

Modernization of Information System for Economic Statistics: An Integrated Approach for Policy Analysis

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Background

I am happy to be here in your midst to attend the 19th conference of the Society of Statistics, Computer and Applications. My emotions run high to pay tribute to our esteemed founder of the society Dr. M N Das to whom we are all deeply indebted for the love and affection he bestowed on us while encouraging us for professional excellence with sincerity and dedication. The spirit of simple living and high thinking was a way of life for him. I first met him in January 1971 when I came to IASRI as a guest of one of his students. I still remember my friend saying that if one wanted to pursue research, he should meet Dr. M N Das. Dr. Das was known as a highly creative, original and considerate person, who gave his students the confidence required to come out with distinction in the chosen area of research. The original research in the area of design of experiments and sample surveys took him to the pinnacle of eminence. An important pastime for him was writing computer programs for empirical solution of difficult problems. The name the Society bears is because of his belief that applied statistics and data analysis are as important as theoretical work. I got associated with the Society from the very inception and extended him support for promoting the cause of the Society. His passing away was a great personal loss for me. It was with great pain and sadness that I saw his last. Though he is no more with us, we shall never forget this great soul for the love and affection he bestowed on us.

I have decided to talk about the need for modernization of information system for economic statistics for deeper insight on the economy for informed policy as a befitting tribute to Dr. Das, who also served the Indian Statistical System. As I explain, the time is ripe for pursuing this idea.

Key words: Economic Statistics, Policy Analysis, Information Revolution, Integrated Approach, GDP, Productivity, Social Accounting matrix, Learning Society.

1. Introduction

We are crossing through information revolution changing our life style and thought process. Anticipating this H. G. Wells said, "Statistical thinking will one day be as necessary

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for the society as the ability to read and write." H. G. Wells, who died in 1946, had leftist leanings but was disenchanted with developments in Russia after what he saw there. He devoted his time in teaching and writing. His writing on evolution of civilization was a must reading for the people who grew up in the midst of fast pace of social transformation during the first half of twentieth century. Such a great thinker foresaw the important role of Statistics notwithstanding the adage "Lie, damn lie and statistics". Though the subject has taken a centre stage in the day to day life around us, I encounter this kind of observations even now. My reply to this is again a quote "Figures don't lie, it's the liars who figure out". Today, statistics is all pervasive. The subject has become an integral part of learning right from school curriculum, proving his prophetic statement correct. However, we have still miles to go before realizing full potential of information age.

We intend to suggest an integrated approach to economic statistics as a part of Official Statistics for informed decisions. In the present state of development in Information and Communication Technology (ICT), when it is possible to have web based reporting of data from field to a central server and process them using state of the art Data Warehousing (DW) technology, relate various data for a multi-dimensional view as per analytical requirement and retrieve such processed data including powerful graphical visualization, we need to take advantage of this technology. We will explain how this effort on modernization of Official Statistics can lead to a new edge on economic development.

2. Economic statistics

Economic statistics are observed data conforming to economic concepts on measurements, covering a wide spectrum of data on output, input, costs and prices, employment, trade, finance, budget and so on, considered relevant for explaining the economy. These data can be grouped in different ways. The System of National Accounts (SNA) under the careful aegis of the United Nations Statistics Office and other international organizations involved in development of standard on statistics provides the basic framework for collection and organization of economic statistics keeping in view their use for analysis.

3. GDP and related aggregates

GDP is a measure of the value of goods and services produced in an economy during a given period of time. With a view to ensuring that there is no multiple counting of goods and services, a concept of value added is used for arriving at unduplicated figure of total amount of goods and services produced. The compilation of GDP and related aggregates are based on "a set of concepts, definitions, classifications and accounting rules that comprise the internationally agreed standard for measuring such items" as covered in the SNA, now following 2008 revision.

The break-up of GDP on goods and services cover output, intermediate consumption, taxes less subsidies on products, final consumption, consumption of fixed capital, changes in inventories, saving, investment, other changes in volume of assets, etc. The system includes external transaction and financial position. The accounting system leads to a summary of accounts, balancing items and main aggregates relating to current account, accumulation account, balance sheets and contributions to changes in net worth, thus setting out a complete set of accounts, measuring both flows and stocks, for a country for analysis of the economy. The analysis is mainly focused on investigation of causal mechanisms that propel the changes in the economy.

4. Sectoral break-up of GDP

The data on output cover primary sector - agriculture, forestry and fishing, mining and quarrying; secondary sector - manufacturing, electricity, gas and water supply, other utility services and construction; and tertiary sector - trade, repair, hotels and restaurants, transport, storage, communication, broadcasting, financial and insurance, ownership of dwellings and real estate, professional, scientific and technical activities, administration and support services, public administration and defence, education, health and social work, art, entertainment and recreation, and other services.

5. Agriculture statistics

Agriculture statistics relate to land use, yield, input-output combination, cost of cultivation, rainfall, price of inputs and output and so on. The data also include grain stock, technology, agri-marketing, tenancy, production system, procurement, agro processing and so on. These data on agriculture on output, terms of trade, labour and employment, productivity, etc. shed light on important parameters for understanding agro-economy.

6. Industrial statistics

Industrial statistics covers data on output, input used to produce the output, profits and their appropriation for estimation of data by industry following standard classification and measurement of aggregates. The data also includes number of persons engaged, employment including hours worked, wages and salaries, revenue earned, taxes paid, subsidies received, changes in stocks, materials consumed, production capacity and its utilizations, expenditure on research and development, exports and imports etc.

The main output based on the collected data relate to quantity, value and volume of production by industrial classification. Gross value added from manufacturing and index of industrial production are two main sets of aggregates compiled from the collected data.

7. Services sector statistics

Services sector, as defined above, follow the same pattern on measurement of output, input used etc. However, measurement issues on services at times pose challenge. For example, measurement of price for financial intermediation services is still a difficult problem. In India, many of the services are deflated by wholesale price indices in absence of appropriate service price indices.

While GDP covers all kinds of goods and services to measure economic growth over time, it is effectively the money value of output that is estimated. In the initial stage of conceptualization of GDP, a major debate was how Apple and Orange can be added together. The famous Cambridge schools debate ended in price mechanism sorting out the problem. However, the question remains if one gets two Oranges for the price of one Apple, does it mean that two Oranges have the same nutrition value or satisfaction level as that of an Apple. This is not a simple question to answer. Leaving this debate to the readers, we will briefly mention about price statistics which is used to estimate GDP.

8. Price statistics

In the multi product context the effect of changes in prices is measured by weighing price quotations and aggregating them to form an index representing a composite basket of commodities. The idea is to find a measure of the different products in value terms for combining them and also estimate effects of price changes.

Consumer price indices measure the average rate of price changes for goods and services forming part of consumption basket, sold to the consumers through retail stores or retail vendors. These indices are used to measure consumer price inflation in the economy.

Producer price index is constructed to measure changes in prices charged by domestic producers at factory gate to the wholesalers, bulk purchasers and exporters. These indices are used to deflate data for comparison of volume of goods and services at constant prices. Wholesale price index measures price changes at the first level of trade in wholesale market and includes transport margin.

GDP deflator is a composite index of CPI and PPI at basic prices. This is a broad index more appropriate for measuring general price inflation in the economy than CPI, PPI or WPI. If we divide GDP at current prices by GDP at constant prices, we arrive at a very broad index known as GDP deflator. The issue is does GDP deflator reflect the appropriate price changes relevant for specific goods and services? Whose price is this?

9. Monetary and financial statistics

As mentioned in SNA 2008, “The financial account is the final account in the full sequence of accounts that records transactions between institutional units.” The institutional units are grouped into five mutually exclusive sectors *e.g.* Non-financial Corporations, financial corporations, government units, including social security funds, Non-profit institutions serving households, and households.

Financial assets include monetary, gold and SDRs, currency and deposit, debt securities, loans, equity and investment fund shares, insurance, pension and standardized guarantee schemes, financial derivatives and employee stock options, trade credits and advances and others. A financial liability is the other side of the financial asset.

Monetary aggregates include currency with the public, demand and time deposits with the Banking System, certificate of deposit issued by banks, and others.

Banking statistics include deposits, credit and investments with details such as priority sector advances, credit to exporters, asset quality, etc.

Financial statistics also includes non-banking financial companies, informal financial sector, insurance, capital market, money market. The data on both flows and stocks form parts of monetary and financial statistics.

Financial Institutions include Central Bank, Depository Corporations except the Central Bank, Money Market Funds, Non-MMF investment funds, Other Financial Intermediaries except Insurance Corporations and Pension Funds, Financial Auxiliaries, Captive financial institutions and money lenders, Insurance Corporations and Pension funds.

10. Financial account and flow of funds

As the name suggests, Flow-of-Funds (FoF) measures financial flows from sources to uses of funds across classes, *e.g.* institutional sectors of the economy through financial intermediaries for acquisition of physical or financial assets and liabilities in the economy. The overall change in balance sheets are decomposed into three flow accounts (1) transactions (FoF), (2) valuation changes, and (3) other changes in volume of assets and liabilities. These accounts show flows and stocks for each economic sector of the economy and each financial instrument. These data highlight the role of financial Corporations in financial intermediation.

An important issue in the analysis of FoF is who gets funds from whom for capital formation for creating additional capacity for production. As we know, rural financial market does not attract enough funds for investment to modernize productive capacity to push production possibility frontier outwards for raising rural income. In view of this it is desirable to decompose FoF by rural and urban breakup, even approximately, to understand how our policy on priority sector lending to agriculture and small business is working. The disaggregation by regions *e.g.* state and district for at least rural lending can also give much needed insight on rural financial market.

11. Fiscal statistics

Fiscal Statistics or Government Finance Statistics (GFS) concerns the finances of government. It includes revenue and expenditure of the government, sources of these revenue, details of government expenditure, including direct benefit transfer for people below poverty level, surplus and deficit along with balance sheet.

Fiscal Statistics is a core concern of both government analysts and external analysts to assess interventionist government policy and sustainability of government revenue and expenditure against prudential norms. Analytical questions relate to its contribution to aggregate demand, investment and savings including resource use, monetary conditions, and national indebtedness, the tax burden, tariff protection, and the social safety net. Effectiveness of spending on poverty alleviation, the sustainability of fiscal policies, net debt, net worth, and contingent claims against government, including obligations for social security pensions are also issues for analysis.

12. External sector statistics

External sector statistics include Exports and Imports of goods and services; Foreign Affiliates Statistics (FATS) covers economic activities of foreign owned or controlled (over 50% ownership); International Investment Position (IIP) measures external flows of investments. Balance of Payments Statistics gives a consolidated picture of a country's income and expenditure with the rest of the world, inflows and outflows of capital, etc. Capital account records non-produced, non-financial accounts such as land sold to embassies and sales of leases and licenses, as well as Capital Transfers. Financial Accounts show the net acquisition of financial assets and net incurrence of liabilities. External Debt Statistics include Direct Investment, Portfolio Investment, Financial Derivatives, other investments, Reserve Assets.

The above segments of National Income are designed to cover all aspects of economic activity of a country. The issue is how these estimates relate to economic performance and welfare of the people.

13. Labour and employment

As the central force behind economic activity is human welfare, it is essential to relate output with their producers. The International Labour Organization (ILO) setting the standards for measurement of labour defines "economically active population in terms of individuals willing to supply labour to undertake an activity included in the SNA production boundary."

The above description indicates how commodity market, financial market, external trade market and labour market are constituents of a unified system of economic activity and forms building blocks of market economy. The next issue is the formulation of analytical framework for macroeconomic analysis.

14. Macroeconomic analysis framework

The economic statistics is the raw material for economic analysis. Economics is variously defined. The easiest one is "Economics is about how economy works." The intellectual idea on economics, however, is not this simple. It is not only production and distribution of goods and services, but also about the way individuals and society make choices, and their consequences. The issues relate to investigation on fundamental principles on how the economy works, how social objectives are to be achieved. As Lionel Robins observed, economics serves as guide to interpretation of reality and as a basis for political practice.

There are a few basic issues for economic analysis. The first is whether the resources available for sustained growth are fully utilized. Are these resources being utilized efficiently? Are the productive capacities growing over time? If yes, what are the factors contributing to this process of growth? These questions relate to production. To understand the dynamics of production, we need to measure them. As explained above, SNA lays out how production should be measured following concepts and definitions consistent with economic reality and comparable internationally. The next issue is to explain the composition of production, namely, consumption, saving and net exports so that these variables can be analyzed behaviourally.

Borne out of behavioural traits of people in market place, economics builds on rational choices of individuals and firms for developing theory. The economic agents are expected to maximize their utility in a frictionless market economy following the axiom of rational choice theory. The market is seen as coordinator of economic agents through price mechanism. In the process a general equilibrium is ensured by the price mechanism and market aggregate. The general equilibrium is a state of affairs in which all markets are in long run competitive equilibrium. This competitive equilibrium is expected to ensure reasonably efficient institutions for allocation of scarce resources leading to high productivity and social welfare. There is a strong mathematical basis for this theorization as explained, among others, by Sen (1982) in the book titled "*Choice, Welfare and Measurement*." These abstract theories under certain assumptions suggest testable hypotheses, such as (1) all consumers marginal rate of substitution for any two goods equals their price ratio, (2) the marginal rate of technical substitution is the same for two inputs in the production of all outputs, and (3) the marginal rate of transformation for any two goods equals their price ratio. We need data for their validation.

15. Building blocks of macroeconomic modelling

Macroeconomic modelling tries to link economic variables behaviourally in the context of integrated market for commodities, money and labour along with external sector. The modelling exercise starts with National Accounts identity representing GDP as Y , consumption as C , saving as S , investment as I , government as G , exports as X and imports as M as below:

$$\begin{aligned} \text{GDP} &= \text{Production} - \text{Intermediate Consumption} \\ &= \text{Wages} + \text{Profits} + \text{Other factor payments} \\ &= C+S+G+\text{Net } X \text{ (excluding net income from abroad)} = Y \end{aligned}$$

Including Net Income from abroad, we have

$$\text{GNP (Demand)} = C+I+G+X-M = A \text{ (Absorption)}$$

Further,

$$Y = C+I+G+X-M-T, \text{ where } Y_d \text{ is disposable income.}$$

If we denote private saving as $S = Y - C$, and rearrange, we have

$$X - M = (S - I) + (T - G)$$

Also, Current account balance = Net saving/dissaving of private sector + Government fiscal deficit/surplus.

This shows that the equilibrium level of national income is determined where injections (left side) are equal to leakages (right side).

The above is also called the Real Sector of the economy. The financial saving and investment is channeled through Financial Sector, and the government revenue and expenditure form part of Fiscal Sector. Export and import form part of External Sector or Rest of the World.

The total income is decomposed into its components for analysis of consumption and investment behaviour. Consumption and savings are the choices of individuals. Savings are used for further production through investment. Economic growth largely depends on how individuals make these choices. In fact, the process of economic growth depends on these choices. Investments made by productive units create value by using factors of production, namely, land, labour, capital and enterprise; each of which needs to be compensated. The question is how should the producing units be compensated for their share of production? The allocative efficiency requires that market works its way through price mechanism in line with changing demand and supply. It is the market forces reflected in price signals which is expected to solve the complex problems of resource allocation equilibrating the demand and supply.

Well, in reality the market is not so self equilibrating. The commodity market, labour market and financial market are not as frictionless as the theory assumes. Government steps in to correct for aberrations in market economy. Also, free market does not by itself ensure social welfare. Further, the pulls and pressures of global market determine the way net export turns out.

So far the discussion has focused at length the controversy around macroeconomics (Barman, 2016). It suffices to quote Turnovsky (1997) who observed, "Macroeconomics has never reached a consensus and probably never will". We are now at an inflexion point, and the information age will lead us to a major change in the way the economy is analyzed.

16. Importance of market microstructure

The political economy plays out on vote maximization and bureaucrats are bureau maximizers. The public choice theory requires that economic statistics are produced independently of these pressure blocks so that the society can assess how they are governed though implicit social contract between them and the government. Hence, we need detailed information on all aspects of economic activity over time and space as credible output for stake holders as public good, relatively free of influences of power blocks.

India growth story is a matter of high satisfaction. The macro parameters support this confidence. So far, so good. How does it matter for the welfare of majority of the people? With eighty percent of Indians living within twice poverty line it is well known that the fruits of high growth went mostly to top deciles of the population. In a recent study by Mishra and Parmar (2017), it was found that 'income inequality (*Gini index*) in rural India has increased from 0.50 to 0.54 between 2005 and 2012, whereas, in urban India income inequality has increased from 0.48 to 0.49 during the same period". We know that there is a huge rural-urban divide in India, and the slums in urban India bear the testimony of this divide. In fact,

rural India is greatly different from urban India with agriculture labourer being worst off, and hence these people migrate to urban slum to escape from abject poverty.

There are many other issues. Measurement of productivity is a crucial area of study to help improve income. Social Accounting Matrix is another important component for facts on social welfare. Environmental accounting is equally important for sustainable development. The basic human needs are not only food and shelter, but also their capability and freedom of choice. The aggregates hide vital distributional aspects, in absence of which an unreal picture of the country's march towards prosperity and welfare tends to take the central stage. To quote from Alice in Wonderland, "Well! I've often seen a cat without a grin", thought Alice; "but a grin without a cat! It is the most curious thing I ever saw in all my life!" India story is similar.

17. Micro-macro linkages matter

The SNA was not intended to be a perfect system for analysis of the economy. As Richard Stone, the main architect of national accounting had put it, national income is not a "primary fact" but an "empirical construct." This empirical construct, adding apples with oranges, became raw material for setting up macroeconomic theory for explaining growth and fluctuations in income and the policy interventions needed to influence a stable trajectory of economic growth with equity. The obsession with GDP created many real problems without commensurate benefits, particularly on social welfare front. Though GDP had started growing at a fast pace, income distribution has become far less equal since 1980s. GDP does not talk about distribution. However, distribution is as important as growth. As Schultz (1981) observed, "If we know the economy of being poor, we would know much of the economics that really matters."

The SNA 2008, in para 1.59 recognized the use of micro-data for macroeconomic accounting. It observed "There would be considerable analytical advantages in having micro-databases that are fully compatible with the corresponding macroeconomic accounts for sectors of the total economy. Data in the form of aggregates, or averages, often conceal a great deal of useful information about changes occurring within the population to which they relate".

The issue is how to build a system for micro-macro linkages for much deeper insight on dynamic forces operating in the economy. The *World Development Report*, in its first issue published in 1997, forecasted: "The global economy is undergoing an information revolution that will be as significant in effect as the industrial revolution of the nineteenth century." In the last twenty years we have seen one of the fastest transformation in the Indian economy with major cities full of skyscrapers, roads chocked with motor vehicles, mega cities under severe grip of pollution as a result. The substantial rise in education, improvement in health and reduction in child mortality, reduction in poverty and hunger, greater gender equality and so on are equally commendable. The economy has bounced back from a spell of GDP growth below five percent to the earlier trend of near eight percent and feel good factors are returning after a short lived shock by way of demonetization of high denomination currency notes. The major issue before us now is inclusive growth to banish poverty and hunger by 2030 while sustaining development and ecology. What is the base line at this stage for this projection? We need to modernize our statistical system to produce data for this base line, which will shed enough light on the dynamic forces shaping the structural transformation of our economy and the intervention that works efficiently to propel the economy in the desired course of inclusive growth.

The theory for analysis of data, using the micro-meso-macro approach, as covered in complex systems (Dopfer, Foster and Potts, 2004) can unearth much needed insight for policy and its evaluation. This approach looks at large whole based on ultimate granular data in the context. Complex Systems approach considers the nature of complexity of the processes involved in an economic system through the interplay of elements and connections that form the network structure of the economy and the dynamic forces changing them through interacting processes. A data scientist with business questions in mind can find an integrated system of Official Statistics as very rewarding for unearthing the intelligence needed to suggest policy for reducing imbalances caused by uneven growth, increasing rural-urban divide in the Indian economy.

In today's world when a person can access information from the web using his mobile phone, is it possible to know what should be the best combination of inputs and output for a farmer to raise productivity? An artisan should know what to produce and where to sell to raise his income. Big business will also gain in many ways from such a rich repository of knowledge on the economy. This is what will lay the foundation of a knowledge economy (Stiglitz and Greenwald, 2015).

18. Top-down and bottom-up mechanism for integrated information system

With a view to build an integrated information system for economic statistics, we have to create a repository for populating data of ultimate granularity in the system with facility for retrieval of these data as per requirement. This is facilitated by a Data Warehouse (DW), which can consolidate data periodically from source systems into a dimensional or denormalized data store. It usually keeps years of history and is queried for business intelligence. The technology allows for distributed set up of data to be integrated as information system. The visual representation of these data using intelligent graphics is another strength. The reports as per user requirements, both regular and ad hoc, can be generated at ease for analytical purposes.

We need to define the concepts and definitions of data elements forming part of National Accounts to be populated in DW. This needs to be done at the apex level clearly defining taxonomy, measurement issues, respondents, formats, APIs, validation rules, methods for aggregation etc. Taking off from this, we need to develop a bottom up approach for collection of data, geo-coding of granular data helping estimation of various variables over time and space. We would also need to put in place a strong data Governance practice allowing for effective checks and balances for quality audit on collected data. With the tracing of data going into various aggregates, using metadata mapping data right from primary level of collection and collation till the final aggregation for each sector constituting GDP, it will go a long way in the improvement of estimates. This is no doubt a very challenging task. For a country of India's size, apart from available technology, we need to gear up the entire machinery right from village panchayat level and entire regulatory system under e-governance to partly address the issue of data collection. The unorganized sector along with households would still remain a difficult area for collection of relevant data. We have to continue with sample surveys for collection of data for these sectors.

It is necessary to examine estimates for coherence by relating them with other relevant estimates. For example, there is a wide divergence between IIP and gross value added (GVA) for manufacturing. While there are reasons for this divergence, the market perception is formed with IIP as a leading/co-incident indicator. With a view to shedding more light on the reasons for this divergence, we need to have a way of going into differences in the

composition, coverage and measurement of the two series. This can be checked effectively, if there is a data repository which allows for seamless access of related sets of data from a distributed network of DWs (Data Lakes in Big Data context). The systems should have capability for integration for multi-dimensional view of data along with end-to-end metadata to undertake such an exercise.

Metadata describes the structure of and some meaning about data, thereby contributing to their effective use. It explains data definitions, components, sources along with life history of data from the origin to the end use. This leaves a very powerful trail for verification of quality of data in a transparent manner along with a lasting memory. It has many advantages including effective external audit on quality of generated statistics.

In short, we need to embrace ICT for modernization of information system and populate ultimate granular data into Data Warehouse and Data Lake, in conformity with recommendation made in para 1.59 of SNA, to support estimation of GDP and related aggregates. This will not only help in improving data quality, consistency and coherence, but also provide deep insight on dynamic forces shaping the economy at its various dimensions, both over time and space.

19. Current state of political economy

The targets set by the present government at the centre for socio-economic development covers the following major objectives:

1. Doubling of farm income in seven years implying a compound growth of 10.4 per cent per year.
2. Make in India implying demand and supply of manufactured goods through structural transformation resulting from high growth in agriculture, additional capacity and capacity utilization, productivity and competitiveness.
3. Sustainable Development Goal for banishing poverty and hunger by 2030, high growth in employment, better skills through education and training, improved health and hygiene, protection of environment.

The reality is India has agriculture caught in low productivity for various reasons. Our manufacturing sector has not been competitive enough to grow the way China has grown in the last few decades. The model followed by China for manufacturing is no longer available to India. If India has to pursue 'Make in India', it has to look for domestic market to demand much more of manufactured products; quality products at a price which is competitive. As Kay (2008) observed, "a development strategy which creates and enhances the synergies between agriculture and industry and goes beyond the rural-urban divide offers the best prospect for generating a process of rural development, which can eradicate rural poverty." The third objective of sustainable development requires government intervention in a big way for inclusive growth. There are many issues and challenges to be addressed if we have to pursue this objective seriously.

According to Schultz (1981), the state of underdevelopment does not have its origin in the reality of physical capital but in the development of quality human resource through knowledge improvement. It is the capability that matters. In absence of an effective market mechanism, the government has a crucial role to play in this effort. However, we need transparency for government being effective, either on its own or in partnership with private sector, to deliver the service efficiently.

With a view to be effective in pursuing political economy objective, we need efficient information system for the market and the government to function efficiently. The integrated information system suggested above, if pursued with required commitment and enthusiasm, will help in building intelligence on Real Sector-Financial Sector-Fiscal Sector nexus, right from district level, if not below, to pursue policy to transform the economy on set lines, also enabling effective monitoring. This will also help improve institutions and governance for a new vista on holistic development of the economy.

20. Conclusion

In the present Information Age, the advancement in ICT and the data science makes it possible to modernize national statistical system for much deeper insight on the economy and social welfare. The SNA provides a framework for doing so for core statistics on the economy. We need to build a repository through a distributed network of data warehouses and data lakes for relating these data seamlessly for understanding and analysis of dynamic forces propelling the economic trajectory. We need to intervene in the market, wherever necessary, for structural transformation serving the cause of social welfare. Macroeconomic analysis relies on highly aggregated data without taking into account data generating process and the related distributional characteristics. Even if it is capable of analyzing fluctuations in aggregate economic activity like growth in GDP, inflation, employment and net exports, and can suggest prescriptions for stabilization policy options based on study of forces of aggregate demand and supply, this by itself is not enough to ensure market efficiency, constrained by inclusive growth. As a result, the cause of inclusive growth for greater social welfare takes a back seat. As Adelman (2001) observed, in the context of “highly multi-faceted, non-linear, path-dependent, dynamic process involving systematically shifting interaction patterns that require changes in policies and institutions over time”, we need a different analytical framework and related data for empirical analysis.

The new approach to growth, development and social progress suggested by Stieglitz and Greenwald (2015) is based on, what he said, “creating a learning society is necessary for advancements in standards of living, even for economies well below the frontier that were not at the vanguard of advances in science and technology”. The issue is how we create such a learning society? We go back to where we started. It is the prophetic observation of H.G. Wells on statistical thinking that will matter for our march towards growth and welfare guided by hard facts.

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