Novelty Traps, Kiwis, and other Flightless Birds

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ABSTRACT

Novelty traps are a unique display of social loss due to patent policy. Novelty traps appear whenever a foreign patented technology (but even unpatented) amounting to prior art chills inventive activity locally. It occurs when the chilled local inventive activity could have otherwise diffused the foreign technology locally through adapting or adopting it by means of incremental innovation. Novelty traps are especially rampant in developing countries. In these countries, such diffusion rates are ever low, and foreign patentees regularly opt for not patenting and commercializing their inventions therein, adding to these countries' underdevelopment.

Using the unique case of New Zealand's 2014 patent prior art reform, this article offers the first account of New Zealand's statutory patent reform's chilling effect twofold. Namely, firstly, novelty traps reduce local patenting activity. Secondly, novelty traps diminish the diffusion of overseas technology.

The policy ramifications of these early findings are potentially radical as they question the efficiency of the standard of 'absolute' novelty or nonobviousness in incentivizing inventive activity. That is, especially in underdeveloped countries where technology diffusion through incremental midlevel invention is critical. Therefore, it is probable that New Zealand's novelty traps intensify in developing countries where technology diffusion is costlier due to lower absorptive capacity.

Table of Contents:

Introduction

Flightless birds are a principal feature of New Zealand's 'edge ecology.' In the past, the forests in New Zealand were dominated by birds, and the lack of mammalian predators led to some like the Kiwi, Kakapo, Weka, and Takahē evolving flightlessness.[1] Among advanced countries, New Zealand is unique for another edgy phenomenon. A legal one. It concerns the country's exceptional innovation policy reform.[2] It derives from its 2013 statutory patent reform raising the patentability bar to an advanced economy standard. The reform mainly focuses on novelty, nonobviousness, and disclosure requirements. Most countries have shifted long ago from the local novelty standard into absolute novelty.[3] In New Zealand, remarkably, this transformation occurred only after this country's exceptionally late patent reform. This reform now offers a rare opportunity to measure empirically and assess the impact of this policy transition given the unaccounted *Novelty Traps* New Zealand's reform entails.

The unique phenomenon underlying novelty traps is a form of social loss caused by patent prior art due to patented inventions that chill the incentive to innovate. Such social harm occurs under the international patent system's veil. Whenever prior art by a foreign patent is not patented locally within the priority periods set in the Paris Convention for the Protection of Industrial Property of 1883 ('Paris convention'), in such a case, the prior art generated by the foreign patent chills the local diffusive activity. This activity is often innovative on its own.

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[1] See, New Zealand ecology: Flightless birds, TerraNature, 2007-2016 TerraNature Trust. There are sixteen extant flightless birds, more than any other region in the world. These include two rails, five ratites, two teal, one parrot, and six penguins. *Id*.

[2] For a first principled discussion of the role of novelty traps in chilling inventive activity see, Rochelle C. Dreyfuss & Daniel Benoliel, Technological Self-Sufficiency and the Role of Novelty Traps, 24(3) Vand. J. Ent. & Tech. L. (2022) (Forthcoming).

[3] Stephen Ladas commented that between the 1950s-1970s, numerous developing countries have opted for a local novelty standard, as found in their patents of importation regulations. These included Argentina, Barbados, Bolivia, Chile, Colombia, Congo (Leopoldville), Costa Rica, Ecuador, Dominican Republic, Guatemala, Haiti, Iran, Iraq, Jamaica, Panama, Paraguay, Peru, Spain, Tangier, Turkey, Uruguay and Venezuela. *See* Stephen P. Ladas, Patents, Trademarks, and Related Rights: National and International Protection, (Harvard University Press, 1975), Vol. 2, at 375.

Consider, for example an industrialist farmer in Novosibirsk, Russia, wishing to integrate an auxiliary article in a soviet-era combine harvester vehicle serving the local bread industry. Such a local inventor, hoping to diffuse foreign technology effectively, might find himself blocked from patenting their locally-adapted version of such alien patented (but even an incomplete patented) technology. Amidst prior art inflicted by that foreign patent by a foreign patentee in Nancy, France, or Zhejiang, China, our Russian industrialist may decide not to invest the much-needed R&D in diffusing such foreign technology. So much so, where the foreign patent has not been granted within the Paris Convention's priority periods at the Eurasian Patent Office (EAPO) to which our Russian industrialist belongs geographically. In our example, elements A, B, and C may constitute the prior art publically disclosed by the foreign patentee. Often, the addition of unpatentable (yet adaptive and costly) elements D1, D2, or D3 by different industrialists in multiple laggard countries might be pricy or impractical. Prior art in the absence of a registered patent in such countries would consequently chill technology diffusion therein. In circumstances where market forces, expressly in underdeveloped countries, would not hedge the risk deriving from the R&D investment in our example, the quality of Russian bread would worsen. A novelty trap would then inflict the social loss we offer to assess empirically.

Serving both inventors in our example, the international patent system may continue to support the absolute novelty of the foreign patent owner in whichever country they patent lawfully. The foreign patent owner holding the original appropriation would constitute prior art. The latter would only be compromised by a local patentability standard used by a following in-state patentee, the Russian farmer, in our example. The local inventor could then receive a derivative patent appropriation assuring the incentive to diffuse the foreign patented technology locally.

Remarkably, to date, novelty traps have been overlooked. The root cause for novelty traps lies in the fact that patentability is designed by the term measured by length instead of geography. In such a way, the current absolute patentability standard has won the day globally. Moreover, the neoliberal rationale for incentivizing inventive activity based on universal or absolute newness remains virtually unchallenged. As a result, the absolute or universal standard of novelty and the nonobviousness requirements remain unforgiving. The stakes are high, especially for inventors in developing countries where incremental inventive activity diffusing foreign technology by local industrialist inventors is critical. So much so, whenever local constituents in such laggard national technology markets work their way to diffusing foreign technology. That is given the daunting effect of prior art imposed on them by foreign patentees such as in the exceptional statutory case of New Zealand.

I. The Basic argument: Novelty Traps reduce Technology Diffusion

A. New Zealand's Patent Reform

New Zealand's unusually late patentability reform occurred through its new Patents Act 2013 which came into effect on 13 September 2014. It substituted the long-since-obsolete Patents Act 1953. The new Act applies for non-divisional applications filed after the date of commencement. According to the 1953 Act, an invention would have been considered not novel if published or used in New Zealand before the patent was filed.[4] Nevertheless, the patent application has been only examined for prior publication or claim, with prior use as a ground for opposition or revocation.[5] In examining a patent for novelty, the novelty had been assessed locally.

Increasing the patentability threshold in New Zealand through the 2013 Act, ultimately upgraded the novelty, inventive step and the disclosure requirements. It meant that many applications that would have met the criteria for patent protection under the 1953 Act are likely to be denied protection under the 2013 Act.

Initially, the outgoing Patents Act of 1953 was based upon the UK's Patents Act of 1949. The latter was itself similarly reformed approximately four decades ago. Common wisdom had it that since the early days of the industrial revolution in the late eighteen-century, to import new technology, one had to embark on a ship, cruise a significant expanse and assemble the new disembarked technology. Local novelty provided an incentive to import technology, be it contemporary or known elsewhere, to a developing country such as the geographically isolated New Zealand has been during the recent centuries since its founding. Arguably, under this archetypal 'patents of importation' regime, no undue monopoly would have been granted. So much so, as importation would have been permitted until local manufacture had begun.[6] Thus, the proposed system would give the right to a local patent government-granted monopoly. This limited monopoly would have been offered to local industrialists willing to diffuse technology in countries where such a patent has not been granted within the priority periods set by the Paris Convention.[7]

New Zealand's 2013 Act has been acclaimed as the advent of the new age for the country's patents and an emblem of the overall consolidation of New Zealand's numerous patentability standards. New Zealand's local novelty's death toll was the dawn of the internet age. That is, as new technologies are recurrently transferred across the globe via the internet instantly. In so doing, the 2013 Act incorporated three changes that raised the bar for New Zealand's patentability threshold. The updated patentability standards, namely novelty and inventive step notably, now presumably constitute the country's self-inflicted novelty traps, as follows. First, the new Act offers a shift from local to absolute novelty. Thus, to decide whether or not an invention is novel, the prior art base includes all matter at any time before the priority date of that claim has been

[4] Patents Act 1953 (New Zealand), art. 21(1)(b), (c) and (d), 41(1)(a) and (e).

[5] *Id.*, art. 21(d) and 41(1)(e).

[6] For discussion concerning pre-TRIPS Agreement patents of importation, see Jerome H. Reichman, The TRIPs Component of the GATT's Uruguay Round: Competitive Prospects for Intellectual Property Owners in an Integrated World Market, 4 Fordham Intellectual Property, Media & Entertainment Law Journal 171-266 (1993), at 252-253; Alberto Bercovitz-Rodriguez, Historical Trends in Protection of Technology in Developed Countries and Their Relevance for Developing Countries, Study prepared for U.N. Conference on Trade & Dev. (UNCTAD), U.N. Doc. UNCTAD/ITP/ TEC/18 (Dec. 26, 1990), at 2-3; Stephen P. Ladas, Patents, Trademarks, and Related Rights: National and International Protection, (Harvard University Press, 1975), Vol. 3, at 1898-99.

[7] Paris Convention for the Protection of Industrial Property, art. 5A, Mar. 20, 1883, 21 U.S.T. 1629, 828 U.N.T.S. 305.

made available to the public in New Zealand or overseas. That is, by written or oral description, by use, or in any other way.[8]

Skeptics initially doubted that the new Act's expected shift to absolute novelty would account for a decline in local patentability rates.[9] The argument could have been that at an earlier event, namely per a 2005 Intellectual Property Office of New Zealand (IPONZ) decision, the transition to absolute novelty has predated the statutory reform de facto. Yet, the figures seem to show differently. Instead, novelty traps were witnessed only as of the statutory reform of 2013 underlying the article's claim altogether. In 2005, the issue decided by the IPONZ Assistant Commissioner's decision in *Molecular Plant Breeding Nominees Ltd* v *Vialactia Biosciences (NZ) Limited*,[10] was the accession date of an internet-based document that was considered relevant to the novelty of the application. Namely, whether a website accessible through the internet constitutes "local publication" until it exists tangibly, namely, is printed, in New Zealand. The IPONZ's Assistant Commissioner held that this is an obsolete standard as the appearance of the internet has presumably made absolute novelty a de facto global standard. Accordingly, if any prior publications or claims contain a clear description of or instructions to do or make something that will infringe the claimed patent is granted, then the claim shall be regarded as novel.[11] In this decision, IPONZ's Assistant Commissioner made precedent whereby a document available via the internet met the statutory definition of "published."[12] While this has not been opposed formally, this finding has been assumed even before the 2013 Act.

Moreover, as Figure 1 discussed in the empirical Part II shows, New Zealand's resident patent application rates have declined substantively only as the 2013 Act came into effect. No decline has been observed after the 2005 *Molecular Plant* Breeding's Application case which raised the patentability bar slightly beforehand. In fact, in 2005, the count of resident patent applications in New Zealand reached 1893, yet in 2006 it slightly increased to 2153 resident patent applications.[13] The fact that the *Molecular Plant Breeding* did not have a chilling effect on resident patent filling rates, as did the 2013 patent reform, begs explanation. Prior to the *Molecular Plant Breeding* decision, IPONZ examiners could (and did) search online databases available to them. Yet, if they located a relevant document they could only cite it if they could verify that a copy

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[8] Patents Act 2013 (New Zealand), Public Act 2013 No 68, sec. 8.

[9] See, e.g., Gareth Dixon, Mondaq, New Zealand: New Zealand's Patents Act 2013 – Local novelty is out (but was it ever really in?) (6 September 2016) ("*we remain to be convinced that a New Zealand patent will become significantly harder to obtain and/or appreciably narrower in scope under the novelty provisions as prescribed by the new Act*."); AsiaIP, What Does "Local Novelty" Really Mean? (29 October 2012).

[10] Molecular Plant Breeding Nominees Ltd v Vialactia Biosciences (NZ) Limited [2005] NZIPOPAT 25 (Commissioner's Decision No P25/2005, 12/9/05, Asst Commr Popplewell) (hereinafter, Molecular Plant Breeding Nominees Ltd's Application)

[11] General Tire & Rubber Co v Firestone Tyre and Rubber Co Ltd [1972] RPC 457 (EWCA) at 485, adopted in New Zealand by Smale v North Sails Ltd [1991] 3 NZLR 19 (HC).

[12] The IPONZ Hearing Officer's decision upheld: "The internet, by 1999, was widely available to New Zealanders and, in fact, a search of the "web," by that date, would have been considered virtually essential for any scientist engaged in a survey of literature relevant to his field." *Id*.

[13] WIPO IP Statistics Data Center, Total patent application (direct and PCT national phase entries) (New Zealand).

of the document was physically available in New Zealand.[14] Surely, they could have cited a document only if the date that the document became available in New Zealand was earlier than the priority date of the patent claims under examination.[15] For example, an examiner might search the USPTO online database. If a relevant US patent was found, the examiner would check the date that a physical copy of the patent was made available in the IPONZ physical library. This could be some weeks after it became available online.[16]

IPONZ's pre-2013 further practice underlies two constraints. That is especially given the *Molecular Plant Breeding* decision's admittance that the new standard would offer a "*much wider effect*," on international prior art examination, twofold.[17] Firstly, the decision ignores, and thereby effectively excludes physical documents which were not present in New Zealand.[18] The effect of this decision is that documents not available online nor physically present in New Zealand remain excluded from the prior art taken into account for determining novelty and inventive step (in post-acceptance and post-grant proceedings) under the Patents Act 1953.

Secondly, the *Molecular Plant Breeding* decision assumed that the standard as of 2005 covers freely available web searches. The decision did no more than determine that documents available online could be considered 'published' in New Zealand for the purposes of the Patents Act 1953. The decision, however, was silent on how online documents are located, and it certainly did not set a *de facto* standard for IPONZ searches.[19] The decision, thus, did not include in the present patentability standard a commitment to databases search of prior art.

The policy of databases examination which the decision ignores, overrides an obligation to search both patented and non-patent literature during patent examination. At a start, the decision did not include published items of non-patent literature. That is neither in general not in specific reference to the main database which the World Intellectual Property Organization (WIPO) notably considers essential, such as for the context of the PCT system. WIPO labels the three following databases which, different than the IPONZ's decision, are not freely available on the web.[20] These are the ISSN

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[14] *See* Warren Hassett, Response to letter accompanying email dated 25 November 2021 in relation to comments on: 'Novelty Traps, Kiwis, and other Flightless Birds' (2 December 2021) (File with authors).

[15] *Id*.

[16] *Id*.

[17] Molecular Plant Breeding Nominees Ltd's Application, supra note 10 ("It seems to me, however, that this amendment will have a much wider effect; it brings into consideration, not only material on the internet, but also all that hard copy material, such as text books and older, non-digitized publications, which are not available electronically."), sec. 45.

[18] *Id*.

[19] *See* Warren Hassett, supra note 14, *Id*.

[20] *Cf*: WIPO, Handbook on Industrial Property Information and Documentation, Ref.: PCT Minimum Documentation page: 4.2.1 (04-02-01), "Minimum Documentation" under Rule 34.1(B)(III) of the Regulations under the patent Cooperation Treaty (PCT) (referring to the three online databases for the purposes of WIPO's PCT Rule 34.1(b)(iii), concerning the PCT "minimum documentation" requirement by International Searching Authorities including published items of non-patent literature).

online website,[21] the UlrichsWeb™ Global Serials Directory website,[22] and the Genamics™ JournalSeek website.[23]

Second, the IPONZ decision did not oblige the use of databased published items of patent literature. It was up to examiners to decide which databases to search and during the old Act's regime there was no legal or official requirement to search databases other than the New Zealand patents register.[24]

Adding to the limits of the *Molecular Plant Breeding* decision in allegedly raising New Zealand's patentability bar prior to the 2013 Patents Act, under the old Act, prior art search by third parties of IPONZ patent applications prior to acceptance, allowed only bibliography information.[25] Simply put, under the 1953 Patents Act, IPONZ patent applications were not published prior to acceptance. Once an application was accepted, the accepted complete specification was published, together with any provisional specification associated with the complete specification. Applications that were not accepted were not published by IPONZ and could be accessed only through databases of foreign patent applications to the degree that such databases were publically accessible.[26] Under the Patents Act 1953, moreover, examiners' reports were not published.[27] The results of prior art searches made on applications could be requested by any person, but were not routinely made available.[28] In balance, it was only after the Patents Act 2013 came into effect that all information and documents which became public were made publically available for prior art search by the public.[29]

The grounds for assessing the effect of novelty traps in New Zealand are also affected by a second statutory transition in the new 2013 Act. It offers an extension of the examination criteria to include an assessment of inventive step. Admittedly, it is unclear whether novelty or inventive step per se had the main role in constituting New Zealand's novelty traps. As Warren Hassett, a former member in the IPONZ's Patents Technical Focus Group (TFG) explains, with the advent of examination for inventive step under the Patents Act 2013, inventions that might have been granted patents under the Patents Act 1953 might no longer be patentable.[30] This may have discouraged some applicants from filing applications.[31] It is probable that the introduction of examination for inventive step in the Patents Act 2013 explain, at least partly, the decline in the number of domestic patent applications filed.[32]

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[21] *See* ISSN online website at https://www.issn.org/.

[22] See, UlrichsWeb™ Global Serials Directory website at http://ulrichsweb.serialssolutions.com/login.

[23] *See* Genamics™ JournalSeek website (freely available) at http://journalseek.net/.

[24] *See* Warren Hassett, supra note 14, *Id*.

[25] IPONZ, Release of information held under the Patents Act 1953, at: https://www.iponz.govt.nz/assets/pdf/Release-of-information/Release-of-information-held-under-Patents-Act-1953.pdf.

[26] *See* Warren Hassett, supra note 14, *Id*.

[27] *Id*.

[28] *Id*.

[29] IPONZ, Release of information held under the Patents Act 2013, at: https://www.iponz.govt.nz/assets/pdf/Release-of-information/Release-of-information-held-under-Patents-Act-2013-v2.pdf.

[30] *See* Warren Hassett, supra note 14, *Id*.

[31] *Id.*

[32] *Id.*

Be that as it may, the shift to absolute novelty in New Zealand has been incorporated into the inventive step standard. That is, in assessing the decline in resident patent application rates twofold. Firstly, in the new Act, the assessment of the inventive step has been incorporated into the examination process.[33] Under the 1953 Act, the use of inventive step was evaluated only during opposition and revocation proceedings.[34] The effect of this evolvement on novelty traps remains, however, uncertain. As IPONZ has not published thus far, any data that could account for the rates of patent oppositions applied and granted, notwithstanding the role of inventive step justifications therein. Secondly, the assessment of inventive step in the new Act has also been broadened in scope concerning prior art evaluation. Thus, according to New Zealand's new absolute novelty standard, the prior art base has been expanded to include published documents and use anywhere in the world.[35]

Lastly, the grounds for assessing the effect of novelty traps in New Zealand are also affected by the added requirement that a patent specification adequately "supports" the invention claimed. That is, instead of the lower standard of 'fair basis' required under the 1952 Act.[36] Together, the inventive step and the novelty standard reforms constituted New Zealand's novelty traps. Namely, regardless of the relative effect the two reforms have had in practice and given that this concern necessitates further empirical assessment. As one commentator concluded, perhaps harshly, under the old Act "IPONZ was effectively only rubber-stamping what had gone before it in IP Australia, the EPO, USPTO."[37]

B. Novelty Traps as Opportunity Costs

1) Overview

Patent owners are not always able to capture the total surplus of their inventions. Others enjoy only part of the surplus as consumer surplus or positive externalities.[38] The social loss is partly gone due to the monopoly power wielded by the patent system.[39] At a

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[33] Patents Act 2013 (New Zealand), supra note 8, sec. 7 ("An invention, so far as claimed in a claim, involves an inventive step if it is not obvious to a person skilled in the art, having regard to any matter which forms part of the prior art base.").

[34] The key case which relates to inventive step, and which has been regularly applied in opposition and revocation cases under New Zealand's Patents Act 1953, is Windsurfing International Inc. v. Tabur Marine (Great Britain) Ltd, [1985] RPC 59. See, also, New Zealand, The Patent Examination Manual, Section 7: Meaning of inventive step.

[35] Patents Act 2013 (New Zealand), supra note 8, sec. 7.

[36] *Id*., Sec. 39(2)(c), 2013 Act ("The claim or claims must…(c) be supported by the matter disclosed in the complete specification;" See, also, Charles Caulder Bree [2017] NZIPOPAT 16 (19 July 2017) (confirming for the first time that "support" under the new Act requires a higher standard of written description than did "fair basis" under the old).

[37] Dr. Gareth Dixon, supra note 9 (concluding "Under the old Act, New Zealand was very much a follow-on jurisdiction").

[38] *See* Michael Kremer, Patent Buy-Outs: A Mechanism for Encouraging Innovation, National Bureau of Econ, Research Working Paper No. (1997), at 1; Steven Shavell & Tanguy Van Ypersele, Rewards Versus Intellectual Property Rights, National Bureau of Econ., Research Working Paper No. 6956 (1999), at 5-6.

[39] *See* Michael Kremer, *Id*., at 1; Steven Shavell & Tanguy Van Ypersele, *Id*., at 5-6.

global level, economic theory considers the social loss, or gap, also across countries abridging the North-South divide twofold. These gaps relate to patent ownership and their subsequent commercialization. At the start, as for ownership, a patent divide is defined as the gap in patent ownership between developed and developing countries. As the WIPO data suggests, this ownership divide is gradually narrowing to more technologically sophisticated developing countries.

The second gap which economic theory discusses refers to the divide in terms of patent commercialization.[40] That is in terms of the volume of licensing and royalty revenues. This divide presides moreover in terms of and the direction of cash flows associated with innovation.[41] In both respects, most developing countries seem to remain marginalized drastically.[42] As foreign patents are often not granted and commercialized in such states, the social loss associated with foreign patent ownership surplus in such countries parallels a market failure due to an inadequate supply of public goods.[43]

We argue that there is a third overlooked display of social loss due to patent ownership. Labeled a Novelty trap, such social loss occurs under the Trade-Related Aspects of Intellectual Property (TRIPS)'s veil whenever prior art by a foreign patent is not patented locally within the priority periods set in the Paris convention. In such a case, the prior art generated by the foreign patent chills the local diffusive activity—an activity that is often innovative on its own. In many cases, such local inventive activity constitutes the diffusion of the foreign patent's underlying technology.

The international patent system may nevertheless offer latitude in novelty trap mitigation. National patent laws, as mentioned, mostly construe patentability in

[40] *See* Eugene Mattes, Michael C. Stacey, and Dora Marinova, Surveying Inventors Listed on Patents to Investigate Determinants of Innovation, 69 Scientometrics 475 (2006), at 483 (reviewing studies on patent commercialization concluding that approximately 43%-54% of patents get commercialized); See Alfonso Gambardella, Paula Giuri and Myriam Mariani, European Commission, The Value of European Patents: Evidence from a Survey of European Inventors, 39, 41 fig. 6.3 (2005), available at: http://www.alfonsogambardella.it/PATVALFinalReport.pdf (For a European Commission-funded survey that focused on "important" patents upholding that 38% of the patents were never commercialized); Subcomm. On Patents, Trademarks, and Copyrights of Comm. On the Judiciary, 85th Cong., An economic Review of the Patent System 12 n.60 (Comm. Print 1958) (Fritz Machlup). For the scope of developing countries, *see* Roya Ghafele and Benjamin Gibert, IP Commercialization Tactics in Developing Country Contexts, Journal of Management and Strategy Vol. 5, No. 2; 2014, at 2.

For a discussion on the various costs of patent commercialization, *see* Ted Sichelman, supra note 5, at 362-381 and sources therein (further proposing to create an entirely new form of patents, labelled as "commercialization patents" meant to reduce the risks associated with commercializing inventions);

[41] *See Id*., Roya Ghafele and Benjamin Gibert, at 3-4 & Table 1 (upholding that global licensing revenues remain unequally distributed across nations as the gap in licensing revenues is even stronger than the gap in patent ownership.)

[42] *Id*., at 6 & Table 2 (Indicating that in high-income countries $237,309,868,237 royalties received from licensing, whereas in middle-income countries the sum was $4,473,163,968 (1.18% of high-income countries) and in low-income countries it was $63,957,821) (a marginal rate of high-income countries)).

[43] The social surplus loss due to patent under commercialization is measured in the short term. *See* Jeffrey L. Bran, Turning Intellectual Assets into Business Assets, in From Ide Wisely in Intellectual Property 65, 78 (Bruce Berman ed., 2) (finding that market adoption occurs between by 3-5 years); Christoph Palmberg, The Sources of Success of Innovations - Determinants of Commercialization Technovation 1253 (2006) (commercialization times ranged from 2.5 to 4.1 years in the chemicals), at 1259 Table 4.

temporal, not spatial, terms. The advance is compared to the existing art to determine whether an advance, namely a potentially patentable technology, deserves protection. With novelty, if no reference describes the advance, it is considered novel. In most modern systems, the novelty requirement is universal or absolute. Namely, there must be no publication, patent, product, or process accessible anywhere globally, including all of the patented invention elements.

Yet, one could think of a different standard. In such a case, novelty, like other patentability criteria, could be measured relatively or locally against materials available within the inventor's country. That would include products and processes manufactured, practiced, or sold within the territory. For patents and publications, that could consist of local patents or publications, or even only patents and publications that describe inventions that are manufactured, practiced, or sold locally.

Consider, for example, our Russian industrialist farmer mentioned above. Serving both inventors in our model, the international patent system may continue to support the absolute novelty of the foreign patent owner in whichever country they patent lawfully. The foreign patent owner holding the original appropriation would constitute prior art. The latter would only be compromised by a local patentability standard used by a following in-state patentee, the Russian farmer, in our example. The local inventor could then receive a derivative patent appropriation assuring the incentive to diffuse the foreign patented technology locally.

Incentivizing technology diffusion underlies that diffusion is not only how innovation becomes useful as it spreads in society. It is, in fact, an intrinsic part of the innovation process itself. Same as original innovation, the following diffusion process incorporates learning, feedback effects, and imitation, which often are innovative per se, even if not always sufficiently so. In such a way, diffusion is said to enhance original innovation.[44] For entities that are "catching up," particularly laggard countries, diffusion can be an essential part of the innovative process.[45] R&D in laggard countries is often undertaken to monitor, assimilate, and modify competitor firms' technological advances in other countries.[46] There is, therefore, no clear-cut distinction between the kinds of activities and resources required for innovation and those needed for their diffusion. This presumable innovation-diffusion reverse causation, or endogeneity,

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[44] See, Bronwyn Hall, Innovation and Diffusion, In the Oxford Handbook of Innovation (Jan Fagerberg & David C. Mowery, Eds.) 459 (2006), at 459-460; Martin Bell & Keith Pavitt, The Development of Technological Capabilities 69, In Trade, Technology, and International Competitiveness (Irfan ul Haque, ed.), The World Bank (1995), at 92.

[45] See, Bronwyn Hall, Innovation and Diffusion, In the Oxford Handbook of Innovation (Jan Fagerberg & David C. Mowery, Eds.) 459 (2006), at 460. See, generally, Jan Fagerberg and Manuel M. Godinho, Innovation and Catching-Up, In the Oxford Handbook of Innovation (Jan Fagerberg & David C. Mowery, Eds.) 514 (2006).

[46] Denis De Melto, Kathryn McMullen, and Russel Wills, Innovation and Technological Change in Five Canadian Industries, Discussion Paper 176, Ottawa Economic Council of Canada (1980); Keith Smith & Tor Vidvei, Innovation Activity and Innovation Outputs in Norwegian Industry, STI Review 11 (Dec. 1992).

may justify combining the incentive to invent with a continuing incentive to diffuse, also based on the patent system.[47]

Prior art, consequently, would serve more than merely disclosing and hedging knowledge within the parameters of absolute or universal novelty and inventive step. It would also help to incentivize technology diffusion in laggard countries. That is by justifying a new form of IPR protection, which should be separately discussed.[48] Yet to be empirically assessed, such a solution may ultimately be Pareto optimal if no single inventor would be worse off. This dual patent appropriation model would economize on the costs of diffusion of locally unpatented foreign technology.

Social loss imposed by the prior art is already partially dealt with by the U.S. patent legal system. U.S. examiners are required to apply the "broadest reasonable interpretation consistent with the specification in the broad sense."[49] Consequently, granting deference to such broad interpretations, notably when the PTO lacks complete prior art information, may impose a questionable chilling effect on competitors. It may further undermine claim construction accuracy.[50]

In a narrower sense, the prior art is also assumed to chill communication between collaborators during the inventive process. Congress, to recall, amended the Patent Act in 1984, focusing only on secret prior art. In so doing, Congress created a safe harbor for some forms of the secret prior art by excluding materials passed among collaborators and co-inventors. The law excludes these materials from the definition of invalidating prior art.[51] As clarified in the bill's legislative history, new technology is often developed using background scientific or technical information known within an organization but unknown to the public. By disqualifying such background information from the prior art, the bill was said to "encourage communication among members of research teams, patenting, and consequently public dissemination, of team research results."[52] Beyond its secretive form, prior art underlies a broader chilling effect that

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[47] The relation between incentivizing innovation (through inflicting R&D costs) alongside incentivizing technology diffusion (through other costs such as design around, administrative, and even litigation costs) remains outside the scope of this article.

[48] *See* Rochelle C. Dreyfuss & Daniel Benoliel, supra note 2, (for a discussion on Diffusion patents, as a second-tier patents regime incentivizing technology diffusion), at 9-11.

[49] In re Bond, 910 F.2d 831, 833 (Fed. Cir. 1990) ("It is axiomatic that, in proceedings before the PTO, claims in an application are to be given their broadest reasonable interpretation consistent with the specification."). *But see* Michael Risch, The Failure of Public Notice in Patent Prosecution, 21 Harv. J.L. & Tech. 179, 180 (2007) (arguing for "the abandonment of the 'broadest reasonable construction' rule for interpreting claims in pending patent applications in order to enhance certainty in claim construction for those who rely on patents").

[50] Thomas Chen, Patent Claim Construction: An Appeal for Chevron Deference, 94 Va. L. Rev. 1165 (2008), at 1190–91, referring to Ian A. Lampl, Comment, Establishing Rules for Resolving Markman Failures, 72 U. Chi. L. Rev. 1025 (2005), at 1037-38.

[51] Patent Law Amendments Act of 1984, Pub. L. No. 98-622, 98 Stat. 3383, § 103 (codified as amended at 35 U.S.C. § 103) ("Subject matter developed by another person, which qualifies as prior art only under subsection (f) or (g) of section 102 of this title, shall not preclude patentability under this section where the subject matter and the claimed invention were, at the time the invention was made, owned by the same person or subject to an obligation of assignment to the same person.").

[52] Legislative History of the Patent Law Amendments Act of 1984, Section-By-Section Analysis of H.R. 6286, Patent Law Amendments Act of 1984, 130 Cong. Rec. H10525-529 (Oct. 1, 1984) (inserted by Representative Kastenmier, chairman of the Subcomm. on Courts, Civil Liberties and the Administration of Justice of the Comm. on the Judiciary), available at http:// ipmall.info/hosted_resources/lipa/patents/Legislative_History1984.pdf.

novelty traps further entail.

In theory, this idea moderately corresponds with Stanford economist Nathan Rosenberg's findings concerning parallel inventions. As Rosenberg explains, firms often remain with previous technologies long after the introduction of a new invention.[53] Technology adoption is usually an absorbing state, whereas the latest technology is rarely abandoned for an old one.[54] The reasons being either because of sustained improvements in the old technologies or because the new technology is insufficiently settled and reliable.[55] Rosenberg has thus found that like the hypothesis concerning our Russian farmer's soviet-era combine harvester vehicles, the water wheel continued to improve and develop long after the steam engine was on the market, and wooden sailing ships were still constructed long after iron-hull ships were obtainable.[56]

2) Technology Diffusion and Development

Most technological progress in developing countries derives from the adoption and adaptation of preexisting northern technologies.[57] In context, novelty traps coincide with suboptimal technology diffusion rates, particularly in developing countries. At the outset, as Dependency theory advocates initially led by Hans Singer,[58] Raúl Prebisch,[59] and others,[60] explain, developing countries are flatly perceived to be dependent on

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The result of the Federal Circuit's use of § 102(f) material as prior art for an obviousness rejection was a perceived chilling effect on team research. Congress was quick to reply. In 1984 Congress reacted to the judicial interpretation of how to fit § 102 into § 103 by passing the Patent Law Amendments Act. S. Rep. No. 98-663, at 5 (1984), reprinted in 1984 U.S.C.C.A.N. 5827, 5833. The CREATE Act resulted from the 1997 Court of Appeals for the Federal Circuit decision in OddzOn Products Inc. v. Just Toys Inc. This decision affected collaborative research programs, particularly collaborative research programs of universities and non- profit research institutes.

[53] See, Nathan Rosenberg, Inside the Black Box (Cambridge: Cambridge University Press, 1982), at 114-116; Nathan Rosenberg, Factors affecting the Diffusion of Technology, Explorations in Economic History (1972) vol. 10(1) 3.

[54] *Id*. See, also, Bronwyn H. Hall and Beethika Khan, Adoption of New Technology, NBER Working Paper Series Working Paper 9730 (May 2003), at 2.

[55] Nathan Rosenberg, Inside the Black Box, supra note 11, at 114-116.

[56] *Id*.; Nathan Rosenberg, supra note 53.

[57] *See,* The World Bank, Global Economic Prospects: Technology Diffusion in the Developing World (2008), https://documents1.worldbank.org/curated/en/827331468323971985/pdf/42097optmzd0REVISED0GEP020081PUBLIC1.pdf, at 15.

[58] See, Hans Singer, Gains and Losses from the Trade and Investment in Underdeveloped Countries (1950); Hans Singer, The South Letter no. 30, The Terms of Trade Fifty Years Later - Convergence and Divergence (1988). See, also, Rabah Arezki; Kaddour Hadri; Prakash Loungani; Yao Rao, Testing the Prebisch-Singer Hypothesis since 1650: Evidence from Panel Techniques that Allow for Multiple Breaks (2013).

[59] See, e.g., Raúl Prebisch, The Economic Development of Latin America and Its Principal Problems (United Nations Department of Economic Affairs, 1950); Raúl Prebisch, International Trade and Payments in an Era of Coexistence: Commercial Policy in the Underdeveloped Countries, 49 American Economic Review 251(1959), at 251–52. For a seminal Latin American perspective, *see* Fernando Henrique Cardoso and Enzo Faletto, Dependency and Development in Latin America 149–71 (Marjory Mattingly Uriquidi, trans.) (University of California Press, 1979).

[60] *See* e.g., Paul A. Baran, The Political Economy of Growth, New York: Monthly Review Press (1957); Andre Gunder Frank, Capitalism and Underdevelopment in Latin America: Historical studies of Chile and Brazil, New York: Monthly Review Press (1969).

developed ones, and freer trade is said to benefit impoverished countries in the "periphery." On their part, dependency theoreticians point towards the structural market and institutional barriers inhibiting catch-up in developing countries. Thus far, goes the theory, over-reliance on a handful of primary goods exports, unequal terms of trade, and high tariff barriers on manufactures in "core" economies were all implicated in continued poverty in the "periphery." Accordingly, far from providing an opportunity for developing countries to escape their peripheral status, technology helped sustain core-periphery divisions.[61] At no point, however, was the chilling effect of patents on innovation-based economic growth also considered. The concentration of technological innovation, ownership, and control in the core allowed developed economies to maintain their dominant position, implying a need for new regulatory corrective measurements such as those we insinuate. A seminal 2008 World Bank report supports this theoretical appraisal. Much of the technological progress in developing countries measured over two decades has been associated with increased openness during that same period. This openness has increased developing countries' exposure to foreign technologies, but as the World Bank explains, their capacity to absorb technology has improved much less.[62]

Developing countries are indeed characterized by low incomes resulting from low average productivity. This reflects their limited market and institutional capacity to create new or adapt and improve existing technologies.[63] Given global inequality, economists Sokoloff and Khan, and Engerman and Sokoloff,[64] add that a large middle class, rampant mostly in developed countries, also helped spur innovation from the demand side globally. This means that while low-income people could not afford much unnecessary consumption and high-income individuals tended to demand customized goods, the middle classes were oriented towards more standardized manufactures. Seen as yet another branch of industrial policy, the patent policy could henceforth possibly add to this developmental effort. The World Bank 2008 report's central dismaying finding on that account is that most developing countries cannot generate innovations at the technological frontier.[65] Instead, many developing countries with relatively advanced technical achievement levels primarily use an explicit policy of copying foreign technologies.[66] These even include more-able emerging economies such as Brazil, China, India, Mexico, Malaysia, as many others.[67] In most developing countries and sectors, R&D should thus focus much on adopting and adapting preexisting

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[61] Wesley Shrum, Science, Technology, and Development, In International Encyclopedia of the Social and Behavioral Sciences 13607 (N. J. Smelser and P. B. Baltes, eds.) (Oxford: Elsevier Science) (2001).

[62] *See,* The World Bank, supra note 57, at 13.

[63] *See,* e.g., Tilman Altenburg, Building Inclusive Innovation Systems in Developing Countries: Challenges for IS Research 33, In Handbook of Innovation Systems and Developing Countries (Bengt-Åke Lundvall and K. J. Joseph, Cristina Chaminade and Jan Vang, Eds.) (Edward Elgar, 2009), at 35.

[64] Stanley L. Engerman and Kenneth L. Sokoloff, Inequality, Institutions and Differential Paths of Growth among New World Economies, in Claude Ménard (ed.) Institutions, Contracts and Organizations: Perspectives from New Institutional Economics (Elgar, 2000), at 108.

[65] *See,* The World Bank, supra note 57, at 3 Fig. 2

[66] *Id.*

[67] *Id.*

technologies, not solely to expand the global technological frontier.[68] Patent law may well have a constructive role in incentivizing such R&D-related diffusing activity henceforth.

Moreover, the north-south technology diffusion gap is consistent with significant economies of scale and entry barriers among developing countries. Once such challenges are overcome and the technology diffusion rate increases, scaling up may occur relatively quickly.[69] The World Bank report shows that for the years 1975-2000, successful diffusion rates are the exception rather than the rule in developing ones. That is, while diffusion has occurred relatively rapidly among advanced countries. As the World Bank report shows, of the 102 country-technology pairings first recorded in 1975–2000, only 56 (55 percent) have reached the 25 percent threshold, and only about 35 (34 percent) have reached the 50 percent threshold. For developing countries, the pace (and extent) of diffusion is significantly slower (lower) than in high-income countries, with only 24 (36 percent) developing countries have reached the 25 percent threshold and only 6 (9 percent) having reached the 50 percent threshold.[70] As the World Bank report indicates, for technologies discovered during 1950-75, only a quarter of the developing countries that have achieved at least a 5 percent penetration level have gone on to reach the 25 percent threshold, and all of these are upper-middle-income countries.[71]

Lastly, the unevenness of technological diffusion across countries is often mirrored within countries, especially large ones. Remarkably, at the urban level, although technology spreads relatively rapidly among elites living in major cities, it takes much longer to find its way to the rest of the population or from top-performing companies to the average firm. Specific sectors in advanced urban centers in China and India, for example, use world-class levels of technology. Still, the incidence of these technologies elsewhere in the country and in rural areas, in particular, remains even lower.[72] The surprisingly low level of overall technological achievement in countries like China and India contrasts with popular perceptions based on some of the two countries' major cities and trading centers' relative technical sophistication. However, the same kind of technological diversity observed across countries is visible within countries as well.[73]

As a result, industrial policy, including international patent policy, should continuously focus on strengthening the infrastructure necessary to successfully diffuse and implement technologies for low-income countries. Industrial policy should further focus on facilitating the diffusion of existing technologies, lowering regulatory entry barriers, and developing domestic competencies.[74] From a patent policy perspective, the lack of advanced technological competencies in developing countries also means that undisturbed technological diffusion shall continue to occur by adopting and

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[68] *See,* The World Bank, supra note 57, at 12; Tilman Altenburg, supra note 63, at 35.
[69] *Id.*, The World Bank, supra note 57 at 90.
[70] *Id.*, at 90, Fig. 2.16.
[71] *Id.*, at 7.
[72] *Id.*, at 7 & Fig 7.
[73] *Id.*, at 90 and see box. 2.9 for the case of India.
[74] *Id.*, at 12.

adapting pre-existing new-to-the-market new-to-the-firm technologies.[75] Should such policies be reoriented from their current focus on R&D towards engineering capabilities, a patent reform would be desirable.

II. The Empirical Analysis

A. Methodology

1) Research Hypotheses and Testing Procedures

This research capitalizes on the quantitative statistical methodology, combining correlation and regression analyses for testing the research hypotheses. Descriptive analysis techniques are used for the visualization and presentation of data before quantitative analysis. The legal decision to move from local novelty to absolute novelty standard is supposed to trigger a shift in the behavior of different economic agents that may change specific vectors in innovation and economic performance nationwide. Such change may be twofold.

Firstly, the increased patentability standard may affect the patenting activity of residents by changing incentives to patent inventions.

Secondly, it may affect innovative performance by suppressing incentives to innovate. Mainly, novelty traps created by prior art may build barriers to knowledge diffusion and other innovation outputs that otherwise would not exist. Accordingly, two research hypotheses have been formulated:

a) Resident patenting activity firmly declines following the shift from a local to an absolute patentability standard. This result underlies a novelty trap.
b) Knowledge diffusion, funneled by knowledge creation, knowledge, and innovation outputs, decreases over time as it correlates with novelty traps created by the shift to a higher patentability standard.

The methodology applied in this research aims to test these two hypotheses in front of the zero hypothesis. The latter entails that a shift from a local to an absolute patentability standard does not significantly affect patenting, technology diffusion on the country level.

The empirical analysis first examines the behavior of the chosen time series over the time interval between the approval of absolute novelty patentability standard and the most recent values available. Second, it tests the correlations between such time series. Third, it applies the regressions of specific time series to other ones. Combining these techniques allows finding clear patterns in the relationships between time series and avoiding occasional coincidences.

75 *Id.*, at 3; Tilman Altenburg, supra note 63, at 35.

2) *The Variables and Data Sources*

The variables chosen for the empirical study comprise two types of time series. These are the patenting activity data, and technology diffusion performance data. These data are available in annual time-series format. The patenting data, including total residents-involved and non-resident patent applications annually filed in the country's patent office. These data are available at the Intellectual Property Office of New Zealand (IPONZ).[76]

a) *Patenting data*

The patenting data chosen for this study assesses IPONZ's patent applications filing. This is a primary choice since patent applications filing is a patenting activity that reacts directly to the changes in patent law. In contrast, patent granting reacts with a significant time lag which can reach few years. The time lag depends on the length of prosecution proceedings, which may vary from country to country. For example, USPTO data reveal a prosecution lag between filing an application and granting a patent between 2 and 3.5 years, whereas a mean value was 28.4 months and median value – 23 months. The lag depended on assignee type and technology fields and was less sensitive to applicants' origin. The shortest lag was for applications filed by firms in traditional technologies, like mechanical or electrical engineering. The most prolonged lag was for applications filed by hospitals and universities and for applications in pharmaceutical, biotechnology, and software technology fields.[77] Naturally, our patenting data are limited to filing in New Zealand by residents. Since filing patent applications abroad by New Zealand residents is largely unrelated to New Zealand's patent law. Hence, patent applications abroad by New Zealand residents are not expected to be affected by a change in New Zealand's patentability standard.

New Zealand's patent applications filing by office available from IPONZ counts patent applications annually filed in the national patent office by all applicants, either residents or non-residents. It accounts for three types of data. These include resident patent applications, wherein all the applicants are New Zealand residents, residents-involved patent applications, including at least one resident applicant, and non-resident applications filed by non-residents only. For the sake of this research, we chose residents-involved applications data. The latter is the most relevant category of patent application filling used to evaluate resident patenting activity. It is worth mentioning that the difference between residents-involved and resident application counts remains negligible.[78]

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[76] See, Intellectual Property Office of New Zealand (IPONZ), at: https://www.iponz.govt.nz/about-ip/patents/.

[77] See, David Popp, Ted Juhl & Daniel K.N. Johnson, Time in Purgatory: Determinants of the Grant lag for U.S. Patent Applications, MBER Working Paper 9518 (February 2003) at 35.

[78] For the period 2009 to 2020 the difference between residents-only and residents-involved patent applications in New Zealand was steady and counted below 2% of residents-involved patent applications. That is, more than 98% of residents-involved patent applications have been filed by residents, and only about 2% included foreign applicants.

For comparison, the non-resident patent applications count was chosen. The patenting activity data were taken over the period 2009-2020 to cover the entire period following the Patents Act 2013 and a sufficient time before it.

b) Knowledge diffusion and innovative performance and data

Knowledge diffusion and innovation performance-related indicators can be found in the World Intellectual Property Organization (WIPO)'s Global Innovation Index (GII) database. The data includes knowledge diffusion, knowledge creation, and output and innovation output annual scores. While patenting activity data are available for decades, GII scores were first recorded in 2007, and their scope has changed significantly until 2011. Since implementing the absolute novelty standard in New Zealand in 2014, these data account for the diffusion of technology and other innovative outcomes in New Zealand, as reflected in New Zealand's patentability standard reform. The Global Innovation Index aims to provide insightful data on innovation and assist economies in evaluating their innovation performance and making informed innovation policy considerations. The GII, co-published by Cornell University, INSEAD, and WIPO, reportedly allows economies to assess their innovation performance and design appropriate innovation and intellectual property (IP) policies.[79]

We have calculated three measures as follows:

1. The innovation input sub-index is capturing elements of the national economy that enable innovative activities.
2. The innovation output sub-index is indicating the results of innovative activities within the economy.
3. We have used the overall GII score, which stands for the average of the input and output sub-indices.

Each sub-index comprises individual indicators, whereas knowledge and technology output indicators constitute section 6 of the GII's output sub-index.

We've further chosen six indicators from the GII dataset. Three of them are integrated: the innovation input score, innovation output score, and overall GII score. Three additional indicators are composite: knowledge and technology output score, knowledge creation score, and knowledge diffusion score. These indicators altogether characterize knowledge output and diffusion within the country. They further measure the ability to create technological knowledge, diffuse it nationally, and transform it into the flow of competitive and export-oriented goods, services and ideas.[80]

[79] See, WIPO, Global Innovation Index (GII), at: https://www.wipo.int/global_innovation_index/en/.

[80] See, WIPO Global Innovation Index 2020 full report, at 354-360.

c) Analytical procedures and calculations

The first descriptive analysis stage, patenting activity data, knowledge, and innovation indicators, were charted as time series. That is, to visualize the changes following the transition to the absolute novelty standard. It should be taken into account that changes in all three sets of variables, if they took place, were expected to occur discursively for numerous reasons. First, part of the patent applications was already filed and counted in the year of change. Second, the Patents Act 2013 allowed filing patent applications according to the old patentability standard. Third, changes in knowledge diffusion, and innovation associated with patent law shifts might require time to occur. Finally, if such changes were associated with patenting activity, they may include a time lag of at least one year. So far, the changes related to both research hypotheses are expected to be observed between 2014 and 2015.

Further processing includes charting innovation and knowledge performance indicators versus residents-involved patent applications. Such procedure aims to reveal the co-incidence of changes in patenting activity with changes in knowledge diffusion, innovation performance-related to the difference in the patentability standard. This visualization also reveals trends in innovation, and knowledge diffusion compared to changes in patenting activity. It also allows unveiling the optimal patenting activity rates ensuring stable growth of innovative performance.

Finally, correlation and regression analysis was applied. A simple ordinary least square regression (OLS) model was chosen for this purpose. The residence-involved patent application count (P1) was selected as a single independent variable for regression analysis, while eight dependent variables were regressed. These dependent variables included five GII indicators, namely innovation output score (K1), knowledge and technology output score (K2), knowledge creation score (K3), and knowledge diffusion score (K4). Regression and correlation coefficients were calculated. The regression factors (slopes) were calibrated to show the change rate of each dependent variable per every 100 annual patent applications. The correlation and regression analyses were performed in two modes. The first connected innovation output, and knowledge diffusion with patenting activity data for the same year. Such contemporaneous correlation may indicate co-incidence between patenting activity, on one side, and knowledge diffusion, and innovation output on the other hand. These may stem from the common cause. Another model connects the same dependent variables with a one-year lagged residents-involved patenting activity, revealing a correlation that may indicate a specific patenting activity effect on knowledge diffusion. That is, albeit causality cannot be concluded from the correlation analysis. However, we believe that this analysis may reveal information on the hidden relationships between novelty traps and their effect on patenting activity, knowledge diffusion alongside innovation performance.

B. Findings

1) Novelty Traps Reduce Local Patenting Activity

According to the first research hypothesis, novelty traps are expected to affect a resident patenting activity within the country adversely. To evaluate the influence of the novelty traps, enhanced by the absolute novelty patentability standard, we've investigated New Zealand's patenting activity before the Patents Act 2013 and after its implementation. Filing patent applications is the patenting activity that is particularly prone to the immediate effect of novelty traps. Either country's residents or non-residents file patent applications to the country's patent office. There are also applications filed by residents and non-resident together. To reduce patent applications filing to a dichotomy, all such applications are considered residents. So far, the total patent applications count by the office is subdivided into residents-involved and non-resident patent applications. Fig. 1 and 2 represent these two types of patent applications, including patent applications filed according to the local novelty standard (1953 Act) and absolute novelty standard (2013 Act) and total count.

The relevant provisions of the New Zealand Patents Act 2013 came into effect on 13 September 2014. As the resident patent rates in Fig. 1 below indicate, the 1953 Act continues to apply. That is, to all complete applications, national phase entries, and convention applications filed before 13 September 2014, which is the date when the 2013 Act came into effect. The application of the old Act includes applications divided from there. Together, the new Act applies to all complete applications, national phase entries, and convention applications filed on or after 13 September 2014, except for applications divided from a 1953 Act case, which remain under the old Act.

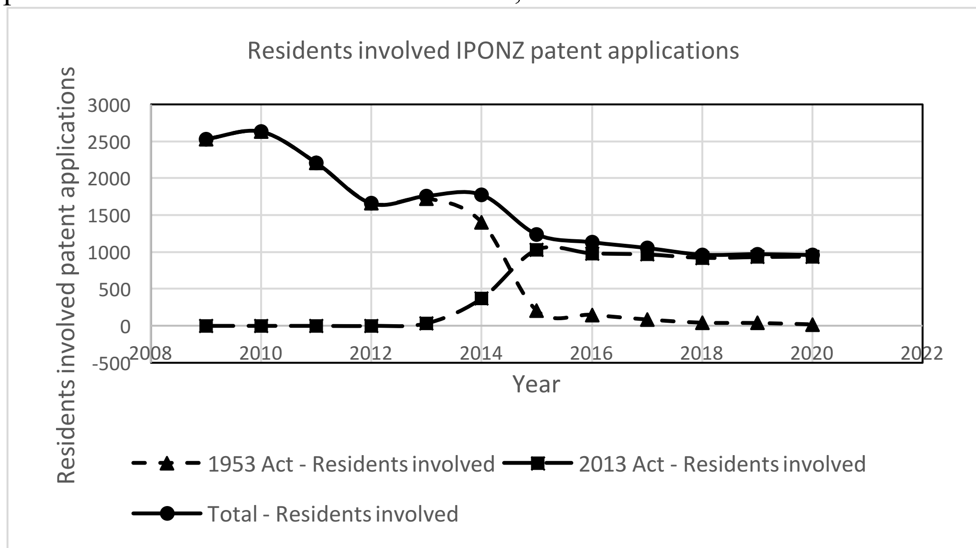

Fig.1. Residents involved IPONZ patent applications filed according to local novelty (1953 Act) and absolute novelty (2013 Act)

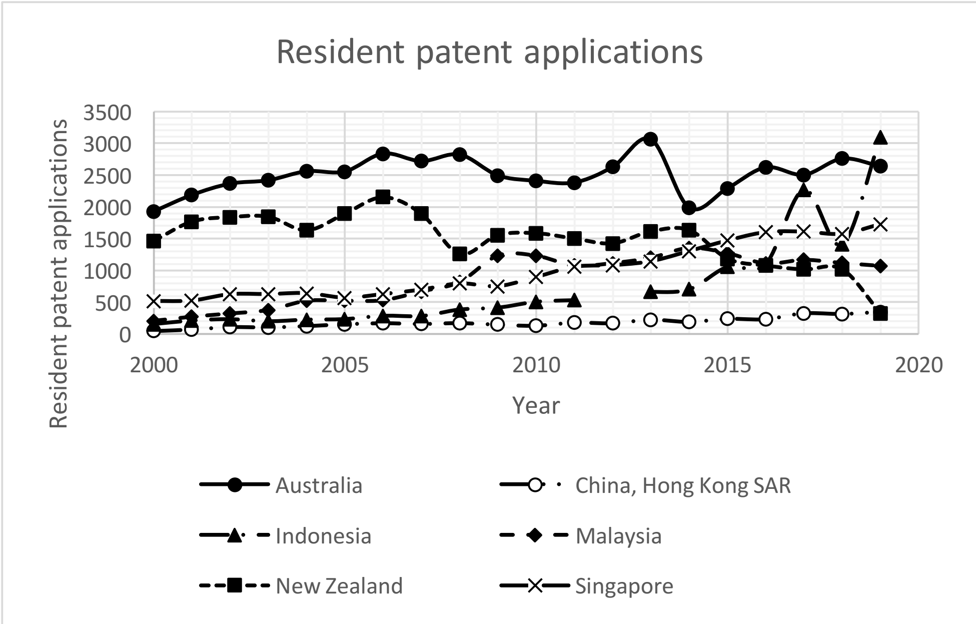

Fig.1a. Resident patent applications filed according in six South-East Asia and Oceania countries in 2000-2019

As follows from Fig. 1, since 2013, we recorded a sharp decrease in residents-involved patent applications filing according to the local novelty standard. The decline is then accompanied by an impressive, albeit less intense, increase in patent applications filed according to the incoming absolute novelty standard. As the graph indicates, the number of applications still proceeding under the 1953 Act unsurprisingly declined. Yet, the number of patents granted under the 2013 Act has not increased at a comparable rate. As a result, the total count of residents-involved patent applications demonstrated a significant decrease. So much so, between 2010 and 2012. This has been followed by a plateau reached in 2013-2014 on 1700-1800 applications annually.

The patenting rates fell steeply to approximately 1200 applications in 2015 and to below 1000 applications by 2018. The overall reduction in residents-involved patent application in New Zealand in 2020 was exceptional and stood out also regionally. The rate of reduction amounted to 70% as compared to 2013. For the same period the number of resident patent application in Australia has actually not changed (except anomalous increase in 2013), in Malaysia remained stable until 2019, in Singapore it increased by 51%, it doubled in Hong-Kong and in Indonesia. The comparison of resident patent applications filings in the countries of South-East Asia and Oceania over the period of 2000-2019 are presented in Fig. 1a below.

Moreover, in 2013 the number of applications filed in New Zealand according to the 1953 Act increased by one-hundred, and in 2014 decreased by three-hundred and fifty. An equal increase followed this in filing according to the 2013 Act. This finding validates the increased motivation to file according to the old standard at the eve of the reform. The decrease of 2014 filing may be related to the incomplete year available for filing according to the old standard. In fact, in 2014, during approximately seventy percent of the calendar year until the deadline of filing according to the 1953 Act, the number of residents-involved patent applications filed according to the local novelty standard was roughly eighty percent of the 2013 count. It seems that resident applicants strategically used the opportunity to file patent applications according to the old standard until the last moment.

Article 64 of the 2013 Act introduced a new system under which examination does not commence until and unless expressly requested by the applicant, with payment of an additional examination fee. The examination request can, in theory, be delayed by up to five years from the original complete filing date. In principle, this could have accounted for a delay in examining new 2013 Act cases, followed by a consequent temporary drop in the number of granted patents. Nevertheless, while the new Act brought New Zealand into alignment with nearly all other patent offices, the significant resources it requires is likely causing a substantial backlog of patent prosecution.[81]

Yet, as the IPONZ database shows, grant rates did not return to 1953 Act levels, given that the arrival rate of new applications has remained relatively consistent. This trend might be understandable. That is as foreign applicants file in New Zealand only as part of wide global filing of high valuable and strategic patents.[82] The most obvious case study of this strategic filing is the very large proportion of foreign applications in the pharmaceutical sector.[83]

Current timeframes for commencement of examination following a request do not seem undue. These range from 4.5 months for mechanical inventions up to 10 months for biotech inventions.[84] Thus, delays of this extent do not account for the drop in New Zealand's resident patent grants all told.

[81] Clarivate Analytics IP Consulting, Survey of New Zealand Patent Activity, Clarivate Reference: 18250, at 8. Higher examination fees were consequently raised with the intent to cover the increased examination effort required under the Patents Act 2013. *See* Warren Hassett, supra note 14, *Id*.

[82] *See* Clarivate Analytics IP Consulting, *Id*., at 5.

[83] *Id*., at 8.

[84] See, IPONZ, Timeframes: Processing times for applications and correspondence, at: https://www.iponz.govt.nz/support/timeframes/ (offering estimates that are updated every three months, and are current as of 16 April 2021); Mark Summerfield, New Zealand Patent Filing Data Shows a Two-Decade Decline in Applications by Domestic Residents, *Patentology*, (18 March 2020).

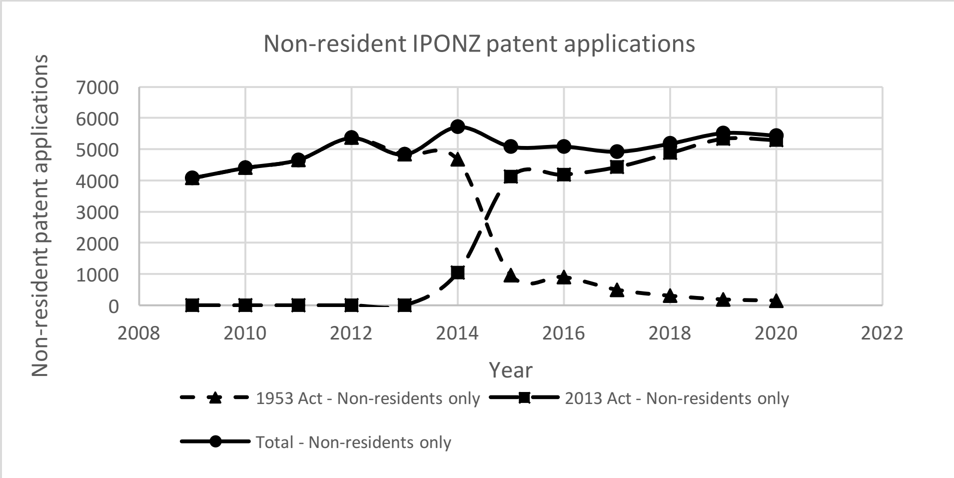

Fig. 2. Non-resident IPONZ patent applications filed according to local novelty (1953 Act) and absolute novelty (2013 Act)

A question remains: are New Zealand's declining resident patent rates comparable, and possibly related, to neighboring Australia's? Indeed, since 24 February 2017, patent attorneys in Australia and New Zealand have been subject to a single regulatory regime. Henceforth, all are to date 'Trans-Tasman' patent attorneys, qualified and registered to practice in both countries.[85] This transformation, however, did not affect the distinct resident filing patterns in both countries. Earlier on, moreover, on 15 April 2013, Australia's Intellectual Property Laws Amendment (Raising the Bar) Act 2012 came into effect.[86] The modifications it offered were intended to increase the quality of granted patents by aligning Australian patentability standards with its leading trading partners.[87] The new laws partly reformed the inventive step standard. They also relate to the sufficiency of utility/usefulness,[88] descriptive support (formerly, "fair basis"),[89] prior use,[90] or the allowability of certain exemptions to patent infringement.[91] This is

[85] See, the Trans-Tasman IP Attorneys Board, established as a statutory body under section 227A of the Australian Patents Act 1990 and constituted under the country's Patents Regulations 1991, at: https://www.ttipattorney.gov.au.

[86] Intellectual Property Laws Amendment (Raising the Bar) Act 2012 (No. 35, 2012).

[87] Explanatory Memorandum to the Intellectual Property Laws Amendment (Raising the Bar) Bill 2011, Schedule 1.

[88] Intellectual Property Laws Amendment (Raising the Bar) Act 2012, Sec. 7A. Under the amended law, an invention is taken not to be useful unless a specific, substantial and credible use for the invention (so far as claimed) is disclosed in the complete specification. The disclosure "must be sufficient for that specific, substantial and credible use to be appreciated by a person skilled in the relevant art".

[89] Patents Act 1990 No. 83, 199O, Sec 40(2)(a) requiring enablement across the full width of the claims. The wording is similar to article 83 of the European Patent Convention (EPC), 1973.

[90] Patents Act 1990 No. 83, 1990, Sec 7 & schedule 1 (definitions of 'prior art base' and 'prior art information').

[91] These amendments present new sections 119B and 119C to the Patents Act, providing exemptions to patent infringement in the events relating to acquiring regulatory approval and launching experimental research.

notwithstanding Australia's patent rates by residents' stagnation in the last few years,[92] with poor outcomes achieved by self-represented applicants.[93] New Zealand's resident patent rates, on the other hand, witnessed a drastic decline. Yet, unlike in New Zealand, the Australian patent reform's effect on patenting activity was thus minor.[94] Readily available data on patent examination activity does not furnish evidence of significant shifts in outcomes since the reforms began. The ratio of accepted applications following examination and the number of revisions made by applicants to achieve acceptance have narrowly changed.[95] Despite raising patentability standards, the Australian patent reform has had negligible impact on the probability that an examined application will be accepted. Standard practice throughout Australia's local industry seems to have been that applicants were encouraged to request examination of any pending Australian patent applications prior to the deadline. Applicants were also encouraged to bring forward the filing of international phase applications, divisional applications, etc. and to capture these as old Act cases by requesting examination prior to the deadline.[96] Moreover, it seems as though Australian patent applicants took heed of the advice they were given; IP Australia was apparently overloaded with approximately 22,000 examination requests in the month leading up to the deadline.[97]

Given New Zealand's rates, Fig. 2, moreover, offers the pattern regarding non-resident patent applications. The total count appears to remain consistent on approximately 5000 applications per annum and even increases. Such tendency is seen from Fig. 3, summarizing total patent applications filed by residents and non-resident. Residents-involved patent applications count abruptly on the background of steady non-resident application count, keeping the values preceding 2013. Moreover, the gap between non-resident and residents-involved patent application counts has increased sharply since 2015.

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[92] From 2009 to 2019 the number of Australian patent applications filed by Australians barely varied from around 2500 per year. Australians actually file more US patent applications than they do Australian applications, however these numbers are also stagnant, fluctuating around 3700 applications over the same eight-year period. See, WIPO IP Statistics Data Center, WIPO statistics database. Last updated: January 2021.

[93] Australian Productivity Commission (PC, *Inquiry into Australia's Intellectual Property Arrangements* (Final report) (20 December 2016).

[94] *See*, e.g., Mark Summerfield, Raising the Bar Has Not Reduced the Patent Acceptance Rate in Australia, Patentology, (17 November 2021) ("Data on patent acceptances into 2021 confirms that the Intellectual Property Laws Amendment (Raising the Bar) Act 2012…has had a minimal impact on the rate of patent application acceptance in Australia"); Gareth Dixon, Australia: Has "Raising the Bar" actually raised the bar on inventive step,? Mondaq (05 March 2017).

Specifically, considering inventive step, the amendment upheld that PHOSITA understands and regards the prior art as relevant. Yet, only the requirement that a document be ascertained has been removed. *See* IP Australia, Patent Manual of Practice & Procedure, section 2.5.2.5.1 "Ascertained". In addition, the assessment of PHOSITA's common general knowledge is no longer restricted to that which would be considered as such in Australia, and the assessment formally became an international one. *Id*. As Dixon confirms, under the old Act, the geographical limitation upon the prior art "was seldom, if indeed ever invoked." Gareth Dixon, *Id*.

[95] In the years prior to the patent legislative reform acceptance rates had been rising, from just under 70% in 2009/10 to 72% in 2012/13. Following the transition period, acceptance rates of post-reform cases have settled at a fairly steady level between 74% and 75%. *See* Mark Summerfield, *Id*.

[96] Gareth Dixon, supra note 94.

[97] *Id*.

At first glance, it may look surprising that the non-resident patent applications count remained steady despite the change in patent law. However, foreign applicants typically do not target IPONZ specifically. They file applications to bigger, more significant, patent offices, prosecuting under absolute novelty standards. We suggest that also before 2013, non-resident applications in New Zealand were filed according to absolute novelty. So far, there was no reason for the change in non-resident applicants' behavior.

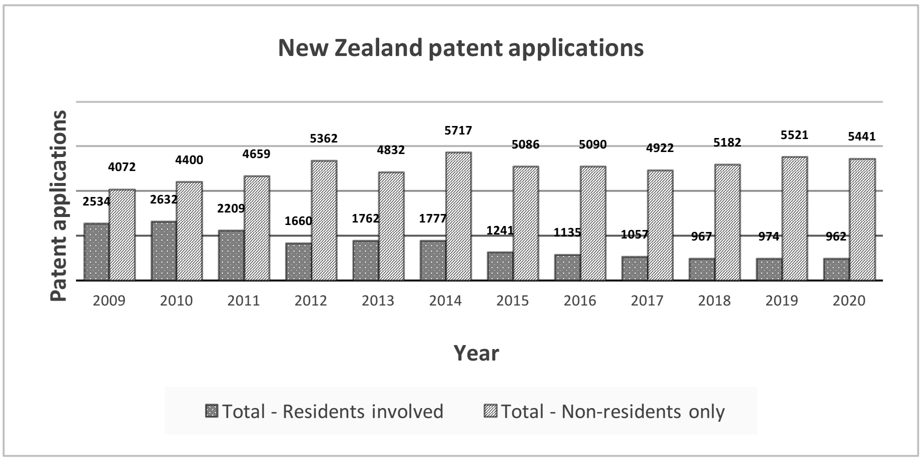

Fig. 3. Total count of residents-involved and non-resident IPONZ patent applications filed in the last decade

Additionally, Fig. 3a below depicts non-resident patent applications filing in six regional South-East Asia and Oceania countries, including New Zealand, during 2011-2020. In all these countries, a coherent steady growth behavior of non-resident patenting activity is observed. Non-resident patenting is not specifically dependent on absolute or local novelty, non-obviousness or other patentability standard criteria, since non-resident patent applications in those countries are usually not primary applications, but rather a national phase entries. Respectively primary applications are filed elsewhere according to absolute novelty standard applied by major legislations. With regard to non-resident patenting activity there is no difference between New Zealand and other countries of the region.

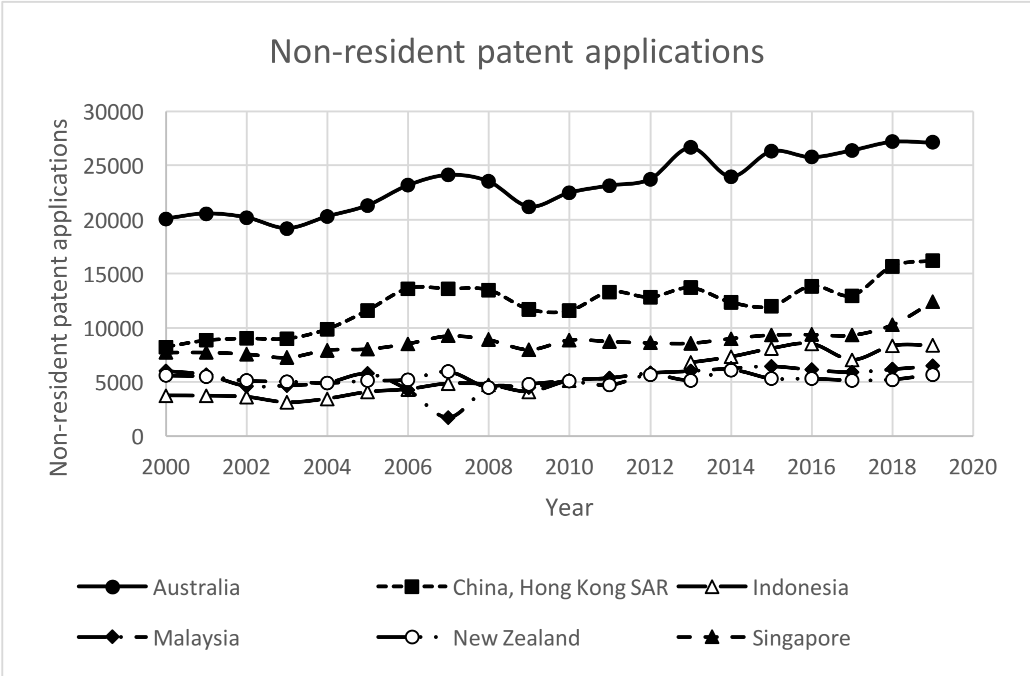

Fig. 3a. Non-resident patent applications in six South-East Asia and Oceania countries over 2000-2020.

These findings, therefore, support the first research hypothesis that novelty traps chill residents-involved local patenting activity primarily.

2) Technology Diffusion Diminishes with Novelty Traps

According to the second research hypothesis, novelty traps may reduce the innovation potential of local inventors and firms in New Zealand by creating barriers in technology and knowledge diffusion. The policy ramifications of this hypothesis are potentially radical as they question the efficiency of the standard of 'absolute novelty' in incentivizing inventive activity, especially in underdeveloped countries where technology diffusion through incremental midlevel invention is critical. Therefore, it is probable that New Zealand's novelty traps intensify in developing countries where technology diffusion is costlier in adapting state-of-the-art technology to becoming 'good enough' midlevel technology, such as in our Russian industrialist's example.

In order to examine this hypothesis, the behavior of technology diffusion-related indicators was investigated over the years 2013-2020 and juxtaposed with residents-involved patenting activity for the same time period. Fig. 4 summarizes technology-related input and output scores of the Global Innovation Index for New Zealand. As follows from Fig. 4, while innovation input scores remained essentially constant between 2013 and 2020, innovation output scores slumped over the same period. So, did knowledge creation, knowledge and technology outputs, and knowledge diffusion indices. Such behavior strengthens the assumptions that novelty traps may significantly impede knowledge diffusion.

When the same indicators were juxtaposed with residents-involved patenting activity data, the depiction shown in Fig. 5 appeared. While innovation inputs seem insensitive to patenting activity, the output scores demonstrate strong dependence. Generally, as follows from Fig.5, innovation outputs and knowledge diffusion indicators tend to rise with the increase in residents-involved patenting activity, reaching maximum values at the level of 1500-1600 patent applications annually filed. This was the level of resident patenting activity in New Zealand prior to the 2013 Act that imposed the absolute novelty standard. Since 2015 patenting activity of residents in New Zealand shrunk to 1000-1200 patent applications per annum, which is evidently suboptimal with regard to knowledge diffusion. These findings support the hypothesis that novelty traps may create barriers, impeding knowledge diffusion chilling local resident patenting activity. Such barriers are assumingly related to reduced incentives of local innovators to file patent applications according to the absolute novelty standard. That is, as such, patent applications are unable to defend incremental improvements that were patentable on the basis of local novelty standard. Such inventions were deemed non-patentable given the absolute novelty standard. The inability of the country's firms to defend a great share of their innovations, in turn, may impede knowledge diffusion as will be analyzed in the following section.

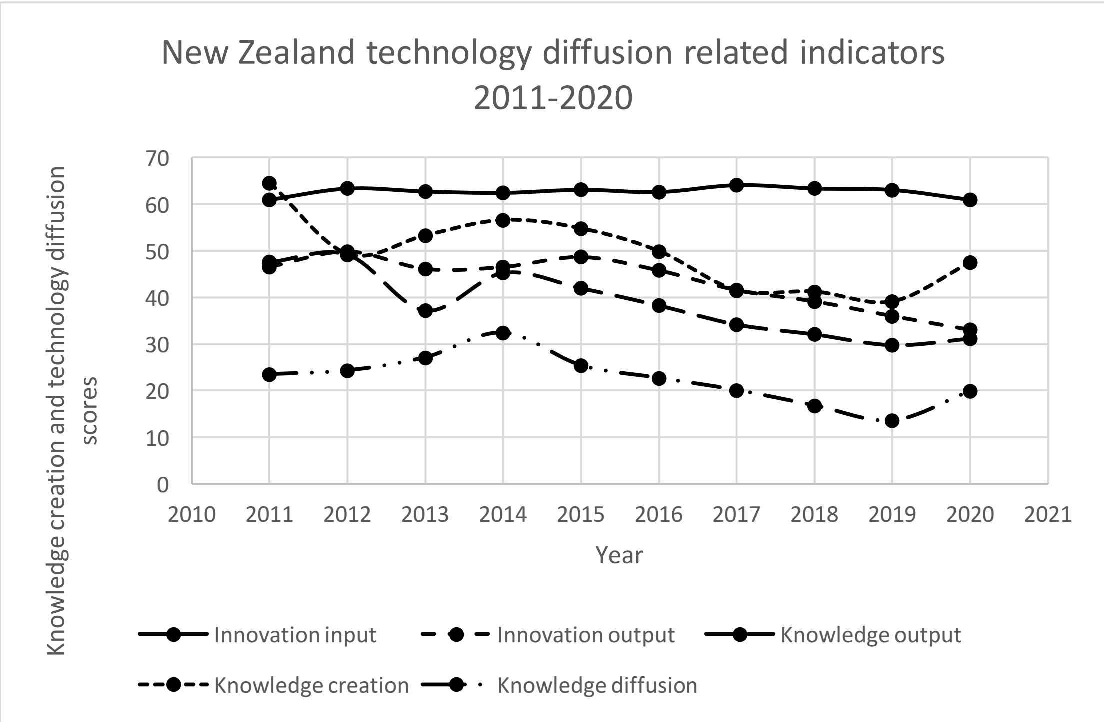

Fig. 4. New Zealand knowledge diffusion and innovation output scores (according to Global Innovation Index (GII))

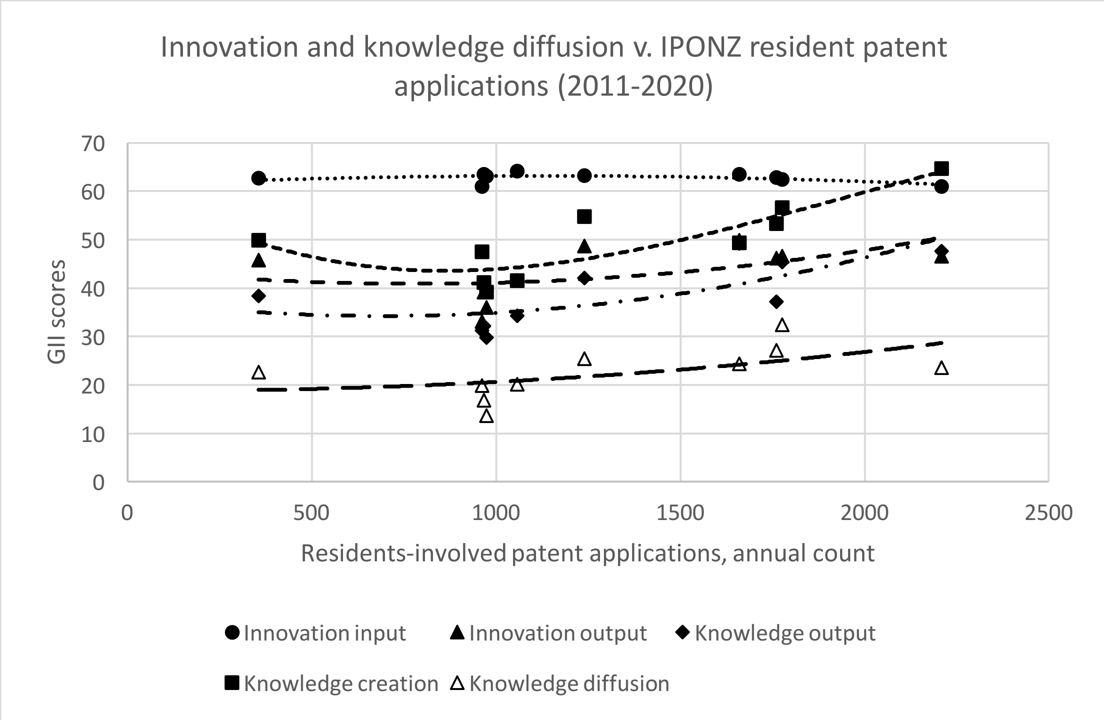

Fig. 5. New Zealand innovation and knowledge diffusion scores (according to Global Innovation Index (GII)) v. residents-involved patent applications

The diffusion of technology, ideas and practices from frontier firms to other firms may be particularly important in New Zealand albeit an advanced economy. That is given the country's remoteness from foreign markets and weaker international connections.[98] New Zealand domestic patent applicants continue to file heavily in technologies such as agriculture and food, industrial engineering, and civil engineering, especially for local building materials. This pattern of technologies suggests that New Zealand's patent activity focuses on primary industries with a domestic focus.[99] Whereas for foreign source New Zealand activity is heavily pharmaceutical and biotechnical in nature, in New Zealand itself, industrial, agricultural and civil engineering disciplines dominate.[100] With high technology disciplines such as IT, telecommunications, semiconductors and biotechnology relatively low in the volume, this reveals that patented innovation from New Zealand is more primary domestic industry focused.[101] This underlies the arguable relation between New Zealand's local patenting rates and its reliance on technological diffusion of foreign technology normally catered by local patenting activity respectively.

[98] New Zealand Productivity Commission, New Zealand firms: Reaching for the frontier: Final Report (April 2021), at 43 & Box 2.1.

[99] Ian Finch, IPONZ Report investigates the Nature and Source of patenting activity in New Zealand. But does it reveal the Secrets of Success? (24 September 2021).

[100] Clarivate Analytics IP Consulting, supra note 81, at 24.

[101] *Id.*

Yet, in its 2021 report *New Zealand firms: Reaching for the frontier: Final Report,* the New Zealand's Productivity Commission considers the "technology diffusion machine" to be "impaired or broken."[102] To a possible extent New Zealand's sharp decline in resident patenting rates can account for that observation, all told.

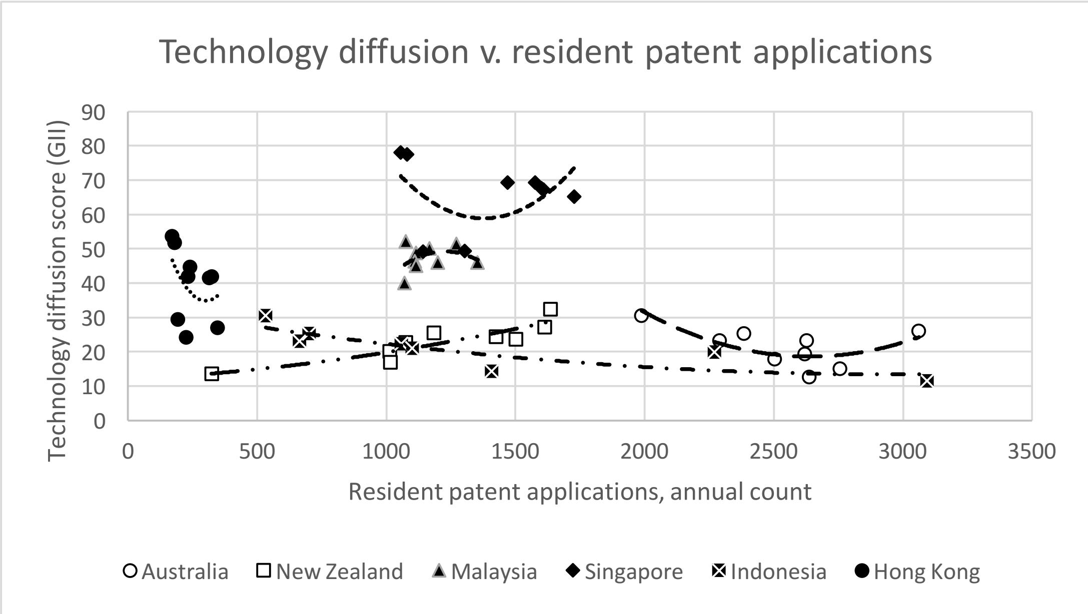

Fig. 5a. Relationships between technology diffusion and resident patent applications for six South-East Asia and Oceania countries

Fig. 5a shows correlations between resident patent applications filed annually and technology diffusion score as defined by GII over the period 2013 – 2020 for the six discussed regional countries. It can be seen that for all the countries except New Zealand the technology diffusion index is either indifferent or decreasing with the increase of resident patenting activity. Only for New Zealand almost a linear growth of technology diffusion score is observed with an increase in resident patent application fillings. These findings are supported by correlation analysis in the Appendix (Table 3), showing strong correlation for New Zealand and insignificant for its regional neighboring countries. We suggest that such strong correlation for the specific country at a specific time may evidence the existence of a common reason for negative tendencies in resident patenting activity and technology diffusion. Such reason may be the substantive reform in its patent law with a transition to the absolute novelty and non-obviousness requirements.

C) Theoretical Ramifications

Economic theory on technology diffusion disregards the international patent system's role in increasing technology diffusion rates. So much so, as foreign patent owners' choice to avoid patenting their inventions overseas impacts the diffusion of that technology, especially in developing countries given their low diffusion rates. A core

[102] New Zealand Productivity Commission, supra note 98, at 43 & Box 3.2.

question remains: Do markets offer an alternative? If markets and institutions had operated efficiently in such countries, technologies would have been diffused optimally, and corrective pro-innovation regulation would be redundant. Markets and institutions in developing countries remain nevertheless suboptimal in diffusing technology. Hence our suggestion for the patent system to add to the overall industrial policies focused on physical and human capital. A patent reform such as we suggest would be one more industrial policy to diffuse technology in such countries. In optimal conditions, markets could benefit from patent policy in diffusing foreign technology. Market conditions, however, are far from optimal, as shall be described below. Thus, the concern over the integration (and possible reverse causality) between markets and patent policy through diffusion patents would justify a future empirical assessment.

Although growth economic theory relates technological change to R&D investments or the generation of new technologies, it is only when these new technologies are diffused that their benefits are realized. Given developing countries, diffusion of foreign technology is a long, drawn-out process involving adopting and applying new technology by a growing share of firms. Should the regulatory solution discussed herein be optimal, one needs to possibly refute the global market regulatory alternative further. In context, economic growth theory disagrees as to why firms adopt innovations at different times. The theoretical literature identifies several potential determinants of the adoption choice. However, we still lack a systematic empirical evaluation of these factors. Most of the empirical studies focus on a specific technology and short cross-country or cross-industry comparisons. The observed variables that cross-country technology adoption economic theories offer in explaining cross-country adoption disparities are thus incomplete. So is the precise impact of prior foreign art on technology diffusion in developing countries given the current vague theoretical setting.

The economic theory focuses on factor endowments measured as part of conventional production factors, namely physical and human capital. Thus, absorptive capacity is mainly said to depend on the overall macroeconomic and governance environment. These are said to influence entrepreneurs' willingness to take risks on new-to-the-country and new-to-the-market technologies, basic technological literacy, and advanced skills in the population, determining a country's capacity to undertake the research necessary to understand, implement, and adapt them.

Also, because firms are the primary mechanism by which technology spreads within an economy's private sector, the extent to which financing for innovative firms is available - through the banking system, remittances, or government support schemes—also influences the time to and speed with which technologies are absorbed. Given developing countries' suboptimal diffusion rates, economic growth theory still arguably disregards the global regulatory system's role in increasing technology diffusion rates. It remarkably discounts the part of the international patent system in the following ways.

Two groups of theories have to date evolved in this backdrop, focusing on the firm and country level. The first is known as the learning or epidemic models, following the seminal work of Harvard economist Zvi Griliches in his seminal study of the economic determinants of the diffusion of hybrid corn in 1957.[103] Edwin Mansfield then followed Griliches' work on the diffusion of innovations in the coal, iron and steel, brewing, and railroad industries.[104] In epidemic models, consumers can have identical tastes, and the cost of new technology can be constant over time. Still, not all consumers are informed about the latest technology at the same time. Because each consumer learns about the technology from their neighbor, as time passes, more and more people adopt the technology during any period, leading to an increasing adoption rate. Eventually, however, the market becomes saturated, and the rate decreases again. Thus, technological adoption seemingly proceeds slowly, accelerating as it spreads throughout the potential adopters, and then slowing down as the relevant population becomes saturated. This, in theory, generates an S-shaped curve for the overall diffusion rate.[105] Each phase's length can significantly vary, from one technology to another, and for similar technology, from one country or one region to another. In advanced countries, present-day explanations for this stoppage include the slow pace of improvement in an economy's ability to absorb new technologies as determined by the level of human capital, the governance structure, and the infrastructure.[106] However, to date, little or no thought has been given the role of industrial IP in technological adaption rates at either the firm, country, or cross-country level. Neither have epidemic models conceded the impact of opportunity costs by novelty traps on technology diffusion or the reverse correlation.

The second group of technological diffusion models overriding the role of IP are known generically as the *economic models*. Accordingly, firms adopt technologies at different rates because they differ concerning various organizational and environmental variables influencing the economic returns from adoption.[107] The critical point is that firms that expect to enjoy higher net returns to adoption are assumed to implement the new technology before their lower expected net returns.[108] The technological diffusion principle applied internationally predicts that new technology will be best adopted in developed economies by both theories. Accordingly, firms in developed economies are systematically viewed as better able to absorb any losses from adopting new, innovative

[103] Zvi Griliches, Hybrid Corn: An Exploration in the Economics of Technological Change, Econometrica, Vol. 25(4) 501 (Oct., 1957).

[104] Edwin Mansfield, Technical change and the rate of imitation. Econometrica 29, 741 (1961).

[105] Bronwyn H. Hall and Beethika Khan, supra note 12, at 2.

[106] Peter Howitt and David Mayer-Foulkes, R&D, Implementation, and Stagnation: A Schumpeterian Theory of Convergence Clubs, Journal of Money, Credit, and Banking 37 (1) (2005); Peter J. Klenow and Andrés Rodriguez-Clare, Externalities and Growth, Working Papers Series 11009. National Bureau of Economic Research, Cambridge, MA. http://www.nber.org/papers/w11009 (2004); Daniel Lederman and Laura Saenz, Innovation and Development Around the World, 1960–2000, Policy Research Working Paper 3774., World Bank, Washington, DC (2005); The World Bank, supra note 57, at 87.

[107] Allen Blackman, The Economics of Technology Diffusion: Implications for Sustainable Development, Discussion Paper 99-42. Washington, D.C.: Resources for the Future (1999); Norman Ireland and Paul Stoneman, Technological Diffusion, Expectations and Welfare, Oxford Economic Papers 38(2), 283 (1986).

[108] Relevant factors here include the country's human capital endowment, type of government, degree of openness to trade, and adoption of predecessor technologies. *See* e.g., Diego Comin and Bart Hobijn, Cross-country Technology Adoption: Making the Theories Face the Facts, Journal of Monetary Economics Vol. 51, 39 (2004), at 61-61.

technologies due to their superior financial resources.[109]

Yet, while many accept that developed economies may be best-placed to adopt new technology first, it has also been suggested that developing countries' late-industrialization status means that they are generally well-positioned to diffuse new technology more rapidly. Underlying this belief stands a fundamental assumption developed by Alexander Gerschenkron. The assumption underlies "technology gaps" between technologically-edged economies, developed economies, and laggard developing countries. The "advantage of backwardness" conferred on technological laggards, of which Gerschenkron analyzed continental Europe and Russia. He concluded that developing countries enjoy enormous economic growth opportunities based on first-comer developed countries' technological advances.[110] This was best achieved directly through Foreign Direct Investment (FDI) and technology purchases via imports, licensing arrangements, etc. Besides, the advantage of backwardness was said to be based indirectly on knowledge spillovers of innovative technology.[111] The indications of knowledge spillovers were imitation through reverse engineering and the transfer of know-how from people's movement between firms.[112] Either way, a strong assumption was that developing countries could acquire modern technology innovated in developed economies. Often, at a fraction of the original R&D costs, which is high-priced, thereby leapfrogging many decades of technological progress.[113] The "advantage of backwardness" ultimately may underlie the allocation of diffusion patents, especially in developing countries, as a novel industrial policy. Global disparities in science and technology (S&T) capacity support this industrial choice especially for underdeveloped countries. In terms of both input and output, R&D spending by the 29 countries of the Organization for Economic Cooperation and Development (OECD) in 1998 was more significant than the world's 61 poorest

[109] Sanjaya Lall, Technological Capabilities and Industrialization, *World Development* 20 (2) 165 (1992); Everett M. Rogers, supra note 63; Martin Bell and Keith Pavitt, Technological Accumulation and Industrial Growth: Contrasts between Developed and Developing Countries 83, In Technology, Globalization and Economic Performance (Daniele Archibugi and Jonathan Michie, eds.) (Cambridge University Press, 1997).

[110] See Alexander Gerschenkron, Economic Backwardness in Historical Perspective (Belknap Press, 1962); Alexander Gerschenkron, Economic Backwardness in Historical Perspective, in The Progress of Underdeveloped Areas (Bert F. Hoselitz, ed.) (University of Chicago Press, 1971).

It was not until the late 1970s that the technology gap standpoint was revived, leading to the so-called "technology gap" theory in modern innovation theory literature. In this later conceptual stage, the literature widely explored the catching-up process by lagging countries. *See* John Cornwall, Modern Capitalism: Its Growth and Transformation (London: Martin Robertson, 1977); Moses Abramovitz, Rapid Growth Potential and Its Realization: The Experience of Capitalist Economics in the Postwar Period, in 1 Economic Growth and Resources 191, Edmond Malinvaud, ed. (1979).

[111] Martin Bell and Keith Pavitt, supra note 73; Roger Hayter and David W. Edington, Flying Geese in Asia: The Impacts of Japanese MNCs as a Source of Industrial Learning, Tijdschrift voor Economische en Sociale Geografie 95 (1):3-26 (2004)

[112] AnnaLee Saxenian, Regional advantage: Culture and Competition in Silicon Valley and Route 128, Cambridge, MA: Harvard University Press (1996); Peter Dicken, Global Shift: Reshaping the Global Economic Map in the 21st Century (4th ed., London: Sage Publications) (2003).

[113] David J. Teece, Firm Capabilities and Economic Development: Implications for the Newly Industrializing Economies, In Technology, Learning and Innovation: Experiences of Newly Industrializing Economies, eds. L. Kim and R. R. Nelson, 105-128. Cambridge: Cambridge University Press (2000).

countries' total economic production.[114] It is further evident that developing countries are incapable of increasing indigenous R&D capacity without increased financial and human resources.[115] Supporting this optimism, proponents traditionally point to Asian success stories such as Japan, South Korea, and Taiwan, whose rapid post-war growth was rooted in the successful acquisition, imitation, and copying of technologies initially developed in industrialized economies.[116]

Measuring the adoption of new technologies at the country-level, growth theory traditionally offered four "latecomer advantage" economic models. Initially constructed for advanced economies, all four models were also wrongly assumed to prevail across the north-south divide flatly. The first considered workhorse of most macroeconomists that try to understand the adoption of new technologies is the *vintage capital model*. Most vintage capital models, like those by neoclassical growth theoreticians Johansen,[117] Solow,[118] in the early 1960s, or Gilchrist and Williams,[119] and Laitner and Stolyarov,[120] and later in the early 2000s - imply or assume that firms or countries do only invest in frontier technology.[121] This would mean that new technologies instantaneously dominate existing ones.[122]

Moreover, various technologies are known to have very long implementation lags. Differences in these lags across countries could, in theory, explain an essential source of technology adoption disparity. Thus far, the vintage capital theory has not accounted for these differences even within advanced countries since it assumes that these lags are zero.[123] Due to their late start in industrializing, many developing countries have yet to install significant corrective measures such as these suggested in the article. This means that such countries can readily select between competing technologies according to their expected returns and adopt the new technology as an integral part of capital expansion.[124] Until then, owing to the non-recoverability of sunk costs, firms in developing countries may find it more profitable to continue using existing, less-

[114] Jean-Eric Aubert, supra note 4, at 24.

[115] *Id*.

[116] Youngil Lim, Technology and Productivity: The Korean Way of Learning and Catching Up (The MIT Press, 1999).

[117] Leif Johansen, Substitution versus Fixed Production Coefficients in the Theory of Economic Growth: A synthesis, Econometrica 27, 157 (1959).

[118] Robert Solow, Investment and technical progress. In: Arrow, K. (Ed.), Mathematical Methods in the Social Sciences, Stanford University Press (1960).

[119] Simon Gilchrist and John C. Williams, Transition Dynamics in Vintage Capital Models: Explaining the Postwar Catch-up of Germany and Japan, Finance and Economics Discussion Series, 2001-7, Federal Reserve Board of Governors (2001).

[120] John Laitner and Dmitriy Stolyarov, Technological Change and the Stock Market, mimeo, University of Michigan (2002).

[121] Hence, once the new vintage is introduced there is no additional gross investment in older vintages and the part of the net capital stock embodying these older vintages decreases because of depreciation.

[122] Diego Comin and Bart Hobijn, Cross-country Technology Adoption: Making the Theories Face the Facts, Journal of Monetary Economics Vol. 51, 39 (2004) (examining the diffusion of more than 20 technologies across 23 of the world's leading industrial economies for the period 1788–2001, suggesting a pattern of lagged trickle-down diffusion originating in advanced economies), at 61-62.

[123] *Id*., at 62.

[124] The International Bank for Reconstruction and Development (IBRD), World Development Report 1992: Development and Environment. Washington, DC: World Bank (1992).

efficient technology than to invest in new, more efficient plant and equipment.[125] That is especially, albeit not solely, in capital-intensive and network industries. The latter are characterized by large investments and long capital turnover times. In such case, past investment may considerably limit the scope for the diffusion of new technology.[126] This ultimately entails a lenient, conceivably favorable approach towards a diffusion patent reform, as this article defends.

There is a second source of latecomer advantage associated with developing countries struggle to adopt foreign technology. It is said to derive from learning investments and increasing net returns to adoption over time. Investment in non-frontier technologies tends to persist for a while after a new technology is introduced. This observation spurred a flurry of theoretical models that we shall designate as *vintage human capital models*.[127] All vintage human capital models have a critical component in common. That is the use of old technology, which results in technology-specific experience labeled as vintage human capital. Such knowledge, at least in theory, reduces the market incentive to update new technologies. This is because doing so would lead to the loss of the value of this experience. Consequently, workers and firms are said to hang on to older technologies and continue to invest in them even though newer and potentially better ones are available.

New technologies are often costly, inflexible, and unreliable during the early stages of development and commercialization. For this reason, take-up is characteristically restricted to a handful of innovative, risk-taking adopters, mostly in developed economies. That is, with the financial, technological, and managerial capabilities required to master the technology profitably. These firms' expenditures reduce costs, improve performance, and make the new technology profitable amongst a much larger number of prospective adopters. In the unsupported setting given technology markets in developing countries, latecomers are flatly assumed to collect efficiency gains from accumulated learning with the new technology, presumably resulting in a faster diffusion rate.[128]

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[125] John Stanley Metcalfe, On diffusion and the process of technological change. In Economics of Structural and Technological Change (Cristiano Antonelli, Nicola De Liso, eds.) 123-144. London: Routledge (1997).

[126] Luc Soete, International diffusion of technology, industrial development and technological leapfrogging, World Development 13(3) 409 (1985); Moses Abramovitz, Catching-up, Forging Ahead and Falling Behind, Journal of Economic History 46 (2):385-406 (1985); Mary Amiti, Regional Specialization and Technological Leapfrogging, Journal of Regional Science 41 (1):149 (2001).

[127] Examples along this line are Varadarajan Chari and Hugo Hopenhayn, Vintage Human Capital, Growth, and the Diffusion of New Technology, Journal of Political Economy 99, 1142 (1991); Elise Brezis, Paul Krugman and Daniel Tsiddon, Leapfrogging in International Competition: A Theory of Cycles in National Technological Leadership, American Economic Review 83, 1211 (1993); Boyan Jovanovic and Yaw Nyarko, Learning by Doing and the Choice of Technology, Econometrica 64, 1299 (1996)).

[128] Arnulf Grübler, Time for a Change: On the Pattern of Diffusion of Innovation, In Technological Trajectories and the Human Environment (J. H. Ausubel and D. H. Langford, eds.) 14-32. Washington, DC: National Academy Press (1997); Farhad Rassekh, The Convergence Hypothesis: History, Theory, and Evidence, Open Economies Review 9, 85 (1998); Marnik G. Dekimpe, Philip M. Parker, Miklos Sarvary, Global Diffusion of Technological Innovations: A Coupled-hazard Approach, Journal of Marketing Research 37:47 (2000).

Like standard vintage capital theory, vintage human capital theories predict that countries that are the most intense users of existing technologies and have built the most technology-specific skills are the countries that have the most to lose from switching to new technologies. Developing countries like all countries, goes the theory, presumably enjoy a latecomer advantage that should imply faster technological diffusion rates altogether. Such market conditions further resonate with the need for corrective regulatory measurements, such as the ones the article entails.

The third source of latecomer advantage are known as the *Imitator–innovator models*. These explain that leader countries tend to innovate and be early adopters while the lagging countries mostly imitate them. Two notable models herein are of particular importance.[129] Barro and Sala-i-Martin consider a two-country model whereby one country is an innovator and the other an imitator. The two essentially offer a version of Paul Romer's endogenous growth theory of 1990. Economic growth is primarily the result of endogenous investments in industrial R&D in innovation by forward-looking, profit-seeking agents.[130] This is the same for Eeckhout and Jovanovic's 2002 model, assuming that all agents are ex-ante identical, and the only ex-post difference between them is essentially their total factor productivity (TFP) level.[131] However, these pro-market models do not provide an extensive empirical setting that identifies the real determinants of adoption disparities across the north-south divide, as exemplified below.

Growth theory offers a fourth empirically untested latecomer technology diffusion model tested only in developed countries. It uniquely focuses on *General Purpose Technology* (GPT) with complementary inventions. It is Helpman and Trajtenberg's model on the diffusion of general-purpose technologies (GPTs). In their model, GPTs arrive exogenously.[132] Countries or sectors which can use them with minor expenditures on complementary innovations can expect a most significant demand shift when adopting a GPT as the early adopters in their model. The adoption only takes place with a delay after the complementary innovations are implemented. In the most straightforward theoretical framework, the early adopters are the same countries/sectors for all GPTs.

This model is further regrettably unfounded given the poor experience of developing countries with technology diffusion explained in the section above. Admittedly, what may be valid among equally advanced countries necessitates

[129] Robert J. Barro and Xavier Sala-i-Martin, Technological Diffusion, Convergence, and Growth. Journal of Economic Growth 2, 1 (1997)); Jan Eeckhout and Boyan Jovanovic, Knowledge Spillovers and Inequality, American Economic Review 92, 1290 (2002)).

[130] See Paul M. Romer, The Origins of Endogenous Growth, 8 Journal of Economic Perspectives 3, 4–10 (1994); Paul M. Romer, Endogenous Technological Change, 98 Journal of Political Economy S71, S72 (1990) ("Technological change provides the incentive for continued capital accumulation, and together, capital accumulation and technological change account for much of the increase in output per hour worked)," at 72.

[131] TFP is usually measured as the ratio of aggregate output such as GDP to aggregate inputs. *See* Robin C. Sickles and Valentin Zelenyuk, Measurement of Productivity and Efficiency (Cambridge University Press, 2019), at 158.

[132] Elhanan Helpman and Manuel Trajtenberg, Diffusion of General Purpose Technologies 86, In, General Purpose Technologies and Economic Growth (E. Helpman, ed.) (MIT Press, 1998).

empirical assessment across countries abridging the north-south divide. That is notwithstanding the significant theoretical reasoning which novelty traps accentuate.

Conclusion

The influence of novelty traps on resident patenting activity, knowledge diffusion, and innovation performance is conceivably evident empirically for New Zealand. Following the adoption and implementation of New Zealand's updated Patents Act 2013, replacing the patentability standard of local to absolute novelty, from 2014 to 2020, we observed an acute breakdown in residents-involved patent applications filing to the country's patent office. New Zealand remains an exception compared with the six South-East Asia and Oceania countries, including Australia, China, Hong Kong SAR, Indonesia, Malaysia, and Singapore. In contrast, moreover, New Zealand's overall non-resident patenting activity remained essentially unchanged. This finding is parallel with the other five above-mentioned regional countries examined. Since patent law directly governs patenting activity in the country, the chilling effect of a higher patentability standard on patenting activity was expected. Consequently, the empirical study revealed that change from local to absolute novelty standard affected specifically patenting activity of residents seeking local patent protection for their innovations. Patenting activity of foreigners seeking protection for their inventions in New Zealand and its regional counterparts remained unaffected.

The empirical study further revealed the influence of novelty traps on technology diffusion, and innovation performance at the country level. It was shown that knowledge diffusion and innovation output scores of the Global Innovation Index in New Zealand decreased significantly over 2014-2020, following the implementation of the 2013 Patent Act.

Our empirical study further unveiled the connection between residents-involved patent applications annually filed to the country's patent office on one side and knowledge diffusion and productivity to input ratios on the other hand. We showed that a decrease in resident patent applications filing is associated with a steady reduction in knowledge diffusion, and innovation output. We further revealed that the optimal annual resident patenting activity rate for knowledge diffusion is in the range of 1600-2000 patent applications per annum. The sharp drop in residents-involved patenting activity following the implementation of the 2013 Act from about 1700 applications in 2013 to below 1000 applications in 2017-2020. The decrease resulted in a substantially suboptimal patenting activity that impedes knowledge diffusion and seems unable to ensure sustainable growth of innovation and productivity.

Finally, the regression and correlation analysis applied in this research discovered the explanatory and predictive power of resident patenting activity on knowledge diffusion, and innovation output. Notably, this analysis provided a robust positive correlation between residents-involved annual patent applications count and knowledge diffusion, knowledge and technology output, and innovation output scores to input ratios lagged by one year.

The existence of such predictive power witnesses that novelty traps reduce resident local patenting activity and adversely affect knowledge diffusion and other innovation indices. Indeed, the connection between local patenting activity, and knowledge diffusion given archetypal novelty traps, is more affluent, and deserves further confirmation to follow on the breakthrough findings this article possibly entails.

Appendix: Novelty Traps Regression and Correlation Analysis

i) Overview

Our regression analysis is aimed at estimating the relationships between residents-involved patenting activity as an independent variable (P1) and a set of dependent variables, including innovation output and knowledge-diffusion related dependent variables (K1-K4). The linear Ordinary Least Squares (OLS) regression model used in this research allows revealing a linear-like relationship between independent and dependent variables and evaluating the strength of such ties via correlation coefficients. It also allows the estimation of a conditional expectation of dependent variables values for specific values of the independent variable. The regression analysis below was performed for contemporary and one-year lagged dependent variables separately.

ii) Contemporaneous variables

The results of regression analysis with contemporaneous variables are summarized in Table 1. For each dependent variable, intercept, slope, standard error, and correlation coefficient were calculated. The slope was normalized to 100 patent applications per annum. In other words, it indicates the change in the dependent variable when resident patenting activity grows by 100 applications per year. The intercept indicates the value of the dependent variable when resident patenting activity is set to zero. The results represented in Table 1 reveal a significant to strong correlation between independent and dependent variables. These results allow the assumption of the co-incidence or collinearity between resident patenting activity and knowledge diffusion on one side and productivity on the other hand. However, these results are insufficient to consider the predictive or explanatory power of resident patenting activity on innovative performance, knowledge diffusion, for two reasons. First, the correlation coefficients are not high enough.

Second, it is not very likely that changes in knowledge diffusion following changes in resident patenting activity will occur in the same year. All the processes related to patent applications filing, knowledge and technology diffusion, and adoption are time-consuming to a certain extent. Even if the time lag between patent applications filing (or refusal to file) and knowledge diffusion takes months, the annual time series format of the available data does not provide sufficient resolution to record the change. This should also be true for knowledge diffusion. Therefore, it seems logical to also perform a regression and correlation analysis using one-year lagged dependent variables, presented in the following section.

Table 1: Regression analysis results for contemporaneous variables

Dependent variable	Independent variable	Intercept	Slope (per 100 patent applications)	Standard error	Correlation coefficient R
K1 - Innovation output score	P1 – Total residents-involved patent applications count	31.57	0.860	0.057	0.672
K2 - Knowledge and technology output score	P1 – Total residents-involved patent applications count	20.81	1.300	0.064	0.818
K3 - knowledge creation score	P1 – Total residents-involved patent applications count	28.74	1.530	0.055	0.855
K4 - Knowledge diffusion score	P1 – Total residents-involved patent applications count	11.35	0.820	0.047	0.678

iii) One-year lagged dependent variables

Table 2 summarizes the regression based on one-year lagged dependent variables on residents-involved patenting activity. It uses the same dependent variables as in the previous section. In this case, high correlation coefficients have been obtained for all the dependent variables. The highest correlation coefficient and slops was observed for knowledge and technology output score (K2), albeit all other dependent variables demonstrate a pretty close correlation with resident patenting activity. These findings provide empirical evidence of the explanatory power of residents-involved patenting activity on knowledge diffusion, and innovation output.

Table 2: Regression analysis results for one-year lagged dependent variables

Dependent variable	Independent variable	Intercept	Factor (per 100 patent applications)	Standard error	Correlation coefficient R
K1 - Innovation output score	P1 – Total residents-involved patent applications count	23.09	1.350	0.046	0.861
K2 - Knowledge and technology output score	P1 – Total residents-involved patent applications count	16.79	1.460	0.028	0.953
K3 - knowledge creation score	P1 – Total residents-involved patent applications count	32.05	1.110	0.065	0.744
K4 - Knowledge diffusion score	P1 – Total residents-involved patent applications count	8.71	0.960	0.048	0.766

iv) Correlation analysis between technology diffusion and resident patenting for six South-East Asia and Oceania countries

Table 3: Contemporaneous correlations coefficients between technology diffusion and resident patent applications count

Country	Correlation coefficient
Australia	-0.4114
China, Hong Kong SAR	-0.3631
Indonesia	-0.8060
Malaysia	0.1700
New Zealand	**0.8809**
Singapore	-0.0381

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