 56–71 (1996); Compare: Georg Licht, and Konard Zoz, Patents and R&D: an econometric investigation using applications for German, European, and US patents by German companies, ZEW Discussion Paper 96-19, Zentrum fur Europaische Wirtschaftsforschung, Mannheim (1996).

Domestic Expenditure on R&D (GERD) by three types of such innovating sectors. These as said are the Government, the Business sector and private investment from abroad by MNEs. For generality, the latter two business sub-sectors are at times combined into an overall business one.[13]

Developing countries led by emerging economies, possibly stand out in their propensity to attract FDI, trade, and technology.[14] They arguably also differ in their overall abilities to innovate and make use of intellectual property protection for that account. Traditional approaches characteristically head off from the eminent North/South dichotomy, or some variation thereof.[15] Out of a hundred and sixty two developing countries only twenty-five - all but one are emerging economies - stand for about ninety percent of the GDP of the developing countries.[16] The International Monetary Fund has recently labeled exactly twenty four such countries as Emerging Economies.[17] These underdeveloped economies and they alone - are presently perceived as a breeding ground for significant innovation within the developing world.[18]

From a political economy perspective, emerging economies are also said to posses meaningful political will to improve access to the world's intellectual output and thus lead remaining developing countries.[19] Their macroeconomics equally facilitates their ability to challenge the Agreement on the Trade Related Aspects of Intellectual Property (TRIPS) towards developed countries.[20]

[13] This analysis uses the 2011 United Nations Educational, Scientific and Cultural organization (UNESCO) Science and Technology (S&T) Statistical report referring to 'Table 27: GERD by sector of performance' and 'Table 28: GERD by source of funds.' See both tables at: http://stats.uis.unesco.org/unesco/ReportFolders/ReportFolders.aspx. Table 27 does not include data on performance by entities from Abroad. Thus the summation of domestic and abroad business sectors occurs for table 28 only. *Id*.

[14] See, Daniel Benoliel & Bruno Salama, Towards an Intellectual Property Bargaining Theory: The Post-WTO Era, 32 U. Pa. J. Int'l L. 265 (2010), at 275-290 & Fn. 25-90 and sources therein.

[15] See Paul Krugman, A Model of Technology Transfer, and the World Distribution of Income 87 J. Pol. Economy 253, 254-255 (1979).

[16] See, World Bank, The Growth Report Strategies for Sustained Growth and Inclusive Development, Commission on Growth and Development, Conference Edition (2008), at: http://www.ycsg.yale.edu/center/forms/growthReport.pdf (adding that the 10 largest developing countries account for about 70 percent of developing countries' GDP), at 111.

[17] As of 16 July 2012 Emerging Economies include: Mexico, Argentina, Pakistan, Brazil, Peru, Bulgaria, Philippines, Chile, Poland, China, Romania, Estonia, Russia, Hungary, South Africa, India, Thailand, Indonesia, Turkey, Latvia, Ukraine, Lithuania, Venezuela, Malaysia. See, International Monetary Fund, supra note 24, *Id*.

[18] Grace Segran, As innovation drives growth in emerging markets, western economies need to adapt (2011), at: http://knowledge.insead.edu/innovation-emerging-markets-110112.cfm?vid=515; Subhash Chandra Jain, Emerging Economies and the Transformation of International Business, Edward Elgar Publishing (2006); Similarly, in her book 'The Rise of 'the Rest' Amsden identifies twelve countries that have acquired considerable manufacturing experience: China, Indonesia, India, South Korea, Malaysia, Taiwan, Thailand, Argentina, Brazil, Chile, Mexico and Turkey. See, Amsden, Alice H. (2001), The Rise of "The Rest": Challenges to the West from Late-Industrializing Economies (Oxford University Press, 2001).

[19] See, e.g., Rochelle C. Dreyfuss, The Role of India, China, Brazil and the Emerging Economies in Establishing Access Norms for Intellectual Property and Intellectual Property Lawmaking, IILJ Working Paper 2009/5, at 1.

[20] *Id*.

The reports of the United Nations Educational, Scientific and Cultural Organization (UNESCO) concerning developing countries from 2010,[21] however is already offering alternative headway. As the UNESCO report suggests developing countries' innovation systems and associated R&D or Gross Domestic Expenditure on R&D (GERD) measurement systems exhibit a wide variety of countries with emphasis on developing ones. This variety is said to probably include an irregular absorption of R&D performers as well as an uneven empirical aptitude to measure R&D or GERD.[22]

II. INNOVATION-BASED GROWTH AND INSTITUTIONAL ANALYSIS

Over the past twenty years OECD countries have witnessed an increasing impact of business R&D. In balance, foreign or R&D from abroad mostly associated with multi-national enterprises has been stable whereas public R&D has decreased.[23]

What is true for such advanced economies is less clear when developing countries are considered. Yet when it comes to an equivalent analysis for developing countries at large, and emerging economies in particular, little policy attention has thus far been given. This section consolidates present-day analysis of all types of institutions promoting patenting activity, including the government public sector, local business sector and the internationalized form of R&D performance and financing by MNEs.

A) Multi-National Corporations (MNEs)

The funding of R&D historically has been conducted by two separate financing institutions. These were the government and private businesses. In recent years a third source of finance has assumed importance in several countries, namely overseas finance for R&D conducted in the domestic economy. To illustrate, an OECD report indicates that between 1995 and 2004, the share of R&D spent outside the home country by Western European multinationals increased from 26 per cent to 44 per cent.[24] Similarly, between 1995 and 2004, the share of R&D spent outside the home country by Japanese multinationals rose from 5 per cent to 11 percent, and by North American multinationals from 23 per cent to 32 per cent.[25] Since then has come the growth of investments by these same multinationals in developing economies, especially Brazil, India, and China.[26] A report published by Goldman Sachs in 2010 identifies present and upcoming R&D facilities in China,

[21] United Nations Educational, Scientific and Cultural Organization (UNESCO) (2010), Technical Paper No. 5, supra note 82, *Id*.

[22] *Id*.

[23] See, e.g., Dominique Guellec & Bruno Van Pottelsberghe de la Potterie, supra note 16, at 3 (and discussion of literature thereof).

[24] See, OECD/OCDE (2005). Background report to the Conference on internationalization of R&D, Brussels, March.

[25] *Id*.

[26] See, Goldman Sachs Group (2010). The new geography of global innovation. Global Markets Institute report, 20 September 2010.

India, and Brazil.[27] The MNEs mentioned in the report are financing agents such as Ford, IBM, Pfizer, Microsoft, Intel, Cisco or Boeing.[28] A fourth source of funding is the set of "nonprofit institutions," including charitable trusts, some of these having been set up by wealthy individuals following success in industry.[29]

The core theoretical idea within innovation theory bestows upon MNEs a central role in fostering innovation.[30] The initiating argument concerning economic growth through innovation originated with Cambridge University economist Nicholas Kaldor already in 1957. As Kaldor theorized differing rates in the adoption of technology explain differences in development stages across countries.[31] The underlying idea was that investment and learning were interrelated and that the rate at which they took place determined technological progress.[32] The dominant underlying notion was that for determining the seed and orienting the direction of technological change for all countries alike, there was need for investment in research and development.[33] In 1995 in a highly cited study of the trade-related impact of international R&D spillovers on a country's total factor productivity (TFP),[34] Coe and Helpman further emphasize that the importance of foreign R&D

[27] See, Goldman Sachs Group (2010). The new geography of global innovation. Global Markets Institute report, 20 September 2010.

[28] *Id*. Similarly, between 1997–2007 the total amount of U.S. multinational R&D spending increased 33-fold in China, from 35 million to 1.17 billion U.S. dollars.28 The growth of R&D in India has been slower. Its R&D intensity was 0.76% of GDP in 2007, essentially unchanged since 2000. Nevertheless, the total amount of U.S. multinational R&D spending increased 16-fold in India, from 22 million to 382 million U.S. dollars over the 1997–2007 period. See, Lee Branstetter, Guangwei Li, Francisco Veloso, The Rise of International Co-invention, NBER (October 2013), at 5 & Fn. 2, referring to U.S. Department of Commerce, Bureau of Economic Analysis, U.S. Direct Investment Abroad: Financial and Operating Data for U.S. Multinational Companies, http://www.bea.gov/iTable/iTable.cfm?ReqID=2&step=1.

[29] See, Christine Greenhalgh and Mark Rogers, Innovation, Intellectual Property and Economic Growth (Princeton University Press, 2010), at 89.

[30] For UNESCO Science and technology data and indicators for R&D funding from abroad, analyzed in the statistical model in Part III, see: http://glossary.uis.unesco.org/glossary/en/home, referring to OECD (2002), Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development, §229. In the context of R&D statistics within the UNESCO dataset analyzed in the empirical model in Part III infra, 'Abroad' refers to "*All institutions and individuals located outside the political borders of a country; except vehicles, ships, aircraft and space satellites operated by domestic entities and testing grounds acquired by such entities*". In addition it includes: "*All international organizations (except business enterprises), including facilities and operations within a country's borders*." For additional discussion see the OECD (2002), Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development, at 72-73. Such funding sources include overseas business enterprise, other national governments, private non-profit, higher education and overseas international organizations. Id., at 73

[31] Nicholas Kaldor, A Model of Economic Growth, Economic Journal, Dec. 1957, 591-624 (1957). The latter analysis has been later on measured using rampant patent statistics methodology. To illustrate, Stanford University Professors Charles Jones and Paul Romer recently exemplified the usage of patent statistics over Kaldor's growth theory. See, Charles I. Jones and Paul M. Romer, The New Kaldor Facts: Ideas, Institutions, Population, and Human Capital, NBER Working Paper Series (2009) (Offering cross-country patent statistics for measuring international flows of ideas alongside trade and FDI as key facets for economic growth.), at 8.

[32] Kaldor, supra note 18, *Id*.

[33] *Id*.

[34] TFP is a function of the domestic R&D capital stock and a measure of the foreign R&D capital stock, where all the measures of R&D capital were constructed from the business sectors'

capital stocks.[35] Focusing again solely on developed countries, they measured the importance of the R&D capital stock by the elasticity of a country's TFP with respect to the R&D capital stock. The two bring evidence to suggest that there exist close links between productivity and R&D capital stocks. Not only does a country's total factor productivity depend on its own R&D capital stock, but as suggested by the theory, it also depends on the R&D capital stocks of its trade partners.[36] Simply put, roughly one quarter of the total remuneration of R&D investment in a G7 country is accrued to its trade partners.[37] With what is merely a frail analogy to developing countries they finally estimate that the foreign R&D capital stock may be at least as important as the domestic R&D capital stock in the smaller countries.[38] That is, while in the larger G7 countries the domestic R&D capital stock may be more significant.[39]

R&D activities. See, D. T Coe and E. Helpman, International R&D spillovers, European Economic Review, Vol. 39, 859 (1995).

[35] As they explain, foreign R&D mostly has a stronger effect on domestic productivity the larger the share of domestic imports in GDP. See, D. T Coe and E. Helpman, International R&D spillovers, European Economic Review, Vol. 39, 859 (1995), 861 (estimate the own rate of return to R&D as 123% for the G-7, and 85% for other 15 countries. Equally importantly, and the spillover return from the G-7 as 32%, implying that roughly a quarter of the benefits from R&D in G-7 countries accrues to their trading partners), at 874.

[36] See, D. T Coe and E. Helpman, International R&D spillovers, European Economic Review, Vol. 39, 859 (1995), 875.

[37] *Id*., 874.

[38] *Id*., 861. For critique of their findings, see W. Keller, Are international R&D spillovers trade-related? Analyzing spillovers among randomly matched trade partners. *European Economic Review* 42(8): 1469-1481 (1997) (casting doubt on the trade-related of Coe and Helpman's finding concerning the effect of foreign R&D spillovers, by showing that significant foreign R&D spillovers can be obtained when the weights in the construction of the spillover are random rather than based on import shares); F. Lichtenberg, and B. Van Pottelsberghe de la Potterie, International R&D Spillovers: A Comment. *European Economic Review* 42(8): 1483-1491 (1998) (criticizing Coe and Helpman's weighting of the foreign R&D stocks by means of the proportion of total imports originating from the foreign R&D sources, it being too sensitive to the aggregation of the data and propose. That is instead normalizing the imports from the recipient country by the GDP of the sending country); B. van Pottelsberghe and F. Lichtenberg, Does foreign direct investment transfer technology across borders? *Review of Economics and Statistics* 83(3): 490-497 (2001) (providing evidence for outward FDI as an overlooked channel of international R&D spillovers); C. Kao, M.-H. Chiang, *et al.*, International R&D Spillovers: An Application of Estimation and Inference in Panel Cointegration. *Oxford Bull Econ & Stats* 61(S1): 691-709 (1999) (using a different empirical methodology thus finding cointegration between the TFP and R&D variables, using cointegration tests that are appropriate for panel data. When they re-estimate the Coe and Helpman specification with a dynamic ordinary least squares (DOLS) estimator (which is not biased in small samples, unlike the ordinary estimator) they no longer obtain a significant effect for the trade-related foreign R&D spillover).

[39] See, D. T Coe and E. Helpman, International R&D spillovers, European Economic Review, Vol. 39, 859 (1995), 861. For critique of their findings, see W. Keller, Are international R&D spillovers trade-related? Analyzing spillovers among randomly matched trade partners. *European Economic Review* 42(8): 1469-1481 (1997) (casting doubt on the trade-related of Coe and Helpman's finding concerning the effect of foreign R&D spillovers, by showing that significant foreign R&D spillovers can be obtained when the weights in the construction of the spillover are random rather than based on import shares); F. Lichtenberg, and B. Van Pottelsberghe de la Potterie, International R&D Spillovers: A Comment. *European Economic Review* 42(8): 1483-1491 (1998) (criticizing Coe and Helpman's weighting of the foreign R&D stocks by means of the proportion of total imports originating from the foreign R&D sources, it being too sensitive to the aggregation of the data and propose. That is instead normalizing the imports from the recipient country by the GDP

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Not surprisingly, this has also been the general policy of different United Nations organs in recent years. Noticeably, this view is to be found in the 2005 United Nations Millennium Project,[43] the view of the World Intellectual Property Organization,[44] and even the United Nations Economic Commission for Africa.[45]

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[40] Frieder Meyer-Krahmer and Guido Reger, New perspectives on the innovation strategies of multinational enterprises: lessons for technology policy in Europe, Research Policy. Vol. 28, 751-776 (1999).

[41] Organization for Economic Co-operation and Development (OECD), Compendium of Patent Statistics, Economic Analysis and Statistics Division of the OECD Directorate for Science, Technology and Industry (2004); Daniele Archibugi & Alberto Coco, The Globalization of Technology and the European Innovation System, IEEE Working Paper DT09/2001. No (2001); Parimal Patel and Modesto Vega, Patterns of internationalization of corporate technology: location vs. home country advantages, Research Policy. Vol. 28, No. 145-155 (1999); Alexander Gerybadze. & Guido Reger, Globalization of R&D: recent changes in the management of innovation in transnational corporations, Research Policy, Vol. 28, No. 2-3 (special issue) 251-274 (1999); Parimal Patel (1995), Localized Production of Technology for Global Markets, Cambridge Journal of Economics, Vol. 19(1), 141-154.

[42] See, UNCTAD, World Investment Report, New York and Geneva, United Nations (2005), at Overview at XXIV.

[43] United Nations Millennium Project (2005), Innovation: Applying Knowledge in Development, London: Task Force on Science, Technology and Innovation, Earthscan ("*thriving private sector depends fundamentally on adequate infrastructure, human capital, and research and development... Through support for higher education and for research and development outlays, the government lays the groundwork for economic growth through technological advance*"), at 123.

[44] See World Intellectual Property Organization (WIPO), see Economic Aspects of Intellectual Property in Countries with Economies in Transition, Ver. 1, the Division for Certain Countries in Europe and Asia, WIPO (2012) (focusing on developing countries mostly while reemphasizing that

Yet a more careful look shows that the role of MNEs in promoting innovation in the developing world and the entire United Nations' innovation voice-over thereof, seem to have fallen short in meeting these high expectations. That is so on three general accounts. For a start, it is confirmed at present that MNEs hardly invest in developing countries and emerging economies in particular – they are justifiably perceived as hotbeds for meaningful innovation thus spearheading the developing world. As a recent prime illustration stands the United Nations Conference on Trade and Development's (UNCTAD) seminal 2005 World Investment Report. It shows that only China, the Republic of Korea, Taiwan Province of China and Brazil, in that descending order, came close to or exceeded the $5 billion U.S. dollars in total gross yearly expenditure on R&D (GERD) as of 2002 (the latest available year per UNCTD's report).[46] What is further disappointing with these results from the standpoint of emerging economies is that they further result in what has been hailed as a successful internationalization R&D process. As UC Berkeley economist Bronwyn H. Hall further describes in her 2010 article, this internationalization R&D process has been measured in during two different recent time periods, 1999 and 2005. That is, for approximately 40 large OECD and non-OECD countries.[47]

Yet even in large emerging economies, such as India, Mexico and the Russian Federation, MNEs have invested in R&D well below the comparable figure of $5 billion U.S. dollars. Even more so is the case of the relatively poorer emerging economies of South-East Europe and the former Soviet Bloc's Commonwealth of Independent States (CIS), where MNEs invested much less.[48] This reality further

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R&D is the most important economic indicator on how effective the innovation process is), at 22. See, broadly also Recommendation no. 26 of the WIPO, 45 Adopted Recommendations under the WIPO Development Agenda (2007) ("To encourage Member States, especially developed countries, to urge their research and scientific institutions to enhance cooperation and exchange with research and development institutions in developing countries, especially LDCs"), *Id.*

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But see critique, e.g., Rasigan Maharajh and Erika Kraemer-Mbula, Innovation Strategies in Developing Countries, In Innovation and the Development Agenda (Erika Kraemer-Mbula and Watu Wamae, Eds.) (2009), at 136; Andreanne Léger and Sushmita Swaminathan, Innovation Theories: Relevance and Implications for Developing Country Innovation, German Institute for Economic Research (DIW) Discussion paper 743 (November 2007).

[46] See, UNCTAD, World Investment Report, New York and Geneva, United Nations (2005), at 119-120 & see Table III.1. *Id*.

[47] As she explains, two basic facts about the distribution of GDP and R&D performance are apparent during these periods. The first is that R&D performance is slightly more concentrated than GDP (Gini coefficients of 0.78 in 1999 and 0.75 in 2005 as opposed to 0.69 in both years for GDP). Second, R&D has been becoming less concentrated over time, even during this brief six year period, in contrast to the GDP concentration, which has remain essentially unchanged. This change, although it appears small, reflects the internationalization of R&D that has taken place during the same period. See, Bronwyn H. Hall, The Internationalization of R&D, UC Berkeley and University of Maastricht (March 2010), at 3, referring to and Figure "Concentration of R&D and GDP ", at 22 & Figure 1. See, also, Greenhalgh and Rogers, *Innovation, Intellectual Property and Economic Growth* (Princeton University Press, 2010) (acknowledging that per UNCTAD's 2005 report "the speed of the internationalization of R&D have increased substantially in recent years"), at 344.

[48] *Id*.

explains why in the United States Patent and Trademark Office (USPTO) most patents assigned to entities in twenty-five selected developing countries in the new millennium were only rarely owned by foreign affiliates.[49] Instead, they were owned by domestic enterprises and at times by public institutions.[50]

A second suggestion that MNEs' internationalized R&D model mostly has poorly met the expectations of promoting innovation in the developing world follows. It concerns the marginal number of MNEs originating from the developing world with emphasis on emerging economies. UNCTAD's 2005 investment report again shows that over eighty percent of the seven hundred largest R&D spending firms come from only five advanced economies, namely the United States, Japan, Germany, the United Kingdom and France, in descending order.[51] Only one percent of the top seven hundred are based in developing countries or South-East Europe and the CIS.[52] Within the list of Developing countries' MNEs almost all these firms come from Asia, notably from the Republic of Korea and Taiwan Province of China.[53] A third related finding follows. For the same seven hundred largest R&D spenders, most are concentrated in relatively few industries offering little innovative diversification and thus adaptability for the plethora of innovative activities occurring in emerging economies. In 2003, more than half of them were to be found in three industries only, namely information technology (IT) hardware, the automotive and the pharmaceuticals/biotechnology industries.[54] Surely at no point has it been suggested that in the entire group of emerging economies such industrial concentration is recommended or satisfactory.

In sum, the role of MNEs in fostering innovation, backed by a high yield of patenting propensity rates in emerging economies is disputable at best. As the UNCTAD 2005 Investment report itself indicates, to date merely an undersized figure of developing countries and economies in transition participate in the process

[49] *Id*., at 134 (for date collected for the years 2001-2003), referring in Table IV.11 to South Africa, Egypt, Kenya, Taiwan Province of China, Republic of Korea, China, Singapore, Hong Kong (China), India, Malaysia, Turkey, Thailand, Philippines, Saudi Arabia, Indonesia, Brazil, Mexico, Argentina, Bahamas, Bermuda, Cuba, Chile, Russian Federation, Ukraine and Bulgaria. Only in Bulgaria and Brazil did foreign affiliates account for more than 20% of all patents assigned. In India and Cuba, public research institutions accounted for the largest shares (68% and 84% respectively) of those countries' totals. Public research institutions in Singapore, the Russian Federation and Ukraine also receive a significant proportion of the patents assigned by the USPTO. *Id.*

[50] *Id*.

[51] *Id*. See, Table IV.2. The IMF's Balance of Payments Manual (fifth edition, 1993) and the OECD Benchmark Definition of Foreign Direct Investment (third edition, 1995) provide agreed guidelines for compiling FDI flows. The largest TNCs remain geographically concentrated in a few home countries. The United States dominated the list with 25 entries. Five and Singapore remained the most important home economies, with ten and nine entries in the list respectively. Taiwan Province of China, with eight companies in the top 50, became the home economy with the third largest contingent of TNCs on the list largely owing to its electronics companies. The growing significance of this economy was mainly at the expense of South Africa, which had four companies listed in the top 50 in 2003 compared to seven in 2002. See, UNCTAD, World Investment Report,supra note 26, at 16-17.

[52] *Id*., see Table IV.1. Several countries have moved up the ranks since the late 1990s. *Id*.

[53] *Id*., See Table IV.2. In balance, only one MNC comes from Africa and two are from Latin America. *Id.*

[54] *Id*. See, Table IV.3. *Id.*

of R&D internationalization.[55] Furthermore, it remains questionable whether MNEs contribute a relatively high marginal growth rate to these countries propensity to patent as proxy of meaningful domestic innovation. The statistical model presented in Part III herein offers in fact a daunting corroboration to the latter type of distrust, in comparison with the possibly opposite reality in advanced economies.

B) The Business Sector

Institutional analysis upholds a second industrial sector for fostering innovation, namely the business sector.[56] Notwithstanding its exact proficiency for developing countries as opposed to developed ones, the business sector unquestionably remains highly influential in it's propensity to patent by both country groups abridging the north-south divide. In the institutional realm of imperfect alternatives, the question remains: What is the relative role of the business sector in promoting domestic innovation based archetypical patenting activity in developing countries in comparison to both the government sector and MNEs? As this article entails the retort to this inquiry is related to the impact on the propensity to patent as proxy for domestic innovation by all three sectors.

Notwithstanding its deep-rooted innovation implications, the TRIPS agreement stands as a fine point of departure concerning the role of the business sector. Rooted in dependency theories of development whereby developing countries were flatly perceived to be dependent on developed ones, the TRIPS agreement was predominantly accepted as a trade-related compromise.[57] Freer trade even more than internationalized R&D via MNEs, was said to impoverish countries of the

[55] See, UNCTAD, World Investment Report, New York and Geneva, United Nations (2005) (adding that the fact that some are now perceived as attractive locations for highly complex R&D indicates permit countries to develop the capabilities that are needed to connect with the global R&D systems of TNCs) , at Overview at XXIV.

[56] For UNESCO Science and technology data and indicators for Business enterprise intramural expenditure on R&D (BERD), analyzed in the statistical model in Part III, see: http://glossary.uis.unesco.org/glossary/en/home, referring to OECD (2002), Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development, §163. R&D expenditure in the business sector, where the business sector in the context of R&D statistics includes: "*All firms, organizations and institutions whose primary activity is the market production of goods or services (other than higher education) for sale to the general public at an economically significant price." In addition it includes "The private non-profit institutions mainly serving them*." *Id*. For additional discussion see OECD (2002), Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development, at 54-56, *Id*.

[57] See, Jayashree Watal, Intellectual Property Rights in the WTO and Developing Countries (2001) (explaining how developed countries agreed to phase out their quotas under the ATC (Agreement on Textiles and Clothing) on the most sensitive items of textiles and clothing. in exchange to developing countries acceptance to the phasing-in of product patents for pharmaceuticals which the perceived as the most important patent-related good), at 20. See, also, Frederick M. Abbott, The WTO TRIPS Agreement and Global Economic Development, in Public Policy and Global Technological Integration 39 (Frederick M. Abbott & David J. Gerber eds., 1997), at 39-40. See, also, Carolyn Deere, supra note 38, at 2; Charles S. Levy, Implementing TRIPS--A Test of Political Will, 31 L. & Pol'y Int'l Bus. 789 (2000), at 790.

"periphery".[58] Yet TRIPS' idealistic pledge for 'freer trade' possibly undermined the role of the business sector in directly fostering innovative activity. So much so, as TRIPS primarily corresponded and still does with the World Bank and UNCTAD's labeling of technology transfer as a reactive form of innovation-based economic growth for developing countries.[59] And so, rather than promoting domestic innovation by the promotion of local technological capacity, innovation was to be received and at most adapted.[60] The business sector henceforth was meant to foster technologically-based trade. The enhancement of domestic innovation based on enhancing the patenting yield of developing countries was initially contained.

In the backdrop of the limited adherence to institutional aspects of innovation enhancement in developing countries as a policy concern, it has been the World Intellectual Property Organization which has gone possibly further. Although it possibly has missed out on an opportunity to carefully adhere to the institutional aspects of innovation in its archetypical 2007 Development Agenda, WIPO has done so directly albeit loosely elsewhere. In a 2012 report WIPO labels the main factors that slow down the process of innovation activity in the developing world.[61] Topping the list in this report connotes an important institutional choice, namely the poor involvement of the business sector in innovative activity in developing countries.[62] The report does indicate the need for private-public partnership.[63] It surely does so without specifically opting for a separate direct regulatory role reserved for the government sector in performing or even financing innovative activity in developing countries. Yet, the general inclination expressed thereof is that the effect of business R&D is mostly found to be larger in size than the impact of public R&D, as the latter is further undesirably deemed to "*take a long time to materialize"*.[64] Notwithstanding WIPO's proclivity towards the *business over government* institutional choice for the unstipulated developing world, it surely remains a future policy challenge. Greater openness to trade and capital flows as the TRIPS dialectics predominantly entail should not reduce the imperative of local

[58] See, e.g., Raul Prebisch, International Trade and Payments in an Era of Coexistence: Commercial Policy in the Underdeveloped Countries, 49 Am. Econ. Rev. 251, 251–52 (1959) (offering examples of reasoning used by developing "periphery" countries fostering an aversion to increasing free trade). For a seminal Latin-American perspective see, Fernando Henrique Cardoso and Enzo Faletto, Dependency and Development in Latin America 149-71 (1979) (depicting the tension between Latin American nationalist and populist political agendas and its impact on related international trade policies).

[59] See, World Bank, Innovation Policy: A Guide for Developing Countries (2010), at 116; UNCTAD and ICTSD (International Centre for Trade and Sustainable Development), Intellectual Property Rights: Implications for Development, Intellectual Property Rights and Sustainable Development Series Policy Discussion Paper, ICTSD, Geneva (2003).

[60] *Id*.

[61] See, Economic Aspects of Intellectual Property in Countries with Economies in Transition, Ver. 1, the Division for Certain Countries in Europe and Asia, WIPO (2012), at 9.

[62] *Id*. (stating as its first recommendation: *"1. Poor involvement of the business community in innovation policy elaboration and implementation (including funding of innovation projects"). Id.*

[63] *Id*. (stating as its second recommendation: *"Poor development of public-private partnerships").* Similarly, the report's fifth recommendation states: *"Inadequate level of interaction between public and private research centres"*. *Id*.

[64] See, World Intellectual Property Report 2011, at 142 ("*The contribution of public R&D can take also a long time to materialize*").

innovative efforts.[65] On the contrary, liberalization, and the open market environment associated with it, makes it necessary for the business sector in developing countries to acquire the technological and innovative capabilities needed to become or stay competitive.[66]

A more accurate if again partial institutional choice is found in innovation-based economic growth literature. On that theoretical front, the effect of business R&D on productivity has been investigated intensively concerning developed countries alone. It has been performed at all aggregation levels, namely business unit, firm, industry and country levels. Yet as said, most empirical analysis was done rather predictably for advanced economies, focusing mainly on the United States. All these studies not only confirmed that business R&D does matter, as they have also confirmed that the estimated elasticity of output with respect to business R&D varies from 10% to the impressive 30% rate of return to business sector R&D.[67] As a principled matter, the earliest panel data analysis has been performed by economists Luc Soete and Parimal Patel for five countries, confirming the impact of business sector R&D on innovation-based economic growth.[68] In turn, University of Columbia Economist Frank Lichtenberg probably has pioneered the use of large country dataset analysis[69] by using a cross section of fifty-three countries to corroborate the impact of business-related R&D on labor productivity. Soon to follow, economists David Coe and Elhanan Helpman alongside Walter Park were the first to combine a large number of countries with long time series.[70] These panel data analyses all converge towards the conclusion that the 'social' return to business R&D is significant in fostering productivity.[71] By means of

[65] *Cf*: UNCTAD, World Investment Report, New York and Geneva, United Nations (2005), at Overview at XXV.

[66] *Id*.

[67] See, Dominique Guellec & Bruno Van Pottelsberghe de la Potterie, supra note 16 (offering estimates based on a panel dataset composed of 16 major OECD countries over the period 1980-1998 suggesting that in these countries the domestic business sector, the government and foreign R&D contribute significantly to output on multifactor productivity growth), at 4, generally referring to I. Nadiri, Innovations and Technological Spillovers, NBER Working Paper Series, 4423, Cambridge, MA (1993). This large variation naturally is due to the fact that studies differ over the econometric specification, data sources, number of economic units, measurement methods for R&D, etc. Similarly, Griliches and Mairesse found that U.S. manufacturing firms' rates of return to private R&D were around 20–40%. See, Griliches, Z., and J. Mairesse. 1990. R&D and productivity growth: comparing Japanese and US manufacturing firms. In *Productivity Growth in Japan and United States* (ed. C. R. Hulten). University of Chicago Press (finding rates of return in the range 30–40% also for the Japanese business sector). Hall and Mairesse found returns to French firms in the 1980s between 22% and 34%. See, Hall, B., and J. Mairesse, Exploring the relationship between R&D and productivity in French manufacturing firms. *Journal of Econometrics* 65: 263–93 (1995). Finally, Harhoff found a rate of return of around 20% for German firms from 1979 to 1989. See, Harhoff, D. 1998. R&D and productivity in German manufacturing firms, *Economics of Innovation and New Technology* 6:22–49.

[68] Luc Soete, L. and Parimal Patel, Recherche-Développement, Importations Technologiques et Croissance Economique, Revue Economique, Vol. 36, pp. 975-1000 (1985).

[69] Frank R. Lichtenberg, R&D Investment and International Productivity Differences, in H. Siebert (ed.), Economic Growth in the World Economy, Tubingen: Mohr (1993), at 47-68.

[70] Namely, 22 industrialized countries from 1970 to 1990 for Coe and Helpman and 10 OECD countries from 1970 to 1987 for Park.

[71] D. T Coe and E. Helpman, International R&D spillovers, European Economic Review, Vol. 39, 859 (1995) (domestic R&D contributes significantly to productivity growth and that this impact

comparing business sector R&D with public sector R&D, Park in his panel data analysis of ten OECD countries have found that public R&D loses its significant impact on productivity growth when business R&D is included among the explanatory variables.[72]

At about the same time series, Professor Bronwyn Hall used a separate market value approach to assess the returns to R&D in United States manufacturing firms over the period 1973–91.[73] For the full sample, R&D spending was strongly and positively associated with share market value. In fact, current R&D spending has was said to have stronger association than the R&D stock (calculated by depreciating past R&D at 15%), which indicated that the share market considers current R&D a better indicator of future performance. Hall's ultimate conclusion similarly has been that the magnitude of the association suggests that the returns to R&D were two to three times those on normal investment.[74] Lastly, in a 2006 following research Bronwyn Hall and Raffaele Oriani expanded their analysis and underlying conclusion to the business sectors in France, Germany, Italy, the United Kingdom, and the United States over the period 1989–98.[75]

Surely, studies on the effect of business R&D on productivity reached overall supportive findings. Yet regrettably none of these findings offered comparisons between developing and developed countries over the impact of business R&D. That is, regardless if domestic innovation is predominantly patent-based or not in emerging economies, South-East Europe and the CIS countries.[76] In effect, as UNCTAD's 2005 World Investment report tellingly indicates, indeed the share in the business sector R&D in the latter group of developing countries reached only 5.4% in 1996 and 7.1% in 2002.[77]

As this article empirically entails in empirical Part III, innovation-based economic growth bears witness of greater reliance on government R&D in these economies. The late Professor Alice Amsden offered additional confirmation of this consciousness. As she foretells in her seminal book titled *The Rise of "The Rest"* based on plentiful post-war national experiences by developing countries, in the early stages of development, institutions in the form of markets are largely rudimentary.[78] Thus the configuration of protected property rights is part of the

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is substantially higher for the G7 than for other developed countries); W. Park, International R&D spillovers and OECD economic growth, Economic Inquiry, Vol. 33, 571 (1995).

[72] See, M. I. Nadiri and T. P. Mamuneas, The effects of public infrastructure and R&D capital on the cost structure and performance of U.S. manufacturing industries, Review of Economics and Statistics, Vol. 76, 22–37 (1994); W. Park, International R&D spillovers and OECD economic growth, Economic Inquiry, Vol. 33 571–591 (1995)

[73] Bronwyn Hall, The stock market valuation of R&D investment during the 1980s. *American Economic Review* 83(2):259–64 (1993).

[74] *Id*.; B. Hall, Industrial research during the 1980s: did the rate of return fall? *Brookings Papers on Economic Activity* Microeconomics (2):289–344 (1993) (connoting a temporal decline in returns in the computing/electronics sector due to the start of the personal computer revolution).

[75] Hall, B., and R. Oriani. 2006. Does the market value R&D investment by European firms? Evidence from a panel of manufacturing firms in France, Germany and Italy. *International Journal of Industrial Organization* 24:971–93.

[76] *Cf:* UNCTAD, World Investment Report, supra note 26, at 106.

[77] *Id*.

[78] See, Alice H. Amsden, The Rise of "The Rest": Challenges to the West from Late-Industrializing Economies (Oxford University Press), at 286-287.

progress toward deeper and more ideal market structures.[79] Like with the TRIPS trade-based narration of economic growth for developing countries today, the latter narration is also a process of creating firm-specific proprietary skills that are distortionary (price exceeds marginal cost) as they gradually confer innovation-based market power.[80]

C) The Government Sector

Lastly, institutional analysis upholds a third industrial sector for fostering innovation, namely the government sector.[81] In comparison to research over the impact of business sector or MNC-based R&D in innovation, there have been very few studies of the effects of alternative governmental sector R&D in fostering domestic innovation at large, but mostly in relation to the patent-based one.[82] Only few components of public research have been empirically analyzed. Again focusing mostly on advanced economies and particularly the United States, James Adams for example finds that fundamental stocks of knowledge, proxied by accumulated academic scientific papers, significantly contribute to productivity growth in United States manufacturing industries.[83] Another proverbial study has been conveyed by Erik Poole and Jean-Thomas Bernard for military innovations in Canada. The two present evidence that a defense-related stock of innovation has a negative and significant effect on the multifactor productivity growth of four industries over the period 1961-85.[84] In turn, Ishaq Nadiri and Theofanis Mamuneas formally include the stock of public R&D, along with the stock of public infrastructure, as a

[79] See, Alice H. Amsden, The Rise of "The Rest": Challenges to the West from Late-Industrializing Economies (Oxford University Press), at 286-287.

[80] *Cf*: Alice H. Amsden, The Rise of "The Rest": Challenges to the West from Late-Industrializing Economies (Oxford University Press), at 286-287.

[81] For UNESCO Science and technology data and indicators, analyzed in the statistical model in Part III, see: http://glossary.uis.unesco.org/glossary/en/home, referring to OECD (2002), Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development, §184. Government intramural expenditure on R&D (GOVERD) or R&D expenditure in the government sector includes "*all departments, offices and other bodies which furnish, but normally do not sell to the community, those common services, other than higher education, which cannot otherwise be conveniently and economically provided, as well as those that administer the state and the economic and social policy of the community. Public enterprises are included in the business enterprise sector.*" It further includes "*the non-profit institutions (NPIs) controlled and mainly financed by government but not administered by the higher education sector*." *Id*.

[82] For an historical account focusing upon the United States in the twentieth century, see generally, D. C. Mowery and N. Rosenberg, Technology and the Pursuit of Economic Growth. Cambridge Univ. Press, New York (1989). For contributions dealing with particular sectors and industries see Roger R. Nelson, Government and Technical Progress: A Cross-Industry Analysis. Pergamon, New York (1982). For the post-Cold War climate affecting government support, especially in the United States, see L. R. Cohen and R. G. Noll, The Technology Pork Barrel. The Brookings Institution Press, Washington, DC (1997).

[83] James Adams, Fundamental Stocks of Knowledge and Productivity Growth, Journal of Political Economy, Vol. 98, 673 (1990).

[84] Erik Poole and Jean-Thomas Bernard, Defense Innovation Stock and Total Factor Productivity Growth, Canadian Journal of Economics, Vol. 25, 438 (1992).

determinant of the cost structure of United States manufacturing activities.[85] Their results uphold that public R&D capital has important industrious effects and is associated with a considerable "social" rate of return. On the other hand, Walter Park also upholds that public R&D loses its significant impact on productivity growth when business R&D is included among the explanatory variables. Park completes these findings based on a panel data analysis of ten OECD countries. The latter important finding surely does not transcend the boundaries of advanced economies as said. Similarly, earlier findings on the negative productivity growth payoff from government expenditures for industrial R&D emerged from an econometric studies mostly identified the seminal work of Harvard University economist Zvi Griliches,[86] and economists Eric Bartelsman,[87] as well as Frank Lichtenberg and Donald Siegel.[88] Numerous others confirmed close to zero and statistically insignificant coefficients on federally funded R&D.[89] All findings, to be sure, have not met the challenge of comparing their findings with developing countries with emphasis on emerging economies. As Amsden explains in the broader context of development in the post-war era, the mutual control apparatus of countries at early stages of development thus transformed the incompetence associated with government interference into communal good, "*just as the ''invisible hand'' market-driven control mechanism transformed the chaos and selfishness of market forces into general well-being*".[90] During this early historical period the role of the government was mainly reactive and oriented toward getting the best terms for a reactive form of technology transfer, as well slowly increasing investments in R&D and formal education.[91] Analyzing the transition in Mexico, Brazil, Mexico and historically also South Korea, Amsden explains that what began to differ sharply was the shift to proactive innovative policy in the post-war era.[92] Industrialization history bears witness to numerous emerging economies that began to develop new technology perceived as a necessary condition for sustainable national enterprise.[93]

[85] M. Ishaq Nadiri and Theofanis P. Mamuneas, The Effects of Public Infrastructure and R&D Capital on the Cost Structure and Performance of U.S. Manufacturing Industries, Review of Economics and Statistics, Vol. 76, 22 (1994).

[86] See, Z. Griliches, R&D and productivity: econometric results and measurement issues, In Paul, S. Ed.., The Handbook of the Economics of Innovation and Technological Change. Blackwell, Oxford (1995). Earlier on, see Z. Griliches and F. Lichtenberg, R&D and productivity growth at the industry level: is there still a relationship?, In R&D, Patents and Productivity (Z. Griliches, Ed.) Univ. of Chicago Press (1984).

[87] Eric J. Bartelsman, Federally Sponsored R&D and Productivity Growth, Federal Reserve Economics Discussion Paper No. 121. Federal Reserve Board of Governors, Washington, DC. (1990).

[88] Frank Lichtenberg and Donald Siegel, The impact of R&D investment on productivity — new evidence using linked R&D-LRD data. Economic Inquiry 29, 203–228 (1991).

[89] See, Paul A. David, Bronwyn H. Hall, and Andrew A. Toole, Is Public R&D a Complement or Substitute for Private R&D? A Review of the Econometric Evidence, Research Policy, vol. 29 (4-5) 497 (2000), at 498 (Adding additional sources).

[90] See, Alice H. Amsden, The Rise of "The Rest": Challenges to the West from Late-Industrializing Economies (Oxford University Press), at 8.

[91] *Id*., 239.

[92] *Id*., at 240-245.

[93] *Id*.

According to economic historian Alexander Gerschenkron who introduced the theory of *economic backwardness* and the process of *catching up* in the early 1960s, any country experiencing industrialization will have a diverse practice depending on its *"degree of economics backwardness*" whilst industrialization starts on.[94] Accordingly, the later a country industrializes in chronological history, the greater the economic interventions of its government.[95] Thus government interventions increase because production methods allegedly become more capital-intensive. Bigger absolute capital requirements over time bring forth new institutional arrangements that entail a larger role for government intervention in economic growth.[96]

In adherence with Gerschenkron catch up flexibility, a range of case studies of such governmental intervention come to mind. At one extreme end stands what political scientist Eswaran Sridharan archetypically denotes as the state-promoted electronics industry case of Brazil. In the latter, practically all R&D efforts have come from state enterprises and national firms. It was only much later that the Brazilian electronics industry witnessed MNC's-led R&D in innovation under much policy pressure for that account.[97] Yet, as Gerschenkron perceived economics backwardness differs widely across developing countries and so does governmental intervention in their economic promotion. And so, in Malaysia, despite more than two decades of government-led protection, innovation-based economic growth has not been achieved. The Malaysian International Trade and Industry Minister recently acknowledged that public efforts to expand the local automotive industry, with emphasis on the National Car have failed to yield the desired results.[98] A second central example has been that of the Indian space program. Since the 1950s this expensive program has been heavily subsidized and still has not yielded commercial success.[99] As Gerschenkron foretold, the distance from the world technological frontier and the degree of government intervention, therefore do not necessarily move in unity in a latecomer developing country.[100] Be that as it may, it

[94] Economics backwardness is not clearly defined in Gerschenkron, but he relates it to: income per capita, amount of social overhead capital, literacy, savings rates and level of technology. Since many of these are positively correlated, it is often proxied by income per capita. See, Alexander Gerschenkron, Economic backwardness in historical perspective (Harvard University Press) (1962) (His analysis came as a reaction to uniform development stages theories like Walt Whitman Rostow's *The Stages of Economic Growth: A Non-Communist Manifesto* (Cambridge University Press, Cambridge) (1960)).

[95] See, Alexander Gerschenkron, Economic backwardness in historical perspective (Harvard University Press) (1962).

[96] *Id*.

[97] See, Eswaran Sridharan, The Political Economy of Industrial Promotion: Indian, Brazilian, and Korean Electronics in Comparative Perspective 1969-1994, at 89 (analyzing the political economy and the role of the state in the electronics industry in India, Brazil, and Korea)

[98] Tilman Altenburg, Building Inclusive Innovation in Developing Countries: Challenges for IS research, In Handbook of Innovation Systems and Developing Countries (Lundvall et at. (Eds.) (2009), at 38.

[99] *Id*., referring to A. Baskaran, From Science to Commerce: The Evolution of Space Development Policy and Technology Accumulation in India, Technology in Society, 27 (2), 155-179 (2005).

[100] See, Alice H. Amsden, The Rise of "The Rest": Challenges to the West from Late-Industrializing Economies (Oxford University Press), at 286. Amsden adds that instead that what probably does increase is the role of the foreign firm in relation to the relative decline in the role of

clearly remains to be seen whether newer attempts to industrialize innovation-based economies will continue to entail a categorical role for government intervention based on patenting activity or other forms of proprietary protection of domestic innovation.[101]

III. THE MODEL

A) Overview

This article offers a novel empirical model of these patenting-related institutional concerns. It compares the thirty-two advanced economies with the twenty-four emerging economies over their innovating industrial sectors from 1996 to 2011. It analyzes possible statistical connections between the government and the business sector (domestic and from abroad) with the propensity to patent (as proxy for domestic innovation) by both country group classifications.

In so doing the model analyzes two R&D-related indicators, namely the *financing* and the *performance* of Gross Domestic Expenditure on R&D (GERD) by three types of such innovating sectors, namely the Government, the Business sector and the private investment from abroad by multinational enterprises. For simplicity, the latter two business sub-sectors are combined into an overall business one.[102]

B) Methodology

The model adheres to four 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 these 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.[103]

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the state in fostering economic growth. This important concern thus remains outside the scope of this article in emphasis on innovation-based economic growth, as explained. She further offers a completing aphorism whereby the later a country industrializes in chronological history, the greater the probability that its major manufacturing firms will be foreign-owned. *Id*.

[101] *Cf*. Alice H. Amsden, The Rise of "The Rest": Challenges to the West from Late-Industrializing Economies (Oxford University Press), at 285.

[102] This analysis uses the 2011 United Nations Educational, Scientific and Cultural organization (UNESCO) Science and Technology (S&T) Statistical report referring to 'Table 27: GERD by sector of performance' and 'Table 28: GERD by source of funds.' See both tables at: http://stats.uis.unesco.org/unesco/ReportFolders/ReportFolders.aspx. Table 27 does not include data on performance by entities from Abroad. Thus the summation of domestic and abroad business sectors occurs for table 28 only. *Id*.

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

In the econometric model appropriate for present panel data, the dependent variable is the expected value of the yearly number of issued patents.[104] 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.[105]

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 subject to a significant prejudice, with most patents producing 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.[106] 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

[104] 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.

[105] The statistical comparison over government/business finance/performance between the two groups of advanced and emerging economies is modeled as follows. Negative Binomial regression showed the best fit to the finance/performance data. Log link was assumed and log GERD of 4 years before was used as offset variable. Random effects of year were included in the models to account for the quantitative heterogeneity among the countries. The fixed effects of year, economy type and their interaction term were used. 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 differences between two types of economies were tested using contrasts defined for each of the time points. The p-values were adjusted for multiple testing using simulation procedure described by Edwards and Berry. See, D. Edwards, and J. J. Berry, The Efficiency of Simulation-Based Multiple Comparisons, Biometrics, 43, 913–928 (1987). To test the relationship between the types of sectors per their finance and performance of R&D activities, and the number of patents per GERD by economy type.

Given that our dependent variable (yearly issued USPTO patents per GERD by national inventor country, labeled as each country's yearly Patent Propensity rate) is an event-count variable, we applied a regression method specifically designed to cope with this kind of data. In contrast to the Poisson distribution, for which the mean is restricted to equal the variance, the Negative Binomial distribution is able to account for a variance that is larger than the mean (overdispersion).

Due to the over dispersion of our dependent variables, we used a negative binomial regression model for panel data. Log link was assumed and log GERD of 4 years before was used as offset variable. Four different models for finance/performance variables were applied. The fixed effects of year, economy type, log-transformed finance/performance and their interaction term were used. The economy dependent slopes between finance/performance with patents per GERD were tested using contrasts.

[106] *See*, Organization for Economic Co-operation and Development (OECD) (2011), Science, Technology and Industry Scoreboard (20 September 2011); de Rassenfosse G, Danguy J. and van Pottelsberghe de la Potterie, Bruno (2010), The R&D - Patent relationship: An industry perspective, ECARES working paper 2010-038 (September 2010).

conclude the patenting process.[107] 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.[108]

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 inquiring with firms about the portion of innovations they normally patent.[109] 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.[110] Yet in the case of developing countries in particular, too many patent applications often do not lead to patent issuance, neither nationally nor 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.[111]

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.[112] The ICN search category indicates the inventiveness

[107] *See*, e.g., B.H. Hall, , A.B. Jaffe and, M. Trajtenberg, The NBER Patent Citations Data File: Lessons, Insights and Methodological Tools, NBER Working Paper No. 849 (2001), at 4.

[108] Patent statistics literature has irregularly considered this limitation. The earliest most important contribution begins with Professor Zvi Grilliches' article titled 'Patent statistics as economic indicators: a survey', published in the Journal of Economic Literature 28, 1661–1707 (1990); *See* also, D. Archibugi and M. Pianta, Measuring Technological Change through Patents and Innovation Surveys, Technovation, 16, 451–468 (1996).

[109] 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.

[110] *See*, e.g., W. M. Cohen, R. R. Nelson and J. P. Walsh, Protecting their Intellectual Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patent (or Not). NBER Working Paper No. 7552. (2000); Anthony Arundel and Isabelle Kabla, What percentage of innovations are patented? empirical estimates for European firms, Research Policy 27 127–141 (1998); E. Duguet and I. Kabla, Appropriation Strategy and the Motivations to use the Patent System: An Econometric Analysis at the Firm Level in French Manufacturing, Annales D'Économie et de Statistique, 49/50, 289–327 (1998); Edward Deering Mansfield, supra note 1, *Id.*

[111] Edward Deering Mansfield, supra note 1, *Id*.

[112] United States Patent and Trademark Office (USPTO) (2012), Patent Full-Text and Image Database - Tips on Fielded Searching (Inventor Country (ICN)), at: http://www.uspto.gov/patft/help/helpflds.htm#Inventor_Country.

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 enterprises originating in advanced economies.[113] 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.[114] 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.[115]

With that said, there is need to account for the methodological choice 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 not dependable. 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 do away with double counting of patents filed at diverse offices),[116] 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.[117] A second reason is that such countries may differ substantively over their national grant rates.[118] Both these methodological partialities are mostly solved by USPTO-

[113] Organization for Economic Co-operation and Development (OECD), Patent Statistics Manual (2009), at: http://browse.oecdbookshop.org/oecd/pdfs/free/9209021e.pdf; Hassan, Emmanuel, Yaqub, Ohid and Diepeveen, Stephanie (2010), Intellectual Property and Developing Countries: A review of the literature, supra note 9, Id; Bergek, Anna and Bruzelius, Maria (2005), Patents with Inventors from Different Countries: Exploring Some Methodological Issues through a Case Study, presented at the DRUID conference, Copenhagen, 27-29 June.

[114] Organization for Economic Co-operation and Development (OECD), Patent Statistics Manual (2009), at: http://browse.oecdbookshop.org/oecd/pdfs/free/9209021e.pdf.

[115] Parimal Patel & Modesto Vega, supra note 15, Id.; Jaffe, Adam. B., Trajtenberg, Manuel. & Henderson, Rebecca (1993), Geographic localization of knowledge spillovers as evidenced by patent citations, The Quarterly Journal of Economics. Vol. 108, No. 3, 577-598; Organization for Economic Co-operation and Development (OECD) (2004), Compendium of Patent Statistics, Economic Analysis and Statistics Division of the OECD Directorate for Science, Technology and Industry.

[116] *See*, OECD Patent Statistics Manual, 2009.

[117] *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).

[118] *Id*.

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.[119] 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.[120]

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.[121] 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.[122]

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.[123]

A fourth 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

[119] Jacques Gaillard, Measuring R&D in Developing Countries: Main Characteristics and Implications for the Frascati Manual, Science, in Technology & Society, Vol. 15(1), 77-111 (2010).

[120] G. de Rassenfosse, J. Danguy and B. van Pottelsberghe de la Potterie, The R&D -Patent relationship: An industry perspective, ECARES working paper 2010-038 (September 2010); Organization for Economic Co-operation and Development (OECD), Patent Statistics Manual (2009), at: http://browse.oecdbookshop.org/oecd/pdfs/free/9209021e.pdf.

[121] United Nations Educational, Scientific and Cultural Organization (UNESCO) (2011), Glossary - 63 terms for science & technology, at: http://glossary.uis.unesco.org/glossary/map/terms/177. As the UNESCO report explains, this methodology was adapted from OECD (2002), Frascati Manual, §423.

[122] *Id*.

[123] *Id*.

there is missing data between two data points, the study uses an interpolation between the two data points.[124]

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.[125] The second manual is the OECD/Eurostat Oslo Manual (2005) on innovation-related statistics.[126] 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.[127] It is funneled by two additional, noticeable OECD manuals. The first of two is UNESCO Technical Paper No. 5, titled: Measuring R&D: Challenges Faced by Developing Countries (2010).[128] 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,[129] 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.[130]

C) Findings

1) The Null Hypothesis (H_0): Gap between impact of sectors over patent propensity

The null hypothesis, H_0, represents this article's main argument whereby the advanced and emerging economies diverge over both their government and business sectors in their financing and performing of domestic innovation (proxied through yearly patent propensity rates).[131]

[124] Seven countries, namely Ireland, Japan, Luxembourg, Malaysia, Malta, Pakistan, Peru and Switzerland were removed from the analysis because of insufficient data for the others imputation procedure was applied.

[125] Organization for Economic Co-operation and Development (OECD) (2002), Proposed Standard Practice for Surveys on Research and Experimental Development (Paris: OECD) (Frascati Manual).

[126] Organization for Economic Co-operation and Development (OECD) and Eurostat (2005), Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data (Paris: OECD) (Oslo Manual).

[127] *See* generally, Benoît Godin, On the Origins of Bibliometrics, Scientometrics, 68 (1) 109-133 (2006).

[128] United Nations Educational, Scientific and Cultural Organization (UNESCO) (2010), Technical Paper No. 5, Measuring R&D: Challenges Faced by Developing Countries, *Id.*

[129] Organization for Economic Co-operation and Development (OECD), Patent Statistics Manual (2009), at: http://browse.oecdbookshop.org/oecd/pdfs/free/9209021e.pdf.

[130] United Nations Educational, Scientific and Cultural Organization (UNESCO) (2010), Technical Paper No. 5, supra note 128, *Id*. This article adheres to these methodologies while entailing a series of statistical analysis using Statistical Analysis System (SAS) software.

[131] 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.

The first set of findings, as shown in Table 1 in Appendix A, infra, were identified between emerging and advanced economies. Emerging economies significantly exceeded advanced countries over the connection between the government sector and their propensity to patent over the years. The Boxplots in the Tables 3 and 4 below visualizes the differences, referring to finance and performance by the government sector respectively.

Table 3: Finance by Government (between 1996-2011)

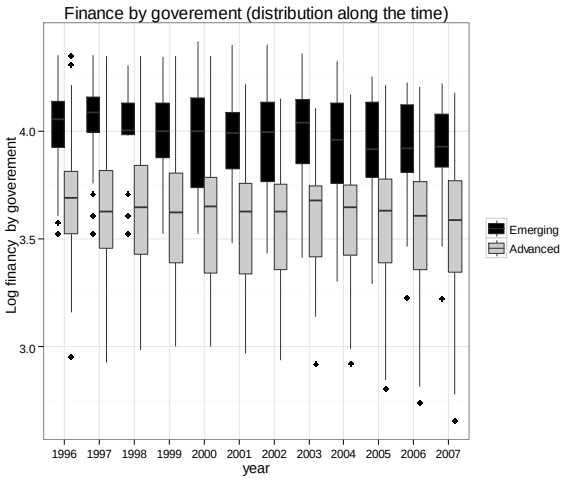
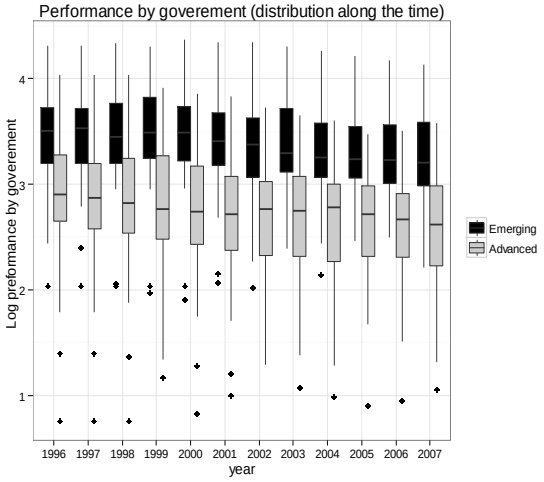


Table 4: Performance by Government (between 1996-2011)



In the same vein, the differences between advanced and emerging economies were tested over finance and performance by the *business* sector. *Business finance* in advanced economies were larger than in emerging economies. Yet no significant statistical difference was found between two types of economies over business *performance* as shown in Table 2 in Appendix A, infra. The Boxplots in the Tables 5 and 6 below visualizes the differences, referring to finance and performance by the business sector respectively.

Table 5: Finance by Business (Local & abroad) (between 1996-2011)

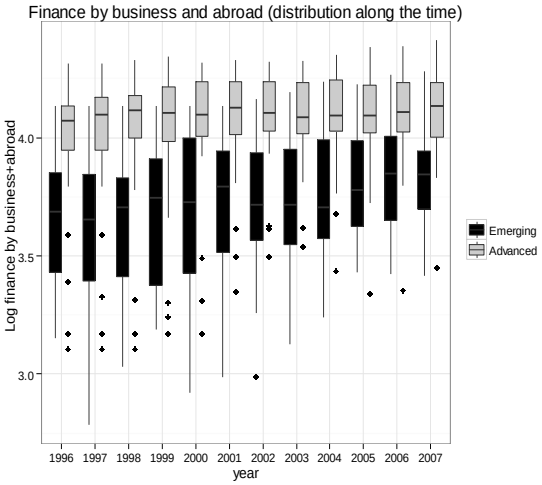
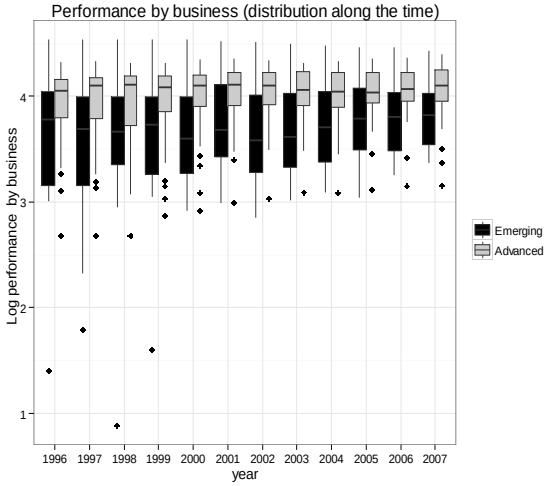


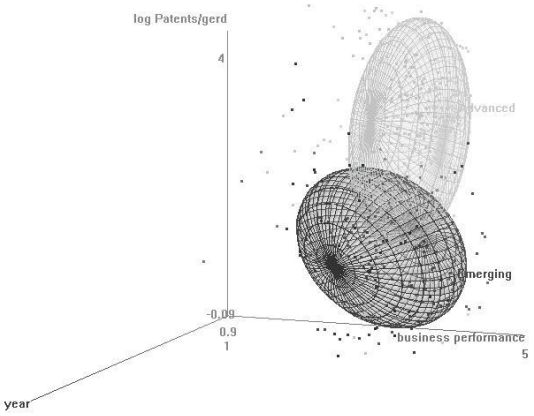
Table 6: Performance by Business (between 1996-2011)



2) The First Hypothesis (H_1): The Business Sector in Emerging Economies

The second finding is that there is a negative trend (slope) in the relationship between business performance and patent propensity for emerging countries, as shown in Table 7, below.[132]

Table 7: The relationship between business performance and patents/GERD for emerging (black) and advanced (grey) economies (between 1996-2011)



In accounting for a relatively lower patent propensity rates in emerging economies in comparison with advanced economies, this hypothesis corresponds with earlier partial findings by Kahn, Blankley and Molotja[133] and the United Nations Educational, Scientific and Cultural Organization (UNESCO), Technical Paper No. 5, Measuring R&D: Challenges Faced by Developing Countries.[134] According to these sources, the business sector in emerging economies finances and performs relatively much less GERD-related innovative activity in comparison with public sector institutions.[135] In continuation, this hypothesis may substantiate UNCTAD's 2005 World Investment Report's primary findings in which the share of emerging economies in global business R&D spending (with emphasis on advanced economies) is lower than in total R&D spending.[136]

Such finding may further correspond with UNESCO's 2010 Technical Paper No. 5 upholding that GERD-related innovative activity in the business sector within

[132] The estimates for the relationship between business performance and patent propensity for emerging countries is β=-1.06, t(60)=-5.50, p<0.001.

In balance, no positive slope was observed between *business* finance/performance and patents/GERD ($t_{(275)}$= 0.36, n.s.) , ($t_{(192)}$= 0.89, n.s.) for *advanced economies*. Lastly, there were no negative relationship between *business* finance and patents/GERD for *emerging economies* ($t_{(157)}$=-1.11, n.s.).

[133] Michael Kahn, William Blankley and Neo Molotja, Measuring R&D in South Africa and in Selected SADC Countries: Issues in Implementing Frascati Manual Based Surveys, Working Paper prepared for the UIS, Montreal (2008)

[134] *United Nations Educational, Scientific and Cultural Organization (UNESCO)* (2010), Technical Paper No. 5, Measuring R&D: Challenges Faced by Developing Countries.

[135] Michael Kahn, William Blankley and Neo Molotja, Measuring R&D in South Africa and in Selected SADC Countries: Issues in Implementing Frascati Manual Based Surveys, Working Paper prepared for the UIS, Montreal (2008); United Nations Educational, Scientific and Cultural Organization (UNESCO) (2010), Technical Paper No. 5, Measuring R&D: Challenges Faced by Developing Countries.

[136] UNCTAD, 2005.

emerging economies is commissioned ad hoc to deal with production issues making it, infrequent, informal and difficult to capture.

Lastly, these findings implicitly correspond with WIPO's 2011 report on innovation. As shown the WIPO report shows, government rather than universities are often the main R&D actors in low- and middle-income economies. That is, as in many cases industry often contributes little to scientific research.[137] As the WIPO report shows, government funding on average is responsible for about 53 percent of total R&D in the middle-income countries for which data are available.[138] As the level of a country's revenue diminishes, governmental endowment approaches 100 percent, in particular for R&D in the agricultural and health sectors. In Argentina, Bolivia, Brazil, India, Peru and Romania the share of public-sector R&D often surpasses seventy percent of total R&D.[139] For instance, the public sector funded 100 percent of R&D in Burkina Faso in the last year for which data are available.[140]

Furthermore, econometric studies at the firm and industry level provide fewer irrefutable results as to the constructive impact of public R&D.[141] More specifically; public R&D is not deemed to donate directly to economic augmentation but has a circuitous outcome via the motivation of increased private R&D. In other words, "crowding in" of private R&D takes place as public R&D raises the returns on private R&D.[142]

One might ask: What explains these highly controversial aspects of the role played by the business sector in emerging economies? The work of the late Alice Amsden in her thorough historical account of late-industrializing economies in her book *The Rise of "The Rest"* throws some light on this phenomenon. Amsden labels *'late-industrializing economies'* as newcomers from the South-East Asian Tiger economies and numerous emerging economies, or archetypically just "the rest." As she explains, governments - substantively more than the business sector in ''the rest'' all intervened in markets in a deliberate and deep way. So much so, as their economies had too few knowledge-based assets, particularly intellectual property assets typically attributed to the business sector. Lack of knowledge-based

[137] See, World Intellectual Property Report 2011, at 140-141 & Figure 4.1: Basic research is mainly conducted by the public sector. *Id.*

[138] *Id*.

[139] Exceptions are Malaysia, China, the Philippines and Thailand where, for both R&D funding and performance, the business sector has the largest share. See, World Intellectual Property Report 2011, at 140-141.

[140] *Id*. More particularly, the WIPO report shows that in low- and middle-income countries for which data are available, public research is also responsible for the majority of basic R&D. See, World Intellectual Property Report 2011, at 141 (offering the examples of close to 100 percent in China, close to 90 percent in Mexico, about 80 percent in Chile and the Russian Federation, and about 75 percent in South Africa).

[141] See, World Intellectual Property Report 2011, at 142 ("The contribution of public R&D can take also a long time to materialize").

[142] For an overview of the literature, see David, P.A. & Hall, B.H. (2006). Property and the Pursuit of Knowledge: IPR Issues Affecting Scientific Research. *Research Policy, 35*(6), 767-771. In turn, some public R&D may crowd out private R&D if it is not focused on basic (pre-commercial) R&D. *Id.*

assets Amsden explains harms the ability of the archetypical "rest" from competing at world market prices even in modern labor-intensive industries.[143]

Amsden surely follows the intellectual trail that growingly focuses on the institutional causes of uncertainty and diversity in the economics of innovation. This scholarly process thus became part of a wider shift in economics towards understanding the role of nonmarket institutions in economic growth. This shift had its roots in Simon's work on organizations and the Behavioral School at Carnegie Mellon, but also the seminal work of economists Cyert and March,[144] March and Simon,[145] or the early 1980s contribution of Levinthal and March on the function of non-market institutions in fostering economic growth.[146]

The theorization of governments, as opposed to the business sector, as the catalyst of innovation activity in developing countries should be deem to merely entail an innovation incentive 'second best' mechanism. That is for lack of better intellectual property incentives in the backdrop of what Amsden labels as "knowledge-based assets" as said. In such countries, second best innovation policies advanced mostly by archetypical government *political pulling* indeed preside in the setting of frequent macroeconomics static efficiency flaws, and mainly government rent seeking. In reality, much innovation is fostered at least in part in the shadow of the intellectual property innovation-incentive mechanisms. In developing countries a system of economic incentives outside of industrial intellectual property law in the face of temporary economic market concentrations, and at times state monopolies are deeply rooted. Simply put, by waiving on temporary legal monopolies offered by industrial intellectual property rights, and mainly patents - government-backed economic clogs evolve. That is, in the defence of much innovation activity all through the developing world, while return on innovation-based investment is possibly certain. Surely, this alternative incentive mechanism in developing countries in emerging economies in particular co-exists with ongoing bilateral and multilateral intellectual property endeavours - both endogenous and exogenous to the TRIPS Agreement funnelled by the World Trade Organization apparatus.

To conclude, the relatively lower patent propensity witnessed in emerging economies seemingly relate to both a suboptimal process of thus 'second best' government political pulling of innovation activity. The latter is directed in tandem

[143] See, Alice H. Amsden, The Rise of "The Rest": Challenges to the West from Late-Industrializing Economies (Oxford University Press), at 284.

[144] R.M. *Cyert*, and J.G. March, A Behavioral Theory of the Firm, Prentice-Hall (1963).

[145] J.G. *March*, H. Simon, Organizations, New York: Wiley (1958).

[146] D. *Levinthal* and J. March, A Model of Adaptive Organizational search, Journal of Economic Behavior and Organization, 2, 307-33 (1981). From the very outset, institutional theorists were committed to capitalist developed countries mostly. While building on Ronald Coase's 1937 earlier idea of transaction costs to explore the nature of institutions in *The Nature of the Firm*, in Economica NS 4, 386-405 (1937), institutional theorists thus made much headway in explaining the role of nonmarket institutions in economic growth in developed countries. Noticeably, these were as Douglas North, *Institutional Change and Economic Performance*, Cambridge: Cambridge University Press (1990), and the late Oliver Williamson in his 1975 book *Markets and Hierarchies, Analysis and Anti-Trust Implications: A Study in the Economics of Industrial Organizations*, New York: Free Press. A later expansion of work on the role of institutions in fostering economic growth is his 1985 book *The Economic Institutions of Capitalism*, New York: Free Press (1985).

by a deficient form of intellectual property regulatory framework promoted by the WTO apparatus and the TRIPS agreement on the whole.

In claiming that different government innovation policies replace intellectual property ones, this study relates to earlier development economics work by Pierre Schlag,[147] followed by Curtis Milhaupt and others,[148] confirmation that ever present political determination has noticeably led governments of many developing countries to promote growth all told.

Such growth also witnessed the substituting of private law, contract law and property law mostly, as an alternative 'first best solution' for the requisition of growth by such governments. Resonating on Schlag's contribution, each time such governments are short-sighted they may fall for regulatory expropriation of innovation activity; otherwise, governments may decide not to expropriate every time they would view such course of action as politically untimely, as they often do in the view of becoming international exporters of innovation-based goods.[149]

The phenomena of political determination or political pull have mostly been witnessed in developed countries. Electronics particularly in the fields of semiconductors and computers, throughout the first two decades of the port-war era is a primary working example. Military and space programmers operated then as an influential mechanism towards defined technological targets, while at the same time providing financial assistance to R&D and assuring public procurement.[150] One more previous case in point has been the appearance of synthetic chemistry in Germany pulled by political will towards self-reliance of the German financial system in the post-Bismarck era.[151] In some high-tech sectors such as aerospace or pharmaceuticals, experimental data is gradually being accumulated maintaining high levels of such 'political pull' leading to government regulation in both the developed and developing world.[152]

The underrated theorization by "political pull' of innovation activity within developing countries - where political causality is often king, could indeed be related to up to date bureaucratic and slow-changing indications by national institutions and governments. To borrow from Freeman, national institutions that mitigate innovation in fact have thus far gained record of very slow movers.

[147] Schlag, P. (1986), An Appreciative Comment on Coase's The Problem of Social Cost: A View from the Left, Wis. L. Rev. 919

[148] Gilson Ronald J., Curtis J. Milhaupt, Economically Benevolent Dictators : Lessons for Developing Democracies, American Journal of Comparative Law (2011), Vol. 59, Issue 01, pp. 227-288; C. Milhaupt and K. Pistor, Law and Capitalism – what corporate crises reveal about legal systems and economic development around the world (Chicago, Chicago Press) (2008).

[149] Schlag, P. (1986), An Appreciative Comment on Coase's The Problem of Social Cost: A View from the Left, Wis. L. Rev. 919

[150] See, G. Dosi, Institutional Factors and Market Mechanisms in the Innovative Process, SERC, University of Sussex, mimeo (1979); G. Dosi, Institutions and Markets in a Dynamic World, The Manchester School 56(2), 119-146 (1988); G. Dosi, The Nature of The Innovation Process, Chapter 10 in G. Dosi et al. (1988).

[151] See, generally, C. Freeman, Technology Policy and Economic Performance, London: Pinter (1987); V.M *Walsh*, J.F. Townsend, B.G. Achilladelis and C. Freeman, Trends in Invention and Innovation in the Chemical Industry, Report to SSRC, SPRU, University of Sussex, mimeo (1979).

[152] *Thomas*, L.G. (1994), Implicit Industrial Policy: The Triumph of Britain and the Failure of France In Global Pharmaceuticals, Industrial and Corporate Change, 1(2), 451-89

Freeman calculated that government innovation policies often persist for a century, despite changes in macroeconomic conditions and government policy.[153]

As a whole, emerging economies well illustrate how the business sector is sub-optimally related to the increase in patent propensity rates as proxy for domestic innovation. These findings are in line with earlier partial and rather preliminary findings already gathered by UNCTAD and WIPO as described. In balance, much evidence withholds the prospect of government-led by an archetypical outline of political pulling of innovative activity in such countries. This is not to say what the law of international intellectual property ought to be, but rather what the real politic of what is a second best solution by all means. In the backdrop of suboptimal intellectual property based knowledge economy in such countries performing of GERD-related innovative activity by the business sector in emerging economies ultimately seem to support the prospect of these countries' lower propensity to patent rates in comparison with that of advanced economies.

3) The Second Hypothesis (H_2): Government Sector in Advanced Economies

The third finding is that there is a negative trend (slope) in the relationship between government *performance* and patent propensity among advanced economies.[154] Additionally, there is no positive relationship between government's finance or performance and patent propensity among *emerging economies*, as shown in Table 8, below.[155]

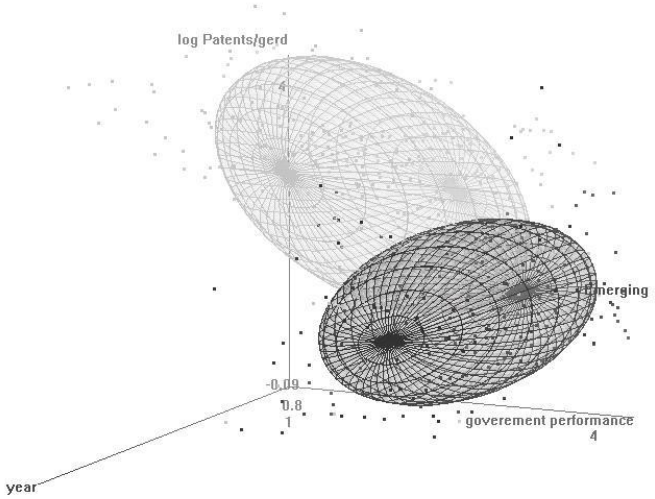
[153] C. Freeman, Technology Policy and Economic Performance, London: Pinter (1987). For later economic growth literature adaptations, see, also, M. Porter, The Competitive Advantage of Nations, New York: Free Press (1990); R. R. Nelson, National Innovation Systems: A Comparative Analysis, Oxford: Oxford University Press (1993); R. R. Nelson, The Co-evolution of Technology, Industrial Structure and Supporting Institutions, Industrial and Corporate Change, 3(1) 47-63 (1994). For the context of the expanding National Innovation Systems theory, see particularly B-Å. Lundvall, Product Innovation and User-Producer Interaction, Serie om industriel odvikling, 31 (1985); B-Å. Lundvall, Innovation as an Interactive Process: From User-Producer Interaction to the National System of Innovation, Chapter 18 in G. Dosi et al. (1988); Lundvall, B-Å. (ed.), National Innovation Systems: Towards a Theory of Innovation and Interactive Learning, Pinter, London (1992).

[154] The estimates for government *performance* among advanced economies are (β=-0.67,$t_{(53)}$=-4.2, $p<0.001$).

On the other hand, there is no statistical indication for a negative slope between government *finance* and patents/GERD among *advanced economies* ($t_{(320)}$=-0.99, n.s.).

[155] The estimates for government's finance or performance of emerging economies are ($t_{(200)}$=-0.35, n.s.) and ($t_{(83)}$=-0.74, n.s.), respectively.

Table 8: The relationship between government performance and patents/GERD for emerging (black) and advanced (grey) economies (between 1996-2011)



The second hypothesis further estimates in relative terms the central role of the government public sector in financing and performing GERD-related innovative activity in emerging economies in comparison with advanced ones. Governments are time and again unreservedly assumed to be benign institutions that are merely, or mostly, driven by their desire to exploit social welfare (even if their limited executing competence is frequently recognized). This supposition plainly differs from research on neopatrimonialism and from rent seeking that emphasizes the function of the state – particularly in developing countries – as entities that follow their individual monetary and political interest and might still demonstrate predatory behavior.[156]

The question remains: What may explain the negative impact of government sector R&D over propensity to patent in advanced economies? This question clearly necessitates further empirical evidence. That said, WIPO's partial findings are already rather telling. WIPO's 2011 indications already provide that in high-income economies, the public sector is responsible for anywhere between 20 and 45 percent of annual total R&D expenditure. More particularly, governments usually provide the majority of the funds for what are the patent-low intensity forms of basic research in these countries. As basic research upholds less patenting activity - as opposed to experimental or applied research, governments in advanced economies possibly decrease the average rates of patent propensity in these countries. To illustrate, in 2009 on average the public sector performed more than three quarters of all basic research over experimental or theoretical work in advanced economies.[157]

[156] See, e.g., Tilman Altenburg, Building Inclusive Innovation in Developing Countries: Challenges for IS research, In Handbook of Innovation Systems and Developing Countries (Lundvall et at. (Eds.) (2009), at 33, referring to earlier work by Shmuel N. Eisenstadt, Traditional Patrimonialism and Modern Neo-Patrimonialism, London Sage (1973). See, also, ; Markus Loewe et al., The Impact of Favoritism on the Business Climate: A Study of Wasta in Jordan, DIE studies 30, Bonn (German Development Institute) (2007). See also, C. Milhaupt and K. Pistor, Law and Capitalism – what corporate crises reveal about legal systems and economic development around the world (Chicago, Chicago Press) (2008).

[157] *See* OECD, Research & Development Statistics. Depending on the country in question, it accounts for about 40 percent (Republic of Korea) to close to 100 percent (Slovakia) of all basic

Additional preliminary evidence may further expand the present finding within the parameters of the second hypothesis. The present hypothesis, to be sure, solely connotes the government sector's impact towards decreasing patent propensity rates in advanced economies. Alas, it does not offer clear evidence as to the impact of the government sector over the propensity to patent in emerging economies. Yet indirect findings may well serve to complete this analysis based on alternative datasets and innovation-based indicators, outside of UNESCO's S&T dataset over GERD indicators used herein.

For that purpose, the 2005 UNCTAD Investment report focusing on R&D measurements worldwide is deemed instrumental. Despite being incomplete in its coverage of emerging economies, the report offers two highly instructive findings concerning developing countries at large. These relate to the relatively low intensity of R&D activity measured per industry, and the low quality of R&D in such countries in comparison with advanced economies. Future empirical research may substantiate these findings in the future.

At a start, UNCTAD's report offers an important account of the relatively low intensity R&D in developing countries in comparison with advanced ones, in what may explain the former countries' lesser propensity to patent rates altogether. As the report shows, most developing economies start modern manufacturing with the simplest technologies directed by low intensity R&D.[158] These technologies include textiles, clothing, food-processing and wood products. Some of these technologies indeed move up the scale into heavy process industries such as metals, petroleum refining and metal products.[159] Hardly any additional such technologies turn into competent users of "medium-high" technologies, making added advanced intermediary and capital goods. These include chemicals, automobiles, and industrial machinery.[160] On average, only few such industries develop competitive capabilities in high-technology industries backed by an extended patent propensity and patenting per se. Similar to advanced economies, these industries in developing countries may include aerospace, micro-electronics and the pharmaceuticals.[161]

The UNCTAD Investment report offers a second highly instructive finding concerning developing countries at large. It relates to the relatively low quality of R&D in such countries in comparison with advanced economies. In developing countries such as those in Latin America and the Caribbean, Multi National Enterprises have so far located only limited R&D. Yet further to that the report indicates that FDI in such countries is rarely in R&D-intensive activities. FDI in such counties is R&D-intensive it mainly remains confined to adaptation of technology or products for local markets. In the case of the Latin American example the process is also known as "tropicalization." In continuation, the Latin American case study further illustrates how foreign affiliates play a relatively large role in business enterprise R&D in Brazil and Mexico, moderate in Argentina and low in Chile.[162] Equally importantly, such low quality R&D in developing countries may justifiably be deem to

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research performed. See, World Intellectual Property Report 2011, at 140 & Figure 4.1: Basic research is mainly conducted by the public sector. *Id.*

[158] See, UNCTAD, World Investment Report, supra note 26, at 108-9. See also, Table III.3: Classification of Manufacturing industries by R&D Capacity Index. *Id.*, at 102.

[159] *Id*., at 102.

[160] *Id*., at 108-9. See also, Table III.3: Classification of Manufacturing industries by R&D Capacity Index. *Id.*, at 102.

[161] *Id*.

[162] See, UNCTAD, World Investment Report, New York and Geneva, United Nations (2005), at 143, referring to Cimoli, Mario (2001). "Networks, market structures and economic shocks: the structural changes of innovation systems in Latin America". Paper presented at the seminar on "Redes peroductivas e institucionales en America Latina", Buenos Aires, 9-12 April.

explain lower patent propensity rates in such countries in comparison with advanced economies.

IV. THEORETICAL RAMIFICATIONS

The core empirical findings above bestow important theoretical ramifications based on additional research. Three such central ramifications come to mind. To begin with, there remains a broad concern whether spillovers or externalities deriving from R&D activity funneled by patenting activity effect economic growth. Economic growth surely is measured through total factor productivity or else, not only between advanced economies, but possibly between advanced and emerging economies in tandem.

Certainly, diffusion of GERD-related knowledge across countries across the North-South divide introduces the idea of absorptive capacity as a conditioning factor. So far, however, empirical studies have merely investigated the question of whether R&D spillovers are internationally present between advanced economies. Little or no findings establish the scope and pattern of R&D spillovers between the development divide. Coe and Helpman most noticeably analyze twenty-one OECD economics between the years of 1970–90.[163] Their rather limited findings uphold that R&D spillovers occur between advanced countries the greater trade openness prevails. Other studies have extended this work to data sets with two,[164] or more countries and looked at other factors affecting R&D spillovers, such as education levels in OECD countries,[165] or public-sector R&D among advance economies as said.[166]

A second theoretical ramification follows. It deals with the relation between public and private R&D in developing countries. Economists, continuing in the tradition pioneered by the advanced economies-based 1957 research by Blank and Stigler who periodically study a

[163] D. Cole and E. Helpman, International R&D Spillovers, European Economic Review 39: 859-887 (1995).

[164] *See* R. Griffith, E. Huergo, J. Mairesse and B. Peters, Innovation and productivity across four European countries, NBER Working Paper 12722 (2006) (upholding substantial R&D spillovers from U.S. manufacturing to U.K. firms whereby the latter undertaking R&D in the United States appear to benefit the most)

[165] *See*, H.J. Engelbrecht, International R&D Spillovers, human capital and productivity in OECD economies: an empirical investigation, European Economic Review 41(8): 1479-1488 (1997)

[166] *See*, Dominique Guellec & Bruno Van Pottelsberghe de la Potterie, From R&D to Productivity Growth: Do the Institutional Settings and the Source of Funds of R&D Matter?, Oxford Bulletin of Economics and Statistics, Department of Economics, University of Oxford, vol. 66(3), pages 353-378, 07 (2004).

Economic studies have further examined the particular impact of academic research on business related R&D, again solely within the context of advanced economies. See, For further research on R&D spillovers within the context of advanced economies, see Z. Griliches, R&D and the Productivity Slowdown. *The American Economic Review, 70*(2), 343-348 (1980); J.D. Adams, Fundamental Stocks of Knowledge and Productivity Growth. *Journal of Political Economy, 98*(4), 673-702 (1990) (finding that basic research has a significant effect on increasing industry productivity, although the effect may be delayed for 20 years); E. Mansfield, Academic Research and Industrial Innovation: An Update of Empirical Findings. *Research Policy, 26*(7-8), 773-776 (1998) (surveying R&D executives from 76 randomly selected firms estimating that 10 percent of industrial innovation was dependent on the academic research conducted within the 15 years prior); K. B. Luintel, , & M. Khan, Basic, applied and experimental knowledge and productivity: Further evidence, *Economics Letters*, 111(1), 71-74 (2011).

selection of data for signs as to whether the connection linking public and private R&D investments is all in all characterized by ‘‘complementarity,’’ or by ‘‘substitution.’’ Numerous current econometric studies, for example, document positive, statistically significant ‘‘spillover’’ effects via the stimulation of private R&D investment by publicly funded additions to the stock of scientific knowledge.[167]

The equivalent could be said concerning a significantly more widespread body of past case studies, featuring the pressure of government-sponsored research programs and ventures on commercial technological innovation.[168] Yet, merely including the numbers of findings for and against that have accumulated on the matter of public–private R&D complementarity ever since the mid-1960s, through cannot be awfully revealing.[169]

This is even more so when developing countries are concerned. As the latter studies mostly focus on United States federally funded research performed in academic institutions or quasi academic public institutes, they hardly bear immediately on the questions raised concerning the impacts of publicly sponsored R&D conducted in developing countries and the comparison with advanced ones.[170]

A third theoretical concern follows. It revolves around the interplay between governmental R&D and the question of governance. Over the past two decades, governance has moved from the fringes to the center of the development discourse.[171] The underlying assumption indeed is that governance in developing countries often remains inefficient or even ineffective. Yet only generally is the precise impact of suboptimal governance accounted for over on governments in the developing world. That is even further the case in view of their R&D policies as part of their overall domestic innovation activity. There is a broad consensus that a well-performing economy rests on a foundation of good governance, including transparent and predictable decision making and implementation, or the oversight by mechanisms that guard against arbitrariness and ensure accountability in how resources are used.[172] Yet the empirical question remains and justifies future research before more finite policy oriented recommendation could be put to action.

Lastly, development economics has yet to account for the particularities over the boundary between R&D and other technological innovation activities can be found in pre-production development activities. In advanced economies to be sure it is deemed difficult

[167] Paul A. David, Bronwyn H. Hall, and Andrew A. Toole, Is Public R&D a Complement or Substitute for Private R&D? A Review of the Econometric Evidence, Research Policy, vol. 29 (4-5) 497 (2000), at 499, referring to Jaffe 1989., Adams 1990., Acs et al. 1991. and Toole 1999a; b..

[168] Paul A. David, Bronwyn H. Hall, and Andrew A. Toole, Is Public R&D a Complement or Substitute for Private R&D? A Review of the Econometric Evidence, Research Policy, vol. 29 (4-5) 497 (2000), at 499, referring to A.N. Link and Scott, J.T., 1998. Public Accountability: Evaluating Technology-Based Institutions. Kluwer Academic Publishers, Norwell, MA.; National Research Council, 1999. Funding a Revolution: Government Support for Computing Research, Report of the NRC Computer Science and Telecommunications Board Committee on Innovations in Computing: Lessons from History. National Academy Press, Washington DC.

[169] Paul A. David, Bronwyn H. Hall, and Andrew A. Toole, Is Public R&D a Complement or Substitute for Private R&D? A Review of the Econometric Evidence, Research Policy, vol. 29 (4-5) 497 (2000), at 500.

[170] *See* e.g., Paul A. David, Bronwyn H. Hall, and Andrew A. Toole, Is Public R&D a Complement or Substitute for Private R&D? A Review of the Econometric Evidence, Research Policy, vol. 29 (4-5) 497 (2000), at 499.

[171] See, e.g., Brian Levy, Development Trajectories: An Evolutionary Approach to Integrating Governance and Growth, The World Bank - Economic Premise, Number 15 (May 2010).

[172] See, e.g., Brian Levy, Development Trajectories: An Evolutionary Approach to Integrating Governance and Growth, The World Bank - Economic Premise, Number 15 (May 2010).

to make the distinction.[173] That is as in technology-intensive industries distinguishing between "research" and "development" is especially tricky since much of the R&D work conducted involves close interaction between researchers in both the private and public sectors, often also including close collaboration with customers and suppliers.[174] The analogous challenge for developing countries thus remains regrettably unmet while it may bear implications on these countries propensity to patent at large.

CONCLUSION

Patenting policy is known to carry deep-rooted institutional implications. Yet in the case of emerging economies, the United Nations is only very loosely concerned with the role institutions take in promoting patenting activity. To date, innovation-based economic growth theory has emphasized how the R&D and particular internationalized R&D should be promoted by MNEs worldwide. Such R&D activity is also strongly connoted with a higher yield of patenting activity measured by comparable national patent propensity rates. Yet across the board, present day literature in support, merely focuses on advanced or developed countries. It is, thus, not surprising either that there are a large number of scientific studies on this occurrence evidently merging the experience mostly of advanced economies or that several of these studies show an increasing internationalization of innovative activity mainly R&D by MNEs in such countries. In practice, numerous examples established the impression that internationalized R&D and the propensity to patent in emerging economies has triumphed. Not surprisingly, this has also been the general albeit mostly implicit policy of different United Nations organs in recent years. Noticeably, this view is to be found in the 2005 United Nations Millennium Project, the view of the World Intellectual Property Organization and even the United Nations Economic Commission for Africa. Rooted in dependency theories of development whereby developing countries were flatly perceived to be dependent on developed ones, the TRIPS agreement implicitly pledge for 'freer trade' role leading for the business sector in directly fostering domestic innovative activity directed by a higher yield of patenting activity. So much so, as TRIPS primarily corresponded and still does with the World Bank and UNCTAD's labeling of technology transfer as a reactive form of innovation-based economic growth for developing countries. And so, rather than promoting domestic innovation by the promotion of local technological capacity, innovation was to be received and at most adapted. The business sector henceforth was meant to foster technologically-based trade.

Yet a more careful look shows that the role of MNEs and the business sector at large in promoting innovation in the developing world and the entire United Nations' innovation view thereof, seem to have fallen short in meeting these high expectations.

On this backdrop, the article offers a novel empirical and conceptual comparison between emerging economies and advanced ones abridging the North-South divide. It analyzes possible statistical connections between the government and the business sector (domestic and from abroad) with the propensity to patent as proxy for domestic innovation by both

[173] See, Alice Amsden and Ted Tschang, A new approach to assess the technological complexity of different categories of R&D (with examples from Singapore), *Research Policy*, 32, 4, pp. 553-572 (2003); Francisco Moris, R&D investments by U.S. TNCs in emerging and developing markets in the 1990s, Background paper prepared for UNCTAD (Arlington, VA: U.S. National Science Foundation), mimeo (2005). See also, UNCTAD, World Investment Report, New York and Geneva, United Nations (2005), at 106.

[174] *Id*.

country group classifications. In so doing the model analyzes two R&D-related indicators, namely the *financing* and the *performance* of Gross Domestic Expenditure on R&D (GERD) by three types of such innovating sectors, namely the Government, the Business sector and the private investment from abroad by multinational enterprises. For simplicity, the latter two business sub-sectors are combined into an overall business one.

In critique of the present business sector sway for both developing and developed countries alike, the article offers two central findings. To begin with, in accounting for a relatively lower patent propensity rates in emerging economies in comparison with advanced economies, it is shown that the business sector in emerging economies finances and performs relatively much less GERD-related innovative activity in comparison with public sector institutions. This hypothesis may substantiate UNCTAD's 2005 World Investment Report's primary findings in which the share of emerging economies in global business R&D spending (with emphasis on advanced economies) is lower than in total R&D spending. Moreover, these findings implicitly correspond with WIPO's 2011 report on innovation. As shown the WIPO report shows, government rather than universities are often the main R&D actors in low- and middle-income economies. That is, as in many cases industry often contributes little to scientific research.

To conclude, the relatively lower patent propensity witnessed in emerging economies seemingly relate to both a suboptimal process of thus 'second best' government political pulling of innovation activity. The latter is directed in tandem by a deficient form of intellectual property regulatory framework promoted by the WTO apparatus and the TRIPS agreement on the whole. As a whole, emerging economies well illustrate how the business sector is sub-optimally related to the increase in patent propensity rates as proxy for domestic innovation.

The article follows with a second empirical illustration of its underlying theoretical setting. It estimates in relative terms the central role of the government public sector in financing and performing GERD-related innovative activity in emerging economies in comparison with advanced ones. Governments are time and again unreservedly assumed to be benign institutions that are merely, or mostly, driven by their desire to exploit social welfare (even if their limited executing competence is frequently recognized). This supposition plainly differs from research on neopatrimonialism and from rent seeking that emphasizes the function of the state – particularly in developing countries – as entities that follow their individual monetary and political interest and might still demonstrate predatory behavior. As this article suggests, future research is necessary if a comprehensive and more accurate institutional policy is to be tailored for developing countries and emerging economies in particular.

Appendix A:

Table 1. Country type differences in government performance and finance

	Finance		**performance**	
	Estimate[a]	**SE**	**Estimate**	**SE**
time 1	0.3119***	0.09355	0.5420**	0.1962
time 2	0.3651***	0.09349	0.6702***	0.1962
time 3	0.3390***	0.09357	0.6485***	0.1961
time 4	0.3521***	0.09376	0.6962***	0.1962
time 5	0.3721***	0.09397	0.7321***	0.1968
time 6	0.3970***	0.09420	0.7154***	0.1974
time 7	0.3949***	0.09421	0.7491***	0.1975
time 8	0.3788***	0.09419	0.7389***	0.1976
time 9	0.3433***	0.09454	0.7214***	0.1982
time 10	0.3332**	0.09460	0.6995***	0.1984
time 11	0.3555***	0.09483	0.7387***	0.1987
time 12	0.3873***	0.09479	0.7196**	0.1991

** p<0.01, ***p<0.001
[e] estimate of difference between the two types of economies

Table 2. Country type differences in business performance and finance

	Finance		**performance**	
	Estimate	**SE**	**Estimate**	**SE**
time 1	-0.3154**	0.09510	-0.2772	0.1407
time 2	-0.3874***	0.09541	-0.3534	0.1408
time 3	-0.3667***	0.09508	-0.3045	0.1405
time 4	-0.3449***	0.09480	-0.2740	0.1403
time 5	-0.3638***	0.09459	-0.3176	0.1402
time 6	-0.3653***	0.09441	-0.3093	0.1400
time 7	-0.3705***	0.09440	-0.3682	0.1403
time 8	-0.3357***	0.09430	-0.3245	0.1401
time 9	-0.3050***	0.09391	-0.2871	0.1399
time 10	-0.2839***	0.09384	-0.2340	0.1396
time 11	-0.2805***	0.09359	-0.2333	0.1395
time 12	-0.2949***	0.09371	-0.2107	0.1396

** p<0.01, ***p<0.001

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