

MEASURING INNOVATION

in OECD and non-OECD countries

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Selected Seminar Papers

Edited by
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Foreword

Through the Department of Science and Technology (DST), South Africa has had the benefit of observer membership on the OECD's Committee for Scientific and Technological Policy (CSTP) since 1998. This allows South Africa to participate in the Global Science Forum (GSF), Working Group on Technology and Innovation Policy (TIP), National Experts on Science and Technology Indicators (NESTI) and the Working Party on Biotechnology (WPB).

The work of NESTI, particularly in the areas of Research and Experimental Development (R&D) and Innovation Surveys, has been of special interest to the Department and led to the OECD and South Africa hosting a joint seminar on the measurement of innovation activities in OECD and non-OECD countries in Pretoria in March 2001. The seminar was well attended, with 132 delegates from OECD countries and other regions of the world (Africa, Latin America and Asia) participating in a very fruitful exchange of experiences. The importance of regular measurement of both R&D and innovation through proper national surveys was brought into focus for South Africa at the seminar. I would like to take this opportunity to sincerely thank the Steering Committee and the team from the OECD Secretariat for their hard work in ensuring that the seminar was a success.

I am pleased to report that since the seminar, South Africa has made rapid progress in establishing a reliable, nationally and internationally accepted set of official science and technology statistics. These statistics in turn provide the main indicators required to underpin the implementation of South Africa's national R&D Strategy as outlined by government. In 2002, the Centre for Science, Technology and Innovation Indicators (CeSTII) of the Human Sciences Research Council was commissioned by DST to undertake a regular series of R&D and Innovation Surveys in order to establish a baseline of official S&T indicators. In June 2004, the DST and Statistics South Africa signed a Memorandum of Agreement concerning the recognition of official national science and technology statistics.

This book thus records an important historical turning point in South Africa's progress towards an effective national system of innovation. The seminar brought to the fore some of the key critical differences between developed and developing countries in their approaches to measuring innovation. These differences are clearly reflected in the various chapters of this book, which cover some of the most important debates that emerged during the seminar.



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Some time has elapsed since the seminar took place and for various reasons the publication of the proceedings from the seminar was delayed. When this process was revived in 2004, some presentations were incomplete or not yet ready for publication. Regrettably, we also found that some authors were not contactable despite extensive searches and enquiries, while other authors had to withdraw their papers because they had been published elsewhere. Nonetheless, we believe that the papers in this volume represent a selection of the most cogent papers presented at the seminar.

The editors would like to thank all the authors who did submit papers for publication, and took the time to update and improve them and meet the deadlines of the editorial process. Special thanks are due to Robyn Arnold of Write Connection for her excellent editing skills and Inga Norenius of HSRC Press who managed the publication process and the design and layout of the book.

Abbreviations and acronyms

ABS	Australian Bureau of Statistics
BIC	Best-in-class
CARMATEC	Centre for Agricultural Mechanisation and Rural Technology
CBS	Central Bureau of Statistics
CEIES	European Advisory Committee on Statistical Information in the Economic and Social Spheres
CIS	Community Innovation Survey
CMEA	Council for Mutual Economic Assistance
COMECON	Council for Mutual Economic Assistance
COSTECH	Tanzania Commission for Science and Technology
CPI	Consumer price index
CV	Coefficient of variation
CYTD	Latin American Programme for the Development of Science and Technology
DACST	Department of Arts, Culture, Science and Technology (South Africa)
DISKO	Danish Innovation System in KOmparative perspective
DTI	Department of Trade and Industry
EBRD	European Bank for Reconstruction and Development
EC	European Commission
ECU	European Currency Unit
EEA	European Economic Area
ERP	Economic Recovery Programme
ESRF	Economic and Social Research Foundation
EU	European Union
FDI	Foreign direct investment
FRD	Foundation for Research Development
GATT	General Agreement on Tariffs and Trade
GDP	Gross domestic product
GERD	Gross national expenditure on R&D
GNP	Gross national product
HCSO	Hungarian Central Statistical Office

HDI	Human development index
ICRG	International country risk guide
ICT	Information and communication technology
IKU	Innovation Research Centre, Budapest
IMR	Infant mortality rate
IOI	Inventory of Organisational Innovativeness
IPAR	Institute of Personality Assessment and Research
ISIC	International Standard Industrial Classification
ISP	Industrial Strategy Project
M&A	Merger and acquisition
MBTI-CI	Myers-Briggs Type Indicator Creativity Index
MCC-PED	Multi-country Comparative Study of Private Enterprises Development
MERIT	Maastricht Economic Research Institute on Innovation and Technology
MMR	Maternal mortality rate
MNC	Multinational corporation
MSTI	Main Science and Technology Indicators
NACE	General Industrial Classification of Economic Activities within the European Communities
n.a.	Not applicable
nec.	Not elsewhere classified
NESTI	National Experts on Science and Technology Indicators
NIS	National innovation system
NPD	New product development
OAS	Organisation of American States
OECD	Organisation for Economic Co-operation and Development
OMFB	National Committee of Technological Development, Hungary
PFSA	Plastics Federation of South Africa
PME	Performance monitoring and evaluation
PPP	Purchasing power parity
PRSP	Poverty Reduction Strategy Paper
R&D	Research and experimental development
RCAP	Risk Capital Action Plan
RDEI	Research and development effectiveness index
REV	Resources, effort, value

RICYT	Ibero-American Network of Science and Technology Indicators
RMB	Renminbi ('People's Currency', China)
ROII	Returns on innovative investments
RTD	Research and technological development
SADC	Southern African Development Community
SAIS	South African Innovation Survey
S&T	Science and technology
SBIR	Small Business Innovation Research Programme
SESSI	Service des Études et Statistiques Industrielles
SISAMF	Survey of Innovation in South African Manufacturing Firms
SME	Small and medium enterprises
SOE	State-owned enterprise
SSB	State Statistical Bureau (China)
TBP	Technology balance of payment
TEMDO	Tanzania Engineering and Manufacturing Design Organisation
THRIP	Technology and Human Resources for Industry Programme
TIRDO	Tanzania Industrial Research Development Organisation
TPP	Technological product and process
TRIZ	Theory of Solving Inventive Problems
UK	United Kingdom
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNIDO	United Nations Industrial Development Organisation
UNU/INTECH	United Nations University Institute of Technology
URT	United Republic of Tanzania
US/USA	United States/United States of America
WIPO	World Intellectual Property Organisation
WTO	World Trade Organisation

Introduction

Mario Scerri

Statistics has helped determine the form of laws about society and the character of social facts. It has engendered concepts and classifications within the human sciences. Moreover the collection of statistics has created, at the least, a great bureaucratic machinery. It may think of itself as providing only information, but it is itself part of the technology of power in the modern state. (Hacking 1991:181)

This book emerged from the seminar on the Measurement of Innovation Activities in Organisation for Economic Co-operation and Development (OECD) and non-OECD countries that was held in South Africa in 2001. The motivation for that forum was the recognised need to address a new and exciting phenomenon in the area of economic policy formulation. The landmarks of this phenomenon were the publication of the 1992 *Oslo Manual* and the new Eurostat Community Innovation Survey (CIS). These events marked a notable rupture in the placement of innovation within macroeconomic policy formulation. This rupture resulted in a shift of innovation theory (offering, as it does, what may well be one of the more formidable challenges to the neoclassical account of economic growth) from the realms of a theoretical debate to praxis. In a way, the paradigm shift that had occurred in theory, with the emergence of evolutionary economics and innovation theory, now became manifest in a corresponding shift in the nature of the statistical tool of (political) economic governance.

Innovation theory had 'arrived', and its legitimacy was further ratified in a later OECD document (OECD 1997) that explicitly articulated the theoretical foundation of this new type of survey, which had gone far beyond the previous data gathering on research and development in OECD member countries. The rupture marked a departure from an economic planning framework wherein the science and technology (S&T) sector was incorporated in the orthodox neoclassical model to an innovation theory-based approach to growth that fundamentally challenges this model. It redirected the analysis of the role of technology, and of innovation in general, in the growth of nations, away from residual analysis to the mainstream. This rupture thus arose from two linked developments. The first was the increasingly apparent importance of innovation in the growth and development of economies, especially in the latter part of the twentieth century. The second was the realisation that the essentially static analytical framework of mainstream neoclassical theory was ill suited for the analysis of the economic role of innovation. These two developments provided what one may call the political basis, the motive force, for the emergence of the new survey.

The development of a new survey, seeking new data and new ways of organising information, is no light matter, and the significance of a new survey is obviously most pronounced when it reflects a shift in the theoretical base, in this case from neoclassical to evolutionary theory. The scope of surveys that are adopted by governments is anchored in governance, and the development of such surveys is thus fundamentally different from the normal process of academic enquiry. There is always an inevitable reciprocal relationship between the object of enquiry and the mode of enquiry, but in the case of official surveys,

especially those that are standardised for groupings of countries, this relationship tends to set early. In a new type of survey that emerges from a shift in theoretical foundations, this reciprocity is a core area of concern, since it sets the form and the parameters for future discourse. Here we may use the analogy of lock-in technologies and cumulative path dependency to caution against the too rapid adoption of a set mode of enquiry. At this initial stage of the emergence of the new survey, the first focus is on the choice of information that is required and the data that will be gathered to capture such information. The issues of inclusion and exclusion that arise at this stage should proceed from a clear statement of the object of enquiry. However, a pristine articulation is often difficult in the period of paradigmatic transitions. It is precisely at this early stage that a clear understanding of the intentionality of officially compiled statistics is necessary, both for the analyst and for the policy-maker. The statement of the objective of the new survey has to be as explicit as possible and be continuously re-examined. There must also be a clear recognition of the consequent and inevitable truth effects of official statistics. With repeated application of a given survey form, the definition of the object of enquiry becomes fixed, and it becomes increasingly improbable that alternative forms will emerge.

The criteria for inclusion and exclusion are numerous. The most obvious one is the technical criterion of quantifiability. Not all information can be quantified, even though survey designers can be quite ingenious in the construction of proxy measures of essentially unquantifiable information. Another set of criteria is based on the theoretical underpinning of the survey, and it is here that the requirement of explicit articulation is strongest. Such articulation would satisfy two core preconditions for the clear scientific application of surveys to research and policy.

The first is what we may call the clarity and purity of the language of analysis. This stems from a clear understanding of the particular paradigm or school of thought within which the specific analysis is set. This clarity is essential if we are to avoid a mixing of languages and the consequent unresolvable confusion of induction. Certainly, such clarity is more difficult in the shift from one theoretical base to another. Inevitably there is a language bind, a set of residues from a previous language of analysis to the new one. In the specific case of innovation surveys, it is the language of neoclassical theory whose traces inevitably persist.

The second precondition is the specification of the contextual demands on surveys. The differentiating criterion among contexts is usually the stage of economic development. It is therefore particularly significant that the seminar on which this book is based sets out specifically to examine the relevance of an established survey, developed within the global economic core, to economies at different stages of development. It would be naive, however, especially with respect to the richness of the analysis of innovation systems, to use a vague concept of 'the stage of economic development' as the differentiating principle among applications. Innovation theory certainly cautions against the glib adoption of apparently self-evident organising taxonomies. There are numerous determinants of the significant differences among innovation systems, and the major cornerstone of innovation theory is the complex specificity of systems and the tension between specificity and commonality. Even though the underlying theory is common, context may very well affect the shape and the consequent utility of the survey.

There is, of course, no single point or event that marks a shift to praxis such as the seminar that is the focus of this volume. Rather, there is a process through which the shift develops and establishes a new order. The *Oslo Manual* and the Eurostat CIS were, so to speak, the launching pads for the process, and the works contained in this volume are part of that

process. The contributions in this book certainly offer wide coverage of the issues and the potential problems and pitfalls of the emerging surveys on innovation. In the process, they set the scope for an exciting agenda for future research on the various aspects of innovation surveys. They range from the purely theoretical exploration of the foundation of innovation surveys to numerous expositions of alternative innovation survey structures in a variety of development contexts. Any classification system is perforce arbitrary and imperfect, and this is also true of the sections within which the various contributions in this book have been placed. The sections are useful, however, in providing a structure within which the contributions may be placed in relationship to one another and to the issues that they address.

The contributions in this volume have been placed in three broad sections. Though the areas that are addressed throughout the book obviously overlap substantially, the grouping of the various chapters offers a progression from a more theoretical approach to the issue of what we may call the localisation of innovation surveys in analyses that become specific to region, country, industry and, finally, organisation. Again, there is a loose transition from theory to praxis in this book that mirrors the emergence of innovation surveys from the theory of the economics of innovation; but, taken together, this body of work is more than that. In its coverage of the gamut of the theoretical, methodological and even the practical implications of innovation surveys, it provides a reference set for a number of interlocking debates in this area. It sets the framework for the emerging discourse on innovation surveys, their anchorage, the limitations of their various specificities and the possibilities for their evolution.

The first section looks at the theoretical foundations on which innovation surveys are constructed. The six contributions in this section introduce the relationship between theory and the consequent empirical methodology contained in innovation surveys. If there is one prime underlying concern in this relationship, it would be that of the 'unsaid' – the omissions and the non-explicit assumptions of survey methodology. It is in this tenebrous area that the clarity of the emergence of a new empirical tool derived from a new body of theory can be tested. From this perspective, Scerri looks at the implicit assumptions of surveys designed for industrialised economies and their implications for alternative applications. Aubert presents a specific assessment of the relevance of structural differences in innovation systems, especially between (economically) developing and developed regions in the world, to the design of innovation surveys. The chapter by Sloan addresses directly the matter of the utility of innovation surveys for the policy-maker. It covers a range of studies on the two-way relationship between innovation surveys and policy formulation. In this analysis, survey methodology itself is assessed as an innovation process that is non-linear, that evolves within its policy formulation environment, and that can often be significantly context specific. Redelinghuys looks at the definitions of innovation and its measurability, primarily from an engineering perspective, and proposes consequent extensions to the survey coverage. The contribution by Ross & Kleingeld considers the same phenomenon from an organisational perspective. Although the empirical part of the work is based on a specific case, the implications for the expansion of innovation indicators to cover organisational 'enablers' certainly involves general methodological issues. Walwyn extends the reach of innovation surveys to assess the returns on innovation expenditures from a commercial perspective. This helps to amplify the range of criteria used by policy-makers to allocate priorities.

The second section examines the methodological implications that are raised by the empirical application of innovation surveys in various countries and regions. All the

contributions look at specific innovation surveys, starting from the *Oslo Manual*, in order to examine the consequences to the core of innovation surveys of expanding the original survey format to accommodate regional and other specificities. The basis is set out in the exposition of the Eurostat survey in Guellec & Pattinson, and in Foyn, providing the point of reference for the methodological extensions proposed from the perspectives of specific regional requirements. Foyn provides a detailed tour through the evolution of the Community Innovation Survey from CIS-1 to CIS-3. In the process, he provides a framework within which the main methodological issues may be identified and located. Guellec and Pattinson go into the survey findings for specific OECD countries and in the process they highlight the core issues of the intentions of the CIS, the comparability of its results across OECD member countries and its methodological shortcomings. Iliev opens up the relatively little-explored area of innovation finance, which is radically distinct from financing other types of investment. Consequently, the incidence and the nature of the institutional bottlenecks in the flow of finance for innovation activity are substantial, varied and certainly context specific. This should therefore be a serious area for concern when designing innovation surveys.

In the case of specific regional requirements, the three main regions that are addressed are Latin America (Anlló & Lugones), Africa (Diyamett & Wangwe) and Central and Eastern Europe (Radosevic). Anlló shows that the nature of innovation that takes places in specific countries and regions can directly and significantly affect the appropriateness of specific survey methodologies. In a very clear manner derived from a specific empirical context, this paper argues that survey design should be preceded by a clear understanding of the specific structure of the innovation system that is to be covered. Anlló also makes a strong argument for coordinated innovation surveys across innovation systems that share common core characteristics. This requirement is addressed in Lugones's exposition of the *Bogotá Manual*, which provides the model for an innovation survey that is indeed relevant to Latin America, while permitting comparative analysis both within the region and with other regions. In a similar manner, Diyamett & Wangwe propose that innovation in economies with very low levels of technological capabilities has to be defined differently from innovation activity in technologically rich economies. They show that most of the measures that are commonly used to capture innovation, such as formal research and experimental development (R&D) investment programmes, are inappropriate when applied to Tanzania and similar countries. Instead, the emphasis of innovation surveys for such economies should be on learning processes. The argument that is advanced implicitly is that not only does the theoretical foundation have to be clearly specified, but that there should also be a clear understanding of the object of the enquiry before the form of the enquiry is designed. In his assessment of innovation surveys in Central and Eastern Europe, Radosevic addresses a number of broader issues. The first is the general case of what he calls the 'catching-up' economies (that is, those innovation systems where the brunt of innovation activity is devoted to the absorption of new technology, rather than its creation). He also queries the implicit assumption of linearity in the relationship between S&T inputs, innovation and economic growth underlying current innovation surveys, an assumption that is generally both theoretically and empirically unfounded. The general contribution of these papers is the insight into the myriad problems of specification and interpretation, as well as the sheer logistical issues involved in conducting the surveys.

This section also contains three reports on country surveys. Two of the reports are on surveys conducted in South Africa (Blankley & Kaplan and Oerlemans, Buys & Pretorius) while the other (De Bresson, Shiqing & Mohnen) offers a comprehensive analysis of the complexities inherent in surveying the Chinese innovation system. Blankley & Kaplan

report on the first pilot survey that was carried out for a section of the South African manufacturing sector. The design of the pilot closely followed the CIS model, and the authors make recommendations for future full surveys from this work. The chapter by Oerlemans et al. provides the design of a fully-fledged survey of the South African innovation system that was about to be undertaken. Its core design follows the CIS model, but some variations are proposed to allow for the specificities of the South African context. De Bresson et al. look at the vast and complex innovation system of China, a system in the process of radical structural transformation, and provide a survey framework within which this system can not only be assessed but also be opened up for comparative analysis.

The three contributions in the third section fall into two categories and serve to identify two further dimensions of specificity that are possible in the design and application of innovation surveys. The first category studies particular types of firms, specifically technology-intensive organisations. The chapter in this category looks at the specific sets of characteristics of high technology organisations (Marcus & Basson). The extension of the implications of this paper to the wide range of specific sectors in specific economies offers almost overwhelming possibilities for extensions to innovation surveys. The second category looks at the survey requirements of specific industries or sectors in specific countries. The two contributions in this category refer to the plastics industry in South Africa (Roberts) and the service sector in Hungary (Inzelt).

If we accept the account of the evolution of knowledge systems that forms the basis of innovation theory, we must also accept the inevitability of the 'lifecycle' progression of innovation theory itself, at least as currently formulated. We must expect that this paradigm will unavoidably reach its limits as an explanation of economic change and that it will become obsolete as a critical mass of inexplicable phenomena provides the basis for the next paradigm shift. This progression will occur both within the context of theoretical development in this field and in the linked body of empirical research. The timespan of this progression obviously depends on a complex interdependence of numerous factors, but one of the more important ones is certainly the role played by innovation surveys, the adoption of which arguably constitutes the most important political gain of the new theory to date. The consolidation of the shift in turn depends on the evolving policy informing analytical prowess of innovation surveys. It is in this respect that the works in this volume, at this early stage of the development of innovation surveys, can play an important role. We hope that this body of work, in its range and scope, provides a valuable basis for the progressive enrichment and applicability of innovation surveys to the issues and problems in an increasingly complex array of innovation systems in the emerging global economy.

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