

Measuring 'SERVERD' – pie in the sky or substantive activity?

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Abstract

All industrialized and even industrializing economies now exhibit a dominance of services in the composition of their GDP. The services sectors are dynamic and innovative, and frequently show growth rates in excess of the manufacturing sector. Services include 'knowledge intensive service activities' or 'KISAs.' However KISAs, especially R&D present difficulties for accounting purposes, let alone the production of meaningful and reliable S&T indicators.

This paper argues that the problem of measuring services expenditure on R&D (SERVERD) is perhaps overstated. Working from the Frascati definition of R&D, a set of company case studies is presented in order to tease out the various dimensions of SERVERD. Case studies include banking, insurance, clinical trials, retail and mineral extraction. It is argued that the solution to the problem of computing SERVERD lies both in the co-generation of a mutual understanding between measurer and respondent of what counts as SERVERD, and a clear understanding of the R&D value chain contributing to the project under scrutiny. I

To this end a core set of questions that can form the basis of semi-structured interviews are identified. The implication of this approach is that conventional 'knock and drop' survey technique is inadequate to the task of measuring SERVERD.

It is further argued that South Africa's outlier behaviour in respect of R&D expenditure per researcher arises through the difficulty of quantifying these extended R&D value chains. An estimation method to deal with this is suggested.

As an effective mechanism for compiling SERVERD it is suggested that survey agencies identify one or two exemplar firms per sub-sector; understand the firm(s); benchmark the scale of firm SERVERD in relation to company revenue (turnover, new premiums written, interest income) and use this ratio to impute comparable SERVERD for other similar firms. SERVERD is thus measurable directly or by careful imputation and estimation. We conclude with remarks on new indicators that emerging innovation pressure will demand of surveys.

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1. Introduction

South Africa is a unique lower middle-income economy with its late (1870) industrial revolution spurred first by diamonds and then gold. The Randlords' problems of extracting ores and labour on one hand led to the purchase of whatever technology was available on world markets and on the other to the development of *apartheid*. The country with its 0.59 Gini coefficient (UNDP, 2003) comprises co-dependent first and second economies as visualized in Petra Rohr-Rouendaal's linocut (Figure 1).

Figure 1: 'South Africans' Petra-Rohr-Rouendaal linocut, 1975



Apartheid was predicated on human resource underdevelopment. Resource-poor India, according to Friedman (2005: 104) 'mined the brains of its own people.' Resource endowed South Africa mined the labour of its people. Internal response was the liberation movement, regional conflict and international sanctions. The state reaction of 'total strategy' achieved secrecy and self-sufficiency among others culminated in weapons of mass destruction and pay TV. Financial services grew expertise in sanctions busting and tax evasion so much so that this was the only sector that grew in the 1980s (Fedderke e.a, 2000). Dis-investment by computer and software companies encouraged local software and systems development - 'build or buy' became build or die.

The first economy of the young democracy is relatively open with exports equivalent to 28% of GDP (Statistics SA, 2005) and trans-nationals that operate on the African continent and globally. They are subjects and objects of mergers and acquisitions *vide* Old Mutual's purchase of Skandia Insurance and the Barclays Bank takeover of ABSA. In many respects the first economy resembles that of the lower income and low R&D intensity member states of the European Union.

While its resource companies have a long history of global activity, the services sector is a relative newcomer and is expanding aggressively. Three South African retailers are now in the world top 250 (NRFE, 2005). This reflects the fact that services now comprise 69% of GDP (Statistics SA, 2005).

Alongside the formal sector is the second economy conservatively estimated at 2,1% of GDP (BMR, 2006) a figure that is low compared with Mexico's 20% (World Bank, 2005a). This second economy also exhibits a large services component that covers health care, transport, finance and leisure.

Globalization and the redress of past inequities are now the innovation pressures facing the economy. Federal Reserve chairman Bernanke (2206: 7) concedes that globalization itself is a driver of both economic development and inequality so that the '...challenge for policymakers is to ensure that the benefits of global economic integration are sufficiently widely shared (and) a consensus for welfare enhancing change can be obtained.'

2. Learning to count all over again

During the 1990s the complexity of the post apartheid transition led to a loss of S&T survey expertise. Accordingly we had to build a representative survey team, re-learn how to produce the data and indicators and win the confidence of new players in the system. One area that presented particular difficulty to the R&D Survey was that of the services sector that had never been adequately surveyed.

This paper outlines approaches to dealing with the measurement of R&D expenditure in the service sector (SERVERD). In so doing we offer suggestions that may be of value to those

involved in measuring knowledge intensive service activities (KISAs) in other countries with a longer stable history of conducting such measurement.

We commence by describing present R&D measurement processes highlighting the difficulties presented in emerging economies where registries of business and R&D performers may be incomplete or even non-existent. We then move on to a set of case studies that highlight some of the varying aspects of measuring R&D in this environment. These provide imputation norms that may be applied where direct observation is impossible. We focus on the difficulty of determining the extent of extended R&D value chains and offer a means of estimating the head counts in these. This is especially needed in the South African case since the country data reveal extreme outlier status for the value of R&D expenditure per researcher, which suggests a serious under count. We conclude with some conjectures regarding new innovation pressures and their implication for S&T indicators.

2. Measuring R&D: the work of the Honey Badger

The Centre for Science, Technology and Innovation Indicators (CeSTII) has carried out the National R&D Survey according to Frascati Manual guidelines since 2002. Given the loss of survey capability through the late 1990s (Blankley and Kahn, 2005) CeSTII had to construct both methodologies and registers anew. Awareness of the R&D Survey among potential respondents was very low, and there was no official requirement to capture R&D expenditure to company accounts. Although a limited form of R&D tax incentive was in place (Kaplan, 2000) by 2002 the incentive was poorly utilized and no useful register of claimants was available. To the present there is still no official register of business sector R&D performers. This information nexus is typical of developing countries.

The R&D Surveys conducts a census of higher education and government research institutes, and purposive surveys of firms and the not-for-profit sector. The 2001/02 Survey received detailed responses for 137 firms in mining, natural resources and manufacturing. The 2003/04 Survey extended the coverage to 366 firms, with some penetration of the services sector. The 2004/05 R&D Survey covered 511 firms with the bulk of business expenditure on R&D (BERD) performed by what we call ‘elephants.’ We were pleased to find that the increase in coverage was accompanied by almost no change in the Gini coefficient for R&D expenditure.

SERVERD accounted for 27% of BERD (CeSTII, 2006a) that may be compared with Australia at 41% and Canada at 38% (OECDa, 2006: Table 44a).

In parallel with the increased coverage of firms the measurement of the other sectors has improved and the 2003/04 and 2004/05 surveys reveal unchanged proportional expenditure across higher education, government and business. To achieve this we expended considerable effort to ensure that the university returns exhibit consistency in the labour to current expenditure ratio. Incomplete or poorly articulated university information systems as well as differing approaches to full cost accounting explain the divergence. Generating consistent primary data is necessary since we cannot rely on secondary sources as do statistics offices in some other countries.

Although from 2005 the R&D Survey is a component of Official Statistics one must still persuade rather than coerce respondents. The absence of a reliable national business register let alone a register of R&D performers requires constant business intelligence gathering. This evokes the image of hunting for the 'big five' in the African savannah. So we took the African Honey Badger (*Mellivora Capensis*) with its symbiotic Honeybird as our mascot.

The 2005/06 R&D Survey will be performed immediately prior to the inception of a new R&D tax incentive that allows deduction of pre-tax R&D expenditure at the rate of 150%. This sweetener to business may induce enhanced participation in the survey and hopefully improve the register of business sector R&D performers.

3. Hunting for elephants on the savannah

The knowledge economy trend toward services, coupled with extended R&D value chains, and the changing definition of R&D increases the risk of under and double counting. The Frascati Manual notes that '(services) R&D is not always organised as formally as in manufacturing companies (i.e. with a dedicated R&D department, researchers or research engineers identified as such in the establishment's personnel list, etc.). The concept of R&D in services is still less specific and sometimes goes unrecognised by the enterprises involved.' (OECD, 2003: 48). This is a problem in both advanced and emerging economies.

Where identification of R&D is difficult, and the value of its quantification to companies is perceived to be low, we have learnt that responses are highly personal and require the building of a relationship of trust with respondents. This is modulated by culture and power relationships that may prevent a team member being able to bring in a particular respondent. Our survey process is thus labour intensive and involves ongoing learning for both the team and the respondents. A ‘knock and drop’ postal or e-mail survey would result in failure.

An example from the minerals sector serves to illustrate the importance of strong personal interaction. A junior level team member approached a previous respondent, and was met with a ‘NIL’ response. This was highly improbable given media statements attesting to buoyant company investment. So a senior team member had to make the follow-up that revealed a major investigation into the use of mineral tailings and expenditure on the construction of a USD 10 millions pilot plant. Although the company R&D payroll involved only ten staff the associated R&D value chain included contractors, knowledge intensive business services (KIBS) provided by consulting engineers and technical services from metallurgical and testing laboratories.

The headcount of graduate professionals (researchers?) in the extended value chain beyond the firm boundary is difficult to quantify. As matters stand South Africa is a high outlier for the expenditure per business sector researcher¹ as reported in the *Main S&T Indicators* (OECD, 2006a). This distortion may arise through two factors: the first is that researchers enjoy excessive remuneration while the second is that an undercount of researchers. To locate the ‘missing’ researchers one could seek access to the official registers of chartered engineers and professional scientists, but this would not reveal the time-activity deployment of these personnel. The pragmatic alternative, as we shall do below is to impute a value for the missing headcount of R&D within the KIBS and technical services in the R&D value chain.

A second example illustrating the importance of understanding the R&D value chain comes from clinical trials² phases II and III. Companies tend to report clinical trials as

¹ The second reason is to do with the cost of scarce skills whereby these are bid up to levels that in nominal terms are close to remuneration levels in the OECD core economies.

² In South Africa such activity conforms to Kuemmerle’s (1997) definition as ‘home base augmenting.’

‘manufacturing activity.’ In general this is incorrect as clinical trials should be located under ‘Research and Development’ that is a KIBS. In the case of contract research organizations (CROs) the services include field observation, pathology laboratory tests, and data processing. In these trials managers and principal investigators are in head office, with scores of individual sites under the local supervision of general practitioners and nurses. This comprises a large R&D value chain the cost of which is predominantly time and consumables. Capital expenditure is low and largely confined to data processing hardware. The undercount of researchers concerns general practitioners especially those who are not on the staff of a university or a research institute. It is impractical to estimate this missing headcount by referring to the state medical practitioner register.

We now direct attention to the area of services proper, those things that ‘... can be bought and sold, but cannot be dropped on your foot’ (Miles, 2003). We shall consider what may count as R&D in services and how the elephants may be identified and captured. Miles (2003: 63) reminds us of the lack of attention that has been paid to technological change in the services sector, it being viewed as populated by ‘innovative laggards’ so that ‘... few services were recognized as exceptions to this rule by the relatively few researchers who have examined the services economy.’

4. The Shrew that didn’t know it was an elephant

To improve understanding of service sector R&D a project (Hounwanou, 2006) was commissioned prior to executing the 2005/06 R&D Survey. We considered sub-sectors covered in sections 50-59 of ISIC Rev. 3.1 and interviewed twenty leading banks, insurance companies, and retail and logistics companies. Our gentle badgering yielded eighteen structured interviews through which we sought information on R&D and inquired into technological learning and innovation activity.

The eighteen firms are their respective sector leaders with total revenue of USD 60 billions (median USD 2,5 billions) and a median number of employees of 21,000. In terms of size they are elephants. That might or might not be the case with respect to their R&D activity.

In all cases we found that the firms had some focal point for R&D or technology acquisition, frequently in the office of a technology manager or ‘head of research’ though only half had an

R&D division. These divisions typically comprise a handful of individuals so that the question ‘how much do you spend on R&D’ would typically generate a response based upon the cost of this division in isolation and might be ¼ million USD. For a firm with revenue of USD 5 billions this looked improbable.

All respondents had difficulty understanding what might count as R&D. Even where they recognized that their company performed R&D the generally dispersed nature of RD effort across divisions created a second problem of how to estimate it.

A third difficulty is the ephemeral nature of R&D projects that might include external CROs, management consultants or software houses. So the extended R&D value chain appears again. It is compounded with the problem of the appropriation and cost sharing of jointly developed intellectual property that is often the case in application development.

None of the firms made direct reference to the involvement of higher education or government research institutes in such value chains. This was also found to be the case in the Norwegian OECD KISA study (Broch and Isaksen, 2006). The low importance accorded to higher education and government research institutes is confirmed in both South African innovation surveys (Oerlemans e.a. 2004 and CeSTII, 2006b). Instead there were claims that collaborative work occurred with foreign peers as well as foreign suppliers. These unstructured relationships constitute knowledge transfer that may be better described as ‘connect and develop’ (Dodgson, Gann and Salter, 2005: 47) than conventional ‘R&D’ activity.

All the companies operate extensive of in-house legacy computer systems alongside proprietary information systems. The expertise to develop the original legacy systems goes back to the sanctions era. Given the massive usage of information systems the interviews required sharp focus on the way that information technology is maintained and developed in the firms. So for example one interviewee had declared R&D expenditure of USD 0,5 millions to the 2004/05 survey. A few months later the company issued a press release announcing migration to a proprietary enterprise resource planning (ERP) system, since their ‘previous three-year in-house investment of USD 40 millions had been unsuccessful.’ So it was clear that the company had under reported to the survey and must have had considerable

systems development capability with expertise to engineer an equivalent to the ERP. So two questions arose: 'what had become of the system analysts and developers and what level of expenditure should have been recorded?' The answer to the first was– 'they are still with us. The ERP will only take care of certain aspects of our business. We shall continue to maintain and develop other legacy systems. These include forecasting software as well as customer profiling packages. In any case one cannot integrate something as complex as ERP without your own skilled people.' It turns out that the company employs fifty software engineers and another fifty technical staff. We agreed that the time split would be around two-thirds for R&D. The shrew turned out to be an elephant.

Last to be considered were the banking and insurance industries. These financial services show quite different customer interaction one to another. Banking involves frequent transactions; insurance by intent anticipates less frequent interaction. Both require extensive IT systems, and rely on careful risk analysis to manage debtor books and customer profiles. Actuarial services are paramount for both. The range of research activities that were reported span economics and management, customer behaviour, product development, pricing research, competitive intelligence, technology scanning, regulatory and tax compliance, system and software development. Hardware was generally sourced from the international market. The decision that the R&D or technology manager now faces is 'build or buy?' It is clear that capability to go either route exists. All of the large financial service companies host IT divisions that are a legacy of the previously closed economy. Staffs in these divisions hold a range of qualifications from a school-leaving certificate through to industry qualifications (Microsoft, Cisco etc.) or university degrees. The members of staff that manage the portfolios are typically chartered accountants often with an MBA.

In general the managers regarded their approach to innovation as being that of early adopters of technology. They often referred to 'looking at what our competitors are doing.' This is perhaps an understatement since many new financial products have been invented in this community. These include a range of ATM enhancements, Internet security and mobile phone banking. The banking industry as a whole has had to re-think its approach to risk, most notably in developing a banking model for those with very low incomes, the so-called 'Mzansi' clients. The banks and insurers also recognize the weight of history and sunk

investment in systems – ‘(upstart) X is more nimble than we are – they don’t have a legacy to hold them back’ was one ironic comment.

5. Some common threads

A sample of eighteen firms is small, but these had all been assessed to be potential elephants, so that their contribution to BERD and services expenditure on R&D (SERVERD) might be considerable. In the event this assumption turned out to be correct.

Commonalty across the firms was strong for certain attributes. The first concordance was the low awareness of what might count as R&D activity and the parallel failure to record the amount of effort attributable to it. Yet all showed considerable innovative ability so one might understand this as arising where innovation is a normal part of business and does not attract specific attention.

The second regards the low number of ‘researchers’ that hold doctoral degrees in these companies. The grand total for the firms in the sample was a dozen, leading one to conclude that doctoral degrees were the exception rather than the norm. Put differently, the availability of PhDs does not appear to be a precondition for the conduct or existence of R&D in the South African service sector. This is contrary to the Frascati view that the presence of a concentration of PhDs is an indicator of R&D capability. Since much of the R&D in the sample is in software and system development for which the PhD is clearly non-essential, the absence of PhDs makes sense.

None of the firms expressed concerns of a shortage of the requisite skills to maintain the R&D function. This suggests that supply from higher education is adequate, which may be counter-intuitive given the widespread belief that a high-level skills shortage prevails in the country (Lunsche, 2006). This apparent contradiction may be explained as follows. While it is true that the production of school leavers with the requisite grades to enter tertiary level science-based careers is inadequate, a significant proportion of this elite stream opt to pursue studies in business science, accounting, economics and law, through which routes they find themselves in the business environment working in software, modeling or marketing roles. It appears that talent is finding its way to careers in sectors that exhibit high growth and personal opportunity. Traditional science and technology-based careers are unable to offer a

strong enough pull to attract all the bright kids with star grades in mathematics and science. The static and even declining level of enrolments in science, engineering and technology streams reflects this new market reality. Accordingly it is less a matter of scarcity rather than a matter of re-allocation.

All the companies in the sample claimed to be undertaking software development of a complexity that qualifies as 'novel.' Indeed the discussion regarding the nature of their software development activities and what component thereof might be countable as R&D turns on this issue. We often put the question: 'would the loss of this intellectual property damage your company and would you therefore seek legal redress?' An answer in the affirmative helps the respondent to recognize the existence of the IP and then to decide how it was generated, what it cost and how much to attribute to R&D expenditure.

Another probe that we use to unpack management or marketing research is to ask whether the product of their work might be of a quality that in a university environment could lead to its publication in a peer-reviewed journal. An affirmative response would suggest that the work is countable as R&D.

Bar one short-term insurer the firms in the study have global footprints and earn significant income abroad. None of the firms appear to operate an R&D facility abroad so that their foreign activities amount to Kuemmerle's (1997) 'home base exploiting.'

We also sought to determine the source of technological learning for the firms. The first finding was that the firms ranked their own R&D division as the most important source of new ideas, followed by 'Management.' Given that half the firms do not have an R&D division *per se* and recognizing the seniority of the technology managers it is reasonable to combine these two groups as 'senior management.' The next most important source of technological learning was customers, followed by 'other staff.' What this suggests is a very strong emphasis on learning through one's own people, rather than from external sources. Next on the list are competitors, suppliers and public sources. Last come the government research institutes and universities. The absence of links with the former makes sense since their work is highly sector specific and far removed from the type of services the firms engage in. But

low engagement with the universities is surprising given the high profile of business schools and computer science departments at the leading universities.

Another common feature is the existence of extended R&D value chains. These appear to be more KIBS than KISA since the role of the public sector was generally described as low. KIBS may be sourced from within (internally) or beyond the group (externally). We denote the expenditure on these services as K_i and K_e respectively. The ratio $K_e: K_i$ indicates the extent to which firms source KIBS outside the company.

In the South African case where we know that the expenditure per researcher deviates considerably from the norm, we note the low number of researchers recorded, namely 1,6 per 1000 of the employed workforce (DST, 2006). One may obtain a rough estimate for the missing headcounts (N) responsible for the production of K_e by assigning say half of K_e to skilled labour costs and then dividing this by the average cost of the skilled labour. Careful judgement is needed as to the cases for which this adjustment should be made. This calculation could be performed for respondents where K_e exceeds the stated labour costs by more than 3:1. We expect shortly to re-analyze our most recent business sector returns to determine the usefulness of this estimation.

Regarding differences across the sub-sectors we found that the banks regarded their own managers as the most important source of technological learning. The two banks that regarded themselves as leading innovators had no R&D department, while the others that claimed to be first followers did.

Insurers on the other hand generally saw themselves as first followers and all had R&D departments. They thought their R&D personnel were most important as the source of technological learning. Retailers on the other hand assigned equal importance to management, R&D personnel, customers, competitors and suppliers.

Earlier we mentioned the R&D tax incentive that will come into force in October 2006. Only one of the more than fifty staff interviewed was aware of this. They expressed surprise at being informed and some indicated that ‘... well we shall now have to keep track of the expenditure, won’t we?’

One of the project aims was to generate imputation norms (Table 1) that could be used to make estimates for similar companies that did not participate in the survey. Banks regard interest income as their main source of revenue while for insurers the industry approach is to regard 'new premiums sold' as the source of revenue. We then generated reasonable norms of expenditure in relation to these different revenue definitions. One notes that the banks and retailers have quite similar ratios, which is in line with expectation given their heavy deployment of hardware at the 'point of sale' be this a supermarket till or an ATM. The difference in scale of expenditure between the banks and insurers also makes sense in that the IT function is much more intense for banking than insurance. In our R&D Survey work we had to this point already found that the 0.3% level for the banking industry was reasonable. On the other hand we had pegged the level for the insurers at 0.03% that turns out to have been a serious under-estimation.

6. Pie is SERVERD

Our study of the services sector developed a shared understanding of what counts as SERVERD. By so doing we reached agreement for each sub-sector on the definition of company revenue and generated norms its relationship to R&D expenditure. These norms are broadly similar to what had begun to emerge through the time series of R&D Surveys with the exception of insurance that we had pegged threefold lower.

The logistics firms were alone in claiming they did no R&D whatsoever. Given the massive dependence of logistics activity on IT, and the fact that at least one publicly traded logistics firm declares expenditure on 'system development' in its annual report, under-reporting is obvious.

We examined SERVERD against the historic context in which indigenous capability in software and systems developed under unique innovation pressure. The study confirms the central role of information technology in the services sector with the need for algorithm construction, programming, and/or reverse engineering of competitor software solutions. These require in-house skills both to conduct and manage R&D. So managing the shift to a proprietary ERP requires integration with company information systems as well as ensuring

one is not taken to the cleaners. R&D on IT comprises a large component of SERVERD, be it provided internally or externally.

While all the firms conduct some R&D in IT there are also strong differences in their R&D portfolios. Clothing retailers have different ways of introducing new product lines to those selling fast foods. The former spend considerable resources on modeling customer behaviour to get optimize stock levels. The latter operates a traditional product development facility with an R&D component.

The firms all performed countable R&D, but prior to being interviewed many did not recognize it as such. In general the bulk of their KISA was provided internally, which concurs with the findings of the OECD (2006b) study. Broadly speaking, South African services sector firms (including those in the study) have had less success abroad than South African resource exploiting firms. This says something about their history and the quite different organizational and trading environments that face an insurance company or retailer as opposed to a pulp mill, brewery or mine. Banks and retailers have so far made poor foreign acquisitions and it is tempting therefore to question their strategies for intellectual capital management of which R&D is such an important part.

The attribute that distinguishes the South African services sector from those in OECD and EU Member States concerns human resources. Firstly the absence of staff with doctoral degrees in the sampled firms belies the presence of considerable R&D. Second is the outlier status in country human resource data. We have argued that the outlier is a statistical artifact arising from the inability to count R&D in extended value chains. To this end we have provided a simple estimation method. The 'extended R&D value chain intensity' K_e : K_i might also become a useful indicator.

We have shown how SERVERD may be measured through direct engagement with respondents and how imputations may assist the quantification.

Following Arundel, Collechia and Wyckoff (2006) we conclude with consideration of the changing nature of innovation, and the way we understand and measure it. Innovation policy examines the relationship between innovation and wealth creation, and arguably with well-

being. The World Bank Investment Climate Survey (World Bank, 2005b) speaks to four factors that modulate investment decisions, namely security and stability, workers and labour markets, tax and regulation, and finance and infrastructure. These general factors explain decisions regarding where to invest i.e. locate facilities such as call centers, clinical trials and software development as in the well-documented case of India, and the unfolding case of South Africa. The financial and people aspects are partially covered in the Frascati approach. The other factors, the framework conditions, are not.

Each national system presents unique factors arising from the innovation pressure that 'constructed crises' (Kim, 1998; Kahn, 2006) may exert. For South Africa these now include the HIV/AIDS pandemic, safety and security, poverty reduction and economic inclusion. In the latter case 'black economic empowerment' is embodied in government regulations.

Surveys are subject to these same innovation pressures and have to adapt their measures to the requirements of policy. However our first innovation survey, as a learning experience studiously follows the CIS 4 framework. On the other hand our first R&D Survey, that for 2001/02 was venturesome. We included items designed to understand mobility as well as to capture a full demographic profile of the research personnel. This was necessary as there was and still is no other national database that can provide this information. We have since begun to experiment with items on R&D collaboration.

Despite legislation participation in the surveys relies on the goodwill of respondents so we must be sensitive to the problem of survey fatigue. Accordingly one tries to restrict the number of items and their complexity. This desire for lightness is tempered with the needs of policy. So we expect to develop indicators that measure innovation in the second economy, indigenous knowledge systems, technologies for poverty reduction, small and micro enterprises, and social delivery. Indicators that deal with the renewal of the workforce and inclusion are also likely to be required. Where one seeks impact indicators one might develop measures and indicators through 'future backward' scenario construction (Fahey and Randall, 1998).

Bearing in mind incomplete information systems, the cost of collection and survey fatigue, there is a strong case for the identification of proxy indicators that may substitute for direct survey method in emerging economies. This may be the substance of a future conference.

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Table 1: Imputation norms for the service sector

Sub-sector	Revenue (main)	R&D : Revenue (%)
Banking	Interest plus non-interest	0.3
Insurance	Value of new premiums plus interest	0.1
Retail	Sales and interest	0.3