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Deciphering innovation: An exploration of USPTO patents granted to Iranian inventors

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A B S T R A C T

Since nearly a decade ago, Iranian policy circles have declared innovation and development of science-based industries as a priority area. This paper utilizes the emerging Iranian patent stock in the USPTO to ascertain progress on this front. Results indicate that there are policy traces in the emerging patent portfolio as proxied by sponsorship statements in 28% of all patents. However, there is little evidence of technological specialization. Breaking down the portfolio into foreign-assigned, Iranian-assigned, unassigned and Iranian-sponsored patents, indicates that foreign-assigned, followed by Iranian-assigned patents are of higher quality and potential value. Nearly half of the patents are unassigned and 40% are assigned to foreign entities. Lack of ownership assignment can be a hurdle to effective exploitation, defense and maintenance of patents. The analysis is concluded by relevant policy lessons.

1. Introduction

Innovation is an age-old human endeavor with far reaching socio-economic implications. Nonetheless, it has not always been the focus of major scholarly efforts. It has increasingly become clear that technological change is a major driver of long-run economic growth. Traditionally, capital accumulation, labor input and the working of markets have received more attention vis-à-vis economic development. However, recent years have seen an upsurge of interest in the role of technological advancement in economic and social change [1,2].

An important subcurrent in the abovementioned research deals with factors impacting innovation and the intricate interaction between basic science, technological development and the actors involved. Various methodologies and approaches have been utilized. A number of holistic frameworks (e.g. the triple helix) seek to model the web of actors and influences [3]. With the advent of high-quality data and the ease of access to patent databases, a body of literature relies on patent citation analysis [4]. Patents contain important information regarding crucial innovative technologies, their scientific and technical precedents and key actors involved.

Iran has enjoyed a wave of interest in high-tech and science-based industries since over a decade ago. A number of sectoral initiatives and policies have also been promulgated. As a case in point, the Iran Nanotechnology Initiative Council (INIC) formed in 2003 and has launched a program encouraging patenting Iranian innovations [5]. Until recently, there were not much patented innovations by Iranian subjects in the USPTO [6]. However, a cursory look reveals a surge in patenting.

An exhaustive research on the international patenting performance of the country is virtually non-existent. Previous research has largely focused on mapping the Iranian intellectual property (IP) system and development [5–8]. This study attempts to scrutinize the emerging stock of Iranian patents in the USPTO as a manifestation of the innovative activities of the country.

This paper proceeds as follows. Section 2 will review the importance of patent documents as a source of innovation-related information. Section 3 will deal with the Iranian innovation performance as proxied by USPTO patents bearing Iranian inventors. Technological specialization, ownership, scope of inventions, quality and value of patents and the geographical characteristics of inventions are topics that will be dealt with. A discussion of the results and policy implications will conclude the paper.

2. Patents as a repository of innovation intelligence

Patents are licenses issued and published by an authorized governmental entity, granting exclusive rights to the production, application or utilization of a novel apparatus or process for a specific period of time. The published information contains important clues to the specific environment in which development efforts occur [9]. Patents are hugely heterogeneous on many measureable dimensions; however, a patent's collection of claims represents a discrete invention. This allows a patent to be treated as a unit of innovation [10].

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Trippe [11] coined the term "patinformatics" to refer to the science of analyzing patent information to discover relationships and trends difficult to extract from individual patent documents. The term is meant to cover all macro-level forms of analyzing patent information such as patent intelligence, patent mapping and patent citation analysis.

Eugene Garfield originated large scale citation analysis and proposed the Science Citation Index in the 1950's as a tool to help scientists retrieve extant scientific papers [12]. However, Francis Narin and his colleagues have pioneered the use of patent citation analysis; especially using patent citations to academic papers to measure knowledge spillovers between academic science and industrial R&D [13].

Citations in patents serve as "knowledge footprints" that can be used to trace various information sources on which the invention depends. For instance, they can illustrate the relations with other inventions as well as geographic, institutional, sectoral and technological linkages [14].

USPTO patents have been used as a proxy for innovative activities in a variety of developing and newly industrialized countries (NIC). For example, Govindaraju and Wong [15] study Malaysian patenting activity in both Malaysia and the US. They observe an increase in patenting activity due to participation of foreign companies in the Malaysian economy. They report a weak domestic inventive capability. Similarly, Jung and Imm [16] compare domestic and USPTO patenting of Korean and Taiwanese subjects. They observe that the 1998–1999 financial crisis reduced domestic Korean patenting without affecting patenting in the US. Taiwan had lower US patent grants than Korea but its grant rate has been constantly improving.

2.1. Patentability

To determine the patentability of an invention, USPTO applies three criteria. It must be novel; non-obvious, i.e. encompass an inventive step and be useful, i.e. have industrial application [4,12]. The invention is described in a number of claims, each of which should meet these requirements. Patent applicants owe a "duty of candor" to the USPTO to disclose all prior art regarding their inventions. This is generally done in the form of citations. The European Patent Office (EPO) does not mandate such duty of candor, where applicants provide only references that are considered relevant [9,10]. Hence, the "references cited" on U.S. patents are an important requirement of the U.S. patent law [12].

2.2. Patent references

Front-page references on patent documents are meant to help evaluate the novelty, non-obviousness and applicability of inventions. They also provide a context for the patent claims. According to the USPTO patent examination procedure manual, the basic purpose of citing prior art in patent files is to inform the patent owner and the public of the existence of such references to be used in evaluating the validity of the patent claims [17]. When a patent is granted, validity is presumed against this declared prior art. Hence, applicants are motivated to declare as much relevant prior art as possible. Granted patents are not automatically valid; their validity can be challenged in court [10].

The functions of patent references differ, to some extent, from those of academic publications. Front page references also include the examiner-given references used to decide on granting the patent or limiting claims. Therefore, these references are not necessarily those originally provided by the applicant; some may have been added or omitted by the examiner to better characterize the claims [9].

2.3. Prior art, patentability and innovation antecedents

Applying for patent protection is a costly and time-consuming procedure with an uncertain outcome. Existence of highly relevant prior art can seriously undermine an application. Such prior art refers to any information source that can be of relevance to some claims in the patent [18]. Consequently, a patentability search report underpins every patent application. The objective of a patentability search report is to document information on the technical content, i.e. "state of the art", that is deemed relevant for patentability of the invention [4].

Traditionally, prior art has been distinguished into patent and non-patent references (NPRs). Patent literature can anticipate novelty. Non-patent literature and especially technological areas closely related to the application can foresee the inventive step [18].

According to Franzosi [19] "the prior art" is not as a single and uniform notion. He defines prior art in various classes or groups according to the ideal average technician's grasp of various pieces of information. The first group is the common general knowledge available to the expert. This class mainly resides in textbooks and leading technical articles. The second group is the enhanced knowledge that the good expert would essentially access when confronted with a new problem, including all textbooks (old and new), patent literature, and articles in the current technical literature. The third group of prior art is the hidden (or imputed) knowledge that is available to somebody in the world; but not in the possession of the average expert such as a thesis paper in a remote university or textbook in a foreign language. The fourth group of prior art, prior applications, consists of patent applications. In assessing novelty all four types of prior art are relevant. However, hidden knowledge and prior applications do not apply to the assessment of non-obviousness.

Patent citation analyses use prior art differently. The non-patent citations (of academic origin) are used to study the relationship between science and technology, including the interaction, linkage, and the relationship between science and technological development. Patent citations hold important information on the connection among technologies, countries, and companies [20].

In an oft-quoted study on the role of public science, i.e. originating from academia, government and other Federal government funded institutions, Narin and colleagues found that during 1993–1994, 73% of the papers cited by U.S. industry patents are the output of public science [21]. There is a burgeoning literature in this tradition with some sectoral or regional delimitation. The main theme here is to ascertain the general role of each class of references in innovation as materialized in patents. For instance, McMillan et al. [22] analyze 2334 biotechnology patents with 23,286 NPRs on their front pages with a patent/NPR ratio of 44.38%; yielding 20,752 science citations representing 12,477 scientific papers. Of these citations, 71.6% were to papers originating solely from public institutions, 11.9% had roots in joint efforts by public and private institutions, and only 16.5% cited papers emanating entirely from private companies. They conclude that the biotechnology industry depends on public science much more heavily than other industries.

Azagra-Caro et al. [14] observe that most studies of patents citations focus on national or international contexts. They choose Valencia in Spain, a region with low absorptive capacity. To better nuance the effects, they distinguish between applicant citations and examiner-inserted citations. With more than 70% of patents having no citations, they observe that citations are not a good measure of an invention's knowledge base in the Valencian Community. Also, the majority of citations turn out to be patent references (82%). Therefore, the knowledge base of Valencian patents seems to be biased toward technology than science. Finally, they