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INDUSTRY SPECIFIC KNOW-HOW, INVENTIVENESS, AND RESEARCH PERFORMANCE OF UNIVERSITIES' ENTREPRENEURS: A CROSS-NATIONAL PATENT PORTFOLIO ANALYSIS

by

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ABSTRACT

This study addresses two major questions of great salience in science, technology and innovation studies. What are the promoters of innovativeness in academia? Are patenting of inventions and research performance in conflict in academia or do they rather co-evolve and/or reinforce each other?

Patents applications to the South African Patent Office from 1996 to 2006 are used as indicators of inventive capacity of South African universities for that period. The investigation determines, for the first time, patenting activities of local universities at the South African Patent Office and identifies the performance of faculties and departments. The assertion that previous industry working experience can affect the inventiveness of academic researchers is then investigated. No other study has investigated this issue in South Africa.

The study finds that most inventors or co-inventors worked in industries before universities employed them. The study contends that employing scientists or engineers who previously worked in industry is an effective mechanism through which universities could absorb scientific and technical skills that could inform researchers on how to design patentable inventions and thus promote their inventive capacity. It is argued that this mechanism is equally valid in developed and developing countries (like South Africa) and those universities internationally wishing to improve their entrepreneurial character should aim to employ academics with previous industry work experience.

The study also investigates whether patenting impedes the research performance (publication outputs, teaching, development of disciplines, etc.) of universities' professors using the Poisson regression model. The confounding effects of other variables deemed to affect the publication productivity, such as research/faculty orientation, collaboration, etc. are taken into account. The results show that professors who are inventive: (i) outperform academically (NRF-rating) and publish more than those who do not invent at all; (ii) inventiveness and academic performance can co-exist peacefully and reinforce each other.

The study finally investigates whether or not concurrent production of scientific articles and patenting of technical inventions can support each other. In an analysis of 70 patents obtained from the USPTO (United States Patent and Trade Marks Office), EPO (European Patent Office), and WIPO (World Intellectual Property Organization) that were invented or co-invented by scientists employed in South African universities from 1994 to 2006, 58 patents (82% plus) overlapped, i.e. formed pairs with scientific articles. Authors tended to patent and publish at the same time and the same intellectual work informed both products. Extended case studies of backward and forward citation patterns of pairs pertaining to the classes of polymers (chemistry and related sciences), optoelectronics (signal processing), biotechnology and related sciences and mineral processing (separation technology) point to two important conclusions. Some technical knowledge can also flow into the public science domain via an article. Some scientific knowledge can also flow into the patent domain via a patent.

OPSOMMING

Hierdie studie ondersoek twee kardinale vrae wat met wetenskap, tegnologie en studies van innovering verbandhou. Waardeur word innovering in die akademie bevorder? Is die patentering van uitvindings en navorsingsprestasie in die akademie in konflik met mekaar, of kan dit saam ontwikkel en mekaar versterk?

Die innoveringskapasiteit van Suid-Afrikaanse universiteite en navorsers word ondersoek deur ‘n analise van universiteite se patentaansoeke te doen. Patentsaansoeke ingedien by die Suid-Afrikaanse Patentekantoor, vanaf die jaar 1996, tot 2006, word aangewend om die innoveringskapasiteit aan te dui. Hierdie ondersoek stel vir die eerste maal vas wat die patente-aktiwiteite van plaaslike Suid-Afrikaanse universiteite is, gebasseer op aansoeke wat by die Suid-Afrikaanse Patentekantoor ingedien is gedurende die afgelope tien jaar. Die studie identifiseer ook die prestasie van fakulteite en departemente.

Die aanname dat industriële ondervinding die innovasievermoë van akademiese personeel beïnvloed, word dan ondersoek. Geen ander studie het nog ooit hierdie konsep in Suid-Afrika ondersoek nie. Hierdie studie bevind dat die meeste innoveerders in die industrie werksaam was voordat hulle deur in universiteit aangestel is. Die studie ondersteun die standpoint dat die aanstelling van wetenskaplikes en ingenieurs wat voorheen in die industrie werksaam was, in effektiewe meganisme is vir die opname van wetenskaplike en tegniese vaardighede, wat navorsers kan toelig oor die ontwerp van innoverings wat gepatenteer kan word en daardeur hulle innoveringskapasiteit kan verbeter. Die argument is dat hierdie meganisme geldig is in ‘n gelyke mate tussen ontwikkelde en ontwikkelende lande (soos Suid-Afrika) en dat universiteite wêreldwyd wat begeer om hulle ondernemingskarakter te verbeter, hulle ten doel moet stel om akademici aan te stel wat wel beskik oor vorige ondervining in industrie.

Die studie ondersoek ook of aktiwiteite wat betrekking het op die patentering van innovasies, ‘n nadelige invloed het op die navorsingsprestasie van universiteit professore (imet betrekking

tot aantal publikasies, onderrig en die ontwikkeling van dissiplines ens.) deur die betref. Poisson Regressie Model te gebruik. Die verwarrende effekte van ander veranderlikes wat klaarblyklik publikasieproduktiwiteit beïnvloed, naamlik navorsing/fakulteitsorientering, samewerking, ensovoorts, word in ag geneem. Die resultate dui daarop dat professore wat innoverend is: (i) presteer uitsonderlik goed akademies (hulle beskik oor ‘n NRF-waardebeoordeling) en hulle publiseer meer as persone wat hoegenaamd nie innoverend is nie, ii) Vindingrykheid en akademiese prestasie kan met gemak saam bestaan en mekaar versterk.

Ten slotte ondersoek die studie of die samelopende produksie van wetenskaplike articles en die patentering van tegniese uitrindings mekaar kan ondersteun. ‘n Analise van ‘n steekproef van 70 patente verkry van USPTO (United State Patent and Trade Marks Office), EPO (European Patent Office) en die WIPO (World Intellectual Property Organization) van uitvindings deur innoveerders of mede-inoveerders werksaam by Suid-Afrikaanse universiteite tussen 1994-2006 is gedoen. Hierdie analise toon ‘n sterk oorvleueling tussen patente en artikels. In 58 van die 70 patente (82%) is dieselfde kennis wat in die patent openbaar gemaak is, ook in ‘n artikel gepubliseer. Tesame vorm hulle ‘n paar patent-artikel. Uitgebreide gevallestudies wat handel oor agtertoe, en voorwaartse vermeldingspatrone van pare wat direk te make het met die klaase van “polymer” “opto-elektronie, bio-teknologie en vemante wetenskapp dui op twe belangrike konklusies: (1) tegniese kennis kan die domein van openbare wetenkap binnerloei deur middel van ‘n artikel; (2) wetenskaplike kennis kan die domein van patente binnevloei deur middel van ‘n patent.

DECLARATION

I hereby declare that, the work contained in this dissertation is my own original work. It has either not been, in its entirety or in part, submitted at any institution for any academic or other qualification.

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Louis M. Lubango Date

DEDICATION

I wish to dedicate this dissertation to my dear parents Fabien and Susan.

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LIST OF ACRONYMS

AHCI	Arts and Humanities Citation Index
AIDS	Acquired Immunodeficiency Syndrome
APTO	Australian Patent Office
AUTM	Association of University Technology Managers
CEO	Chief Executive Officer
CIPRO	Company and Intellectual Property Registration Office
CMOS	Complementary Metal-Oxide-Semiconductor
CSIR	Counsel for Scientific and Industrial Research
CV	Curriculum Vitae
DTI	Department of Trade and Industry
DVC	Deputy Vice Chancellor
EPO	European Patent Office
FAPS	Focus Areas Programme
FORPRO	Foreign University's Professor
FORU	Foreign University
GLM	Generalized Linear Model
IKS	Indigenous Knowledge System
IP	Intellectual Property
IPC	International Patent Classification
IPR	Intellectual Property Rights
IPRS	Intellectual Property Rights Systems
ISI	Institute for Scientific Information
JPO	Japanese Patent Office
KMLC	Knowledge Management Life Cycle
OECD	Organization of Economic Cooperation and Development
NACE	Nomenclature Générale des Activités Economiques
NACI	National Advisory Counsel on Innovation
NRF	National Research Foundation
PCR	Polymerase Chain Reaction

PCT	Patent Cooperation Treaty
R	Rands
R&D	Research and Development
RIETI	Research Institute of Economy, Trade and Industry
RISA	Research and Innovation Support and Advancement
SAASTA	South African Association for Science and Technology Advancement
SAIND	South African Industry
SAPRO	South African Professor
SAU	South African University
SAS	Statistical Analysis System
SCI	Science Citation Index
SECI	Socialization Externalization Combination Internalization
STAF	Science and Technology Agreement Fund
SUN	Stellenbosch University
TB	Tuberculosis
TFS	Technikon Free-State
THRIP	Technology and Human Resources for Industry Programme
TQM	Total Quality Management
TTO	Technology Transfer Office
TUT	Tswane University of Technology
UCT	University of Cape Town
UK	United Kingdom
UJ	University of Johannesburg
UOFS	University of Free-State
UNNW	University of the North West
UP	University of Pretoria
USA	United States of America
USD	US Dollars
USPC	United States Patent Classification
USPTO	United States Patent and Trade Marks Office
WIPO	World Intellectual Property Organization

WITS	University of the Witwatersrand

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