Volume III

USAID/INDIA
REFORM PROJECT
COMPENDIUM WITH PRACTITIONERS' GUIDE

To State Fiscal Management Reform

The Revenue Management Practitioners' Guide

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REFORM
Rationale, Objective & Terms of Reference

The REFORM Vision ……

"State governments have the necessary organizational structures, analytical tools and decision-making processes, information sources and trained staff that enable them to make better informed choices on a transparent and accountable basis with respect to state public finances. Subsequently, this capacity is institutionalized into the mainstream of state government practices to ensure the sustainability of the effort."

The Rationale:

The starting point of the USAID/India Fiscal Management Reform Project (REFORM) is that the fiscal distress seen at the state level in early 2000 was, to a large extent, a result of the systemic weaknesses in state fiscal management (Box 1), including within the key departments of finance and planning. This prevented forward-looking fiscal decision-making grounded in careful analysis and leading to good governance. In short, the majority of Indian states needed better analytical capacity backed by appropriate institutional infrastructure to formulate and implement good fiscal policy.

Box 1: Systemic Weaknesses in Fiscal Management

The systemic weaknesses found in fiscal management at the state level may be described as "inadequate":

- Technical know-how in modern fiscal management practices.
- Comprehensive, current information databases.
- Robust analytical tools and techniques that correspond to internationally accepted standards.
- Integrated management information systems and systematic approaches to the fiscal decision-making processes.
- Transparent, consistent and institutionalized fiscal practices, reporting systems, and structures that promote the desired accountability for the effective and efficient mobilization, allocation and utilization of public funds.

Currently, therefore, many Indian states do not have the *appropriate capacity*[1] and the *necessary practices*[2] to perform relevant, economic and statistical analyses (Box 2).

Box 2: Consequence of Systemic Weaknesses

As a consequence of the systemic weaknesses, most Indian states, for example, have inadequate fiscal management expertise and institutional infrastructure to perform revenue and expenditure projections and distributional analysis, assess multiplier and elasticity effects, and run policy simulation and develop alternative policy scenarios. This includes their inability to establish strong links between budgetary outlays and program outcomes for efficient and effective delivery of results, establish debt and investment frameworks to improve their quality and profile, and conduct rigorous project appraisals to ensure selection of socio-economically viable projects.

[1] i.e., fiscal management skill-sets, tools and techniques and organizational structures.
[2] i.e., consistent, transparent and accountable processes.

Given increasing decentralization and the continued significance of public finance in India, many state governments will be required to assume greater responsibility for the design and implementation of their own development strategies. As a result, their ability to strike the *right balance between fiscal policy, broad-based growth, and financial sustainability* will be fundamental to promoting and sustaining development across every sector of the state economy and, consequently, the nation as a whole, especially in light of the new challenges posed by the opening-up of the Indian economy and state finances getting substantially linked with market forces.

The Objective:

As a response, USAID/India's REFORM project (September 2003 - 2008) was designed to provide practical hands-on "how to" skills transferal, based on international best practices, to strengthen fiscal analytical expertise, structures and systems of selected Indian states. The objective was to help these states to better plan and manage their public finances, especially in the light of the challenges they faced following the 2000-01 fiscal crisis. Jharkhand, Karnataka, and Uttarakhand were identified as the three REFORM partner states.

The specific objectives of REFORM were:

1) To improve "informed" decision-making within state (sub-national) governments;
2) To ensure that decision-making processes followed consistent and transparent principles, leading to greater accountability; and,
3) To sustain the efforts by institutionalizing and mainstreaming the capacity built.

> *REFORM, therefore, was not designed to advise or guide Indian state governments on specific policy decisions but rather to enhance their ability to evaluate and to address crucial policy choices and implementation options, based on an understanding of the environment - i.e., its potentials, its limits and its perceived needs.*[3]

Terms of Reference:

Based on discussions with the respective partner states, the REFORM terms of reference were to help enhance their fiscal management capacity in the following four (4) areas:

- *Revenue Management Capacity* – To help states undertake detailed analysis of revenue projections and the implications of alternative tax policies and revenue choices. Interventions included: Introduction of improved revenue forecasting methodologies, an Input-Output (I-O) framework and macro-economic database. A practitioners' guide was also developed along with hands-on training to build state capacity in the above areas.

[3] Capacity-building as defined by the United Nations Center for Education and Development, (Agenda 21's definition, Chapter 37, UNCED, 1992).

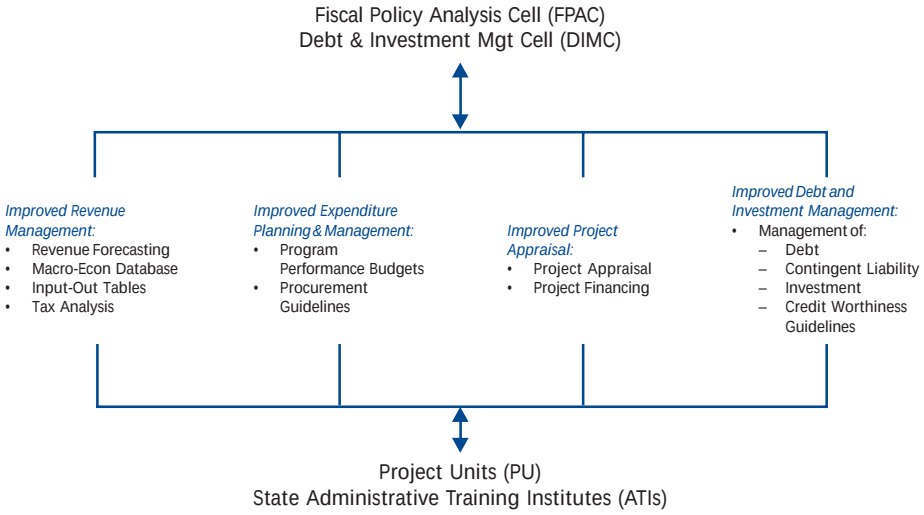
- *Expenditure Planning and Management Capacity* – To help states improve quality and accountability of expenditures. Interventions included: Introduction of an outlays to outcomes budgeting methodology (*i.e.*, program performance budgeting (PPB)) to help states' prioritise the allocation of public funds, improve program planning, monitoring and evaluation, increase transparency, accountability, and consequently, the quality of public services delivery. A practitioners' guide with related software was developed and delivered. Structured/hands-on training was provided across all levels and in almost all departments. Detailed public procurement guidelines were also developed for two out of the three states.
- *Debt and Investment Management Capacity* – To help states to better document, track, analyze, and manage debt, contingent liabilities and investments, in the medium to long term. Interventions included structured and hands-on training as well as introduction of practical guides (with reporting templates). Comprehensive debt datasets were developed and migrated into a database using the *Commonwealth Secretariat-Debt Recording and Management System (CS-DRMS)* software.
- *Project Appraisal Capacity* – To help states improve appraisal and selection of socio-economically viable capital projects. Interventions included: Training in the Harberger project appraisal technique which involves financial, economic, social and stakeholders' risks analysis. A Project Appraisal practitioners' guide with sector-specific guidelines was also developed and introduced to serve as a desk reference.

To sustain and mainstream the above fiscal management reform efforts, four (4) institutional structures were designed and supported:

- The Fiscal Policy Analysis Cell (FPAC) – To help states institutionalize continuous analysis of the implications of policies, procedures and regulatory decisions on the fiscal health of the states. An analytic unit supported by a team of dedicated and trained staff, with access to relevant and quality data, tools and techniques was established.
- The Debt and Investment Management Cell (DMIC) –To help states identify, generate, and analyze data and support more effective and prudent debt/investment decision-making. Similar to the FPAC, an analytic unit supported by a team of dedicated and trained staff, with access to relevant and quality data, tools and techniques was established.
- Project Unit (PU) – To help states offer a comprehensive range of services from project appraisal and monitoring, to final end-of-project evaluation, a project unit was designed that would also help promote public-private partnerships (PPPs).
- Administrative Training Institutes (ATIs) and State Institutes for Rural Development (SIRDs) – To help state civil service training institutes (ATIs and SIRDs) train entry level and mid-career state civil servants in fiscal planning and management, training courses; training materials and reference guides were developed and provided.

The REFORM project may therefore be considered as four-by-four (4x4), consisting of four intervention areas (expenditure, revenue, project appraisal, and debt and investment management) supported by four institutional structures (FPAC, DMIC, PUs, and ATIs/SIRDs).

REFORM: Four-by-Four



The Final Products:

A project *Compendium with Practitioners' Guides* was developed under REFORM to assist state governments to implement necessary fiscal management practices in the areas of forecasting, budgeting, tracking of debt and investment, and improving project appraisal techniques. Specifically, these Guides were developed to function both as desk references for government officers earlier trained under REFORM as well as training tools for strengthening capacity of new officers. For officers not earlier exposed to the new fiscal practices, the Guides will need to be supplemented with additional technical support or guidance.

The Compendium also includes a variety of case studies including the experiences of the three REFORM partner states – Jharkhand, Karnataka, and Uttarakhand – with respect to the implementing the new practices under REFORM.

"Fiscal Watch", a virtual resource center, has also been designed and launched to provide a dedicated site to promote greater thinking, collaboration, discussions, best practices and, exchange information and post current data on the fiscal health (and related issues) of Indian states and India. The key feature of "Fiscal Watch" is the dedicated discussion forums to facilitate interaction between fiscal practitioners, both Indian and international (*e.g.*, to provide a platform for finance secretaries, budget officers, revenue officials, and researchers). In addition, there are numerous hyperlinks to related online resources such

as government websites, professional societies, consultancy opportunities, and training and education providers.

To Conclude:

Despite spending large sums of money, governments and donors in many countries have been limited in their ability to develop successful, sustainable programs due to the inadequacy of fiscal management expertise and infrastructure. Such inadequacies prevent the productive absorption of funds. They also prevent states from equipping themselves with the necessary fiscal shock absorbers to cushion them against unexpected fiscal challenges - some arising out of discretionary, unplanned decision-making and others as a result of increased globalization. More often than not, these unexpected challenges can and have served as the tipping points, seriously affecting the fiscal condition of even fiscally healthy states, as seen in India especially post 1995-96.

However, given the increasing recognition by state governments of the role of and need for improved fiscal management capacity in Indian states' development process, and indeed for India as a nation, we are confident that endeavors such REFORM will be sustained and further strengthened.

Madhumita Gupta, Team Leader REFORM, USAID/India

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Why develop this Guidebook?

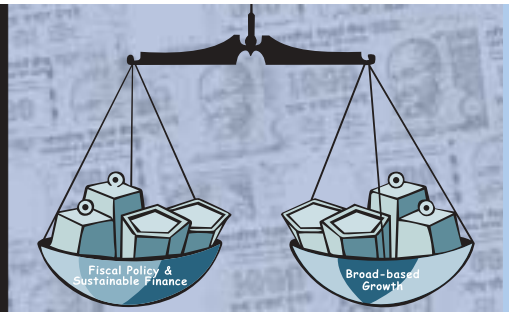
The purpose of this Guidebook is to help an Indian State Government to improve their projection of various tax revenues.

What is the Guidebook and Who should use it?

This Guidebook is a supplement to training of those employees who are responsible for making and reviewing revenue forecasts and related emerging issues especially in the various revenue administrative departments. It will help their understanding of public sector revenue management practices and protocols using international revenue forecasting tools and techniques.

How to use the Guidebook?

The Guidebook serves as a baseline tool to assist state governments to implement necessary fiscal management reform. The compendium includes guidelines for on-the-ground implementation of international best practices by state officials in the areas of forecasting, budgeting, tracking of debt and investment, and improved project appraisal. These guidelines have been developed with the aim of serving both as desk references for government officials already trained in the respective fiscal competency as well as training tools for structured capacity-strengthening programs. For officials not already exposed to the fiscal practices introduced under REFORM, the guidelines will need to be supplemented with technical support or guidance.



Section I

Revenue Management Overview

Part 1: Introduction

India is a Union of States. In addition to the Central government, there are elected governments at the state level with separate tax and spending powers. Since the 73rd and 74th amendments to the Constitution of India[3], the local bodies are also required to have elected governments with separate tax and spending powers.

In this Revenue Management Practitioners' Guide, the focus is on tax revenue sources, which comprise the bulk of state revenues. The nontax revenues are an important and emerging source and this has been underscored by the recommendations of the Twelfth Finance Commission (TFC). However, in this Guide, this is not being addressed in great detail since the priority of the three REFORM Project partner state governments had been on tax revenue management.

The Constitution of India gives exclusive powers to different tiers of the government to raise resources for discharging their functions. It contains three lists relating to revenue and functional assignments of different tiers of the government. List I is referred to as the Union list that describes the tax and spending jurisdictions of the Central government. List II is referred to as the state list that describes the tax and spending jurisdictions of state governments. List III is referred to as the concurrent list that describes the tax and spending jurisdictions that are shared by the Central and state governments. The residual items, not covered in the State List or the Concurrent List are also included in List I. These Lists I, II, and III are in Annexures A.1, A.2, and A.3, respectively.

As per the current tax assignment to different tiers of the government, the taxes can be divided into the following five broad categories:

- Levied, collected and retained by government of India (GoI), such as surcharges, and cesses.
- Levied and collected by GoI but wholly assigned to the states, such as estate duty (abolished), taxes on railway fares and freights (abolished), and additional excise duty (AED) on textiles, tobacco and sugar (Article 252: Tax-rental arrangement).
- Levied and collected by GoI but shared with the states, such as corporate tax, personal income tax, customs duty, and Union excise duties.
- Levied by GoI but collected and retained by the states such as stamp duties, excise duties on medicinal and toilet preparations, and taxes on interstate trade or consignments (Central Sales Tax).
- Levied, collected and retained by the states such as sales tax[4], state excise, passenger and goods tax, motor vehicles tax, and entertainment tax.

The states collect about 35 per cent of combined revenue of the Centre and states, and account for about 60 per cent of the combined expenditure. In order that the states fulfill their obligations, the Center is required to transfer resources to the states. The Central transfers account for about 37 per cent of its tax revenue and the institutions involved in effecting these transfers are Finance Commission, Planning Commission, and Line Ministries

Clearly, resource raising powers and spending

[3] These amendments were made in 1992 and are effective from 1993.
[4] That has been now replaced with value added tax (VAT) in the process of major tax reforms at the state level.

jurisdictions differ across different tiers of the government, and these governments have to optimize within their constitutional jurisdictions.

The structure of this Revenue Management Practitioners' Guide is as follows: first, to give a brief description of the revenue sources of the states, and second, to discuss the various methods of forecasting revenues.

Annexure A.1

List I: Union List–Sources of Revenue and Functions

Sources of Tax Revenue

Sources of tax revenue of the Central government include:

- Taxes on income other than agriculture
- Duties of customs including export duties
- Duties of excise on tobacco and other goods manufactured or produced in India, expect
  - Alcoholic liquor for human consumption,
  - Opium, Indian hemp and other narcotic drugs and narcotics

  But including medicinal and toilet preparations containing alcohol or any other above mentioned substance.
- Corporate tax
- Taxes on capital value of assets exclusive of agricultural land
- Estate duty on properties other than agricultural land
- Duties in respect of succession of property
- Terminal taxes on goods or passengers carried by railways, sea or air; taxes on railway fares and freights
- Taxes other than stamp duties on transactions in stock exchange and future markets
- Rates of stamp duty in respect of bills of exchange, cheques, promissory notes, bills of landing, letters of credit, policies of insurance, transfer of shares, debentures proxies and receipts
- Taxes on sale or purchase of newspaper and on advertisements published therein
- Taxes on sale or purchase of goods other than newspaper where such sale or purchase takes place in the course of inter-state trade or commerce
- Taxes on inter-state consignments of goods for trade or commerce
- Fees in respect of the matters in the list, but not including fees taken in any court
- Fees taken in Supreme Court
- Any other tax (entry 97) not mentioned in State List or Concurrent List[5]

Sources of Nontax Revenue

Sources of nontax revenue of the Central government include:

- Borrowings (both internal and external) subject to any limit that Parliament may lay down
- Income from various government undertakings and monopolies including lotteries organized by the Central government
- Incidental receipts such as income from government property

[5] Taxation of services falls in this entry, and Centre taxes selectively (about 66 items). Recent proposals for taxation of services are in Section 268A of the Constitution of India. It visualizes three broad categories of services: first, those which will not be taxed by any government, second, those which will be taxed by the Centre and third those which will be taxed by the states.

Functions

Functions of the Central government include:

- Defence of India
- Foreign affairs
- Railways, national highways, shipping and navigation, lighthouses, ports, and airways
- Carriage of passengers and goods by railway, sea or air, or by national waterways in mechanically propelled vessels
- Patents, currency and coinage, copyrights, trade marks and merchandise marks
- Trade and commerce with foreign countries
- Inter-state trade and commerce
- Regulation and development of oilfields and mineral oil resources, petroleum and petroleum products, other liquors and substances declared by Parliament by law as dangerously inflammable
- Functions not covered elsewhere (residual)

Annexure A.2

List II: State List–Sources of Revenue and Functions

Sources of Tax Revenue

Sources of tax revenue of the states include:

- Land revenue
- Taxes on agricultural income
- Duties in respect of succession of agricultural land
- Estate duty in respect of agricultural land
- Taxes on land and buildings
- Taxes on mineral rights
  - Subject to any limitations imposed by Parliament by law relating to mineral development
- Duties of excise on the following goods manufactured or produced in the state and countervailing duties at the same or lower rates on similar goods manufactured or produced elsewhere in India
  - Alcoholic liquors for human consumption
  - Opium, Indian hemp and other narcotic drugs and narcotics

  But not including medicinal and toilet preparations containing alcohol or any substance included in this sub-paragraph
- Taxes on entry of goods into local area for consumption, use or sale therein
- Taxes on consumption or sale of electricity
- Taxes on sale or purchase of goods other than newspaper excluding interstate sale
- Taxes on advertisements other than advertisements published in the newspapers and advertisements broadcast by radio or television
- Taxes on goods and passengers carried by road or inland waterways
- Taxes on vehicles for use on roads
- Taxes on animals and boats
- Tolls
- Taxes on professions, trades, callings and employments
- Capitation taxes
- Taxes on luxuries, including taxes on entertainments, amusements, betting and gambling
- Stamp duty in respect of documents other than those subject to stamp duty by the government of India
- Fees in respect of any of the matters in the State List, excluding court fees
- Fees taken in all courts except Supreme Court
- Share in some specified Union taxes

Sources of Nontax Revenue

Sources of nontax revenue of the states include:

- Income from government undertakings
- Income from public property owned by the state government
- Royalty from mines, forests, treasure-trove etc.
- Grants-in-aid from the Central government
- Other grants from the Central government
- Borrowings within the country including loans from the Central government

Functions

Functions of state governments include:

- Police (including railway and village police)
- Prisons and other institutions of similar nature
- Local governments
- Public health and sanitation, hospitals and dispensaries
- Pilgrimage other than outside India
- Intoxicating liquors, that is to say, the production, manufacture, possession, transport, and purchase and sale
- Relief of the disabled and unemployable
- Burial and burial grounds, cremation and cremation grounds
- Libraries, museums and other similar institutions controlled or financed by the state, ancient and historical monuments and records other than declared to be of national importance
- Communications, that is to say, roads, bridges, ferries, and other means of communication not specified in List I, municipal tramways, roadways, inland waterways and traffic thereon subject to the provisions of List I and List III with regard to such waterways, vehicles other than mechanically propelled vehicles
- Agriculture, including agriculture education and research, protection against pests and prevention of plant diseases
- Water, that is to say, water supplies, irrigation and canals, drainage and embankments water storage and water power subject to the provisions of List I
- Regulation of mines and mineral development subject to the provisions of List I
- Industries subject to the provisions of List I
- Gas and gas works
- Trade and commerce within the state subject to the provisions of List III
- Production, supply, and distribution of goods subject to the provisions of List III
- Markets and fairs
- Money lending and money lenders, relief of agricultural indebtedness

Annexure A.3

List III: Concurrent List–Sources of Revenue and Functions

Sources of Tax Revenue

Sources of tax revenue with concurrent jurisdiction include:

- Recovery in a state of claims in respect of taxes and other public demands, including arrears of land revenue and sums recoverable as such arrears arising outside that state
- Stamp duties other than duties or fees collected by means of judicial stamps, but not including rates of stamp duty

Sources of Nontax Revenue

Sources of nontax revenue with concurrent jurisdiction include fees in respect of any of the matters in this List, but not including fees taken in any court

Functions

The functions with common jurisdiction of the Centre and the state governments include:

- Prevention of cruelty to animals
- Protection of forests, and wild animals and birds
- Economic and social planning
- Population control and family planning
- Education
- Price control
- Electricity
- Bankruptcy and insolvency
- Administration of justice, constitution and organization of all courts except the Supreme Court and the High Courts
- Adulteration of food stuffs and other goods
- Social security and social insurance
- Ports other than those declared as major ports
- Price control
- Mechanically propelled vehicles
- Newspapers, books, and printing presses
- Archaeological sites and remains other than those declared to be of national importance

Suggested Readings:

- Ahmed Liaquat (1986), Stabilisation Policies in Developing Countries, *World Bank Research Observer,* January.
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- Tanze Vito (1990) (editor), *Fiscal policy in Open Developing Economies,* IMF, Washington.
- The Constitution of India, Seventh Schedule (Article 246).

Part 1: Tax Revenue Sources of the States

Revenue sources of the states can be divided into two broad categories: tax and non-tax. Importance of different components of revenue can be studied in terms of their shares in total revenue of the states. These shares have been computed based on the data compiled from the RBI (Reserve Bank of India) studies on State Finances, and are presented in Table 1.1.

Taxation is a major source of revenue of the states. It accounts for about 70 per cent of their total revenue (column 2, Table 1.1), implying about 30 per cent contribution of nontax revenue sources.

Given the revenue raising powers of different tiers of the government, the states raise lesser revenues than their expenditure needs. Therefore, the states receive Central grants in addition to a share in the Central taxes[6]. Accordingly, tax revenue of the states comprises of their own tax revenue and their share in Central taxes. Similarly, their nontax revenue comprises of their own nontax revenue and Central grants. Their own tax revenue accounts for about 70 per cent of their total tax revenue, implying that their share in Central taxes accounts for about 30 per cent of their total tax revenue (columns 4 and 5 in Table 1.1). Their own nontax revenue accounted for about 45 per cent of their total nontax revenue in 20010-01, and its contribution declined over time to about 37 per cent in 2005-06 (columns 7 and 8 in Table 1.1), implying an increase in significance of Central grants.

The major sources of states' own tax revenue can be categorized into the following three broad groups:

Taxes on income

- Agricultural income tax
- Tax on professions, trades, callings and employment

Taxes on property and capital transactions

- Land revenue
- Stamps and registration fees
- Urban immovable property tax

Table 1.1: Revenue Composition of All States (Percent)

Year	Share of tax revenue in total revenue	Composition of states tax revenue			Composition of states nontax revenue		
		Total	Own revenue	Share in central tax	Total	Own revenue	Central grants
1	2	3	4	5	6	7	8
2000-01	70.9	100.0	69.9	30.1	100.0	45.4	54.6
2001-02	70.5	100.0	71.0	29.0	100.0	42.8	57.2
2002-03	70.9	100.0	71.5	28.5	100.0	44.0	56.0
2003-04	71.7	100.0	70.4	29.6	100.0	42.7	57.3
2004-05RE	69.8	100.0	69.9	30.1	100.0	42.3	57.7
2005-06BE	70.9	100.0	70.5	29.5	100.0	37.2	62.8

Source: Computed on the basis of data compiled from RBI, State Finances: A Study of Budgets of 2005-06 (December 2005) and for earlier years.

[6] The States share in Central taxes is based on the recommendations of the Finance Commission set up at regular intervals of five years. Currently, as per the recommendations of the 12th Finance Commission, the states share in Central taxes is fixed at 30.5 per cent. For this purpose, additional excise duties in lieu of sales tax are treated as part of the general pool of Central taxes.

Taxes on commodities and services

- Sales tax (or Value added tax)
- State excise
- Taxes on vehicles
- Taxes on passengers and goods
- Electricity duty
- Entertainment tax
- Other taxes and duties[7]

All the states do not levy all taxes. The current status as to the levy of these taxes in different states is shown in Table 1.2. Importance of these taxes can be identified in terms of their shares in total tax revenue. These shares are computed on the basis of the data compiled from RBI studies on state finances, and reported in Table 1.3.

From Tables 1.2 and 1.3, it would be noted that land revenue, stamp duty and registration fees, sales tax/VAT, state excise and taxes on vehicles are levied by all the states, and they account for more than 91 per cent of states' own tax revenue (columns 5, 6 and 8-10 in Table 1.2, and columns 7, 8, and 11-13 in Table 1.3). Agricultural income tax and urban immovable property tax are levied only by a few states (not exceeding 6), and their contribution to the states' tax revenue is negligible (columns 3 and 7 in Table 1.2, and columns 4 and 9 in Table 1.3). Profession tax though prevalent in 16 out of the 29 states (column 4 in Table 1.2), it contributes only a little over 1 per cent to the own tax revenue of the states (column 5 in Table 1.3). Similarly, entertainment tax that is prevalent in 22 states (column 13 in Table 1.2) accounts for only about a half per cent of states' own tax revenue (column 16 in Table 1.3). Electricity duty is charged in 24 states while taxes on goods and passengers are levied in 25 states (columns 11 and 12 in Table 1.2). Both of these levies account for about 6 per cent of own tax revenue of the states (columns 14 and 15 in Table 1.3).

From Table 1.3 it would be noted that among the three broad groups of taxes, taxes on goods and services are the most important, and they account for more than 87 per cent of the total own tax revenue of the states (column 10). Taxes on property and capital account for about 11 per cent of states' own tax revenue (column 6), while taxes on income contribute about 1 per cent (column 3).

In terms of contribution of individual taxes, sales tax/VAT is the major source of revenue that accounts for more than 60 per cent of the total own tax revenue of the states (column 11 in Table 1.3). The other major taxes in order of their contribution are state excise, stamp duty and registration fees, and taxes on vehicles. These four taxes, namely, sales tax/VAT, state excise, stamp duty and registration fees, and taxes on vehicles account for more than 90 per cent of the own tax revenue of the states.

The major sources of states' own nontax revenue include:

- Interest receipts
- Dividend and profits
- General services including lotteries
- Social services such as education, health, housing, employment, and social security
- Economic services such as fisheries, forestry, plantations, irrigation, power, transport, industry and tourism

[7] Such as betting and gambling tax.

Table 1.2: Status of Levy of Different State Taxes in Individual States: 2005-06

S. No.	State	Taxes on income		Taxes on property and capital transactions			Taxes on commodities and services						
		Agriculture income tax	Profession tax	Land revenue	Stamps and registration fees	Urban immovable property tax	Sales tax/ VAT	State excise	Taxes on vehicles	Taxes on goods & passengers	Electricity duty	Entertainment tax	Other taxes & duties
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Andhra Pradesh	0	1	1	1	1	1	1	1	1	1	1	1
2	Arunachal Pradesh	0	0	1	1	0	1	1	1	0	0	0	0
3	Assam	1	1	1	1	0	1	1	1	1	1	1	1
4	Bihar	0	0	1	1	0	1	1	1	1	1	0	1
5	Chhattisgarh	0	1	1	1	0	1	1	1	1	1	1	1
6	Goa	0	0	1	1	0	1	1	1	1	0	1	1
7	Gujarat	0	1	1	1	1	1	1	1	1	1	1	1
8	Haryana	0	0	1	1	0	1	1	1	1	1	1	1
9	Himachal Pradesh	0	0	1	1	0	1	1	1	1	1	1	1
10	Jammu and Kashmir	0	0	1	1	1	1	1	1	1	1	0	1
11	Jharkhand	0	0	1	1	0	1	1	1	1	1	1	1
12	Karnataka	1	1	1	1	0	1	1	1	1	1	1	1
13	Kerala	1	0	1	1	0	1	1	1	0	1	1	1
14	Madhya Pradesh	0	1	1	1	0	1	1	1	1	1	1	1
15	Maharashtra	0	1	1	1	0	1	1	1	1	1	1	1
16	Manipur	0	1	1	1	0	1	1	1	1	1	0	1
17	Meghalaya	0	1	1	1	0	1	1	1	1	1	1	1
18	Mizoram	0	1	1	1	0	1	1	1	1	0	0	1
19	Nagaland	0	1	1	1	0	1	1	1	1	1	0	1
20	Orissa	0	1	1	1	0	1	1	1	1	1	1	1
21	Punjab	0	0	1	1	0	1	1	1	0	1	1	1
22	Rajasthan	0	0	1	1	1	1	1	1	1	1	1	1
23	Sikkim	1	0	1	1	0	1	1	1	1	0	0	1
24	Tamil Nadu	0	0	1	1	0	1	1	1	1	1	1	1
25	Tripura	1	1	1	1	0	1	1	1	0	1	1	1
26	Uttarakhand	0	1	1	1	0	1	1	1	1	1	1	1
27	Uttar Pradesh	0	1	1	1	0	1	1	1	1	1	1	1
28	West Bengal	1	1	1	1	1	1	1	1	1	1	1	1
29	NCT of Delhi	0	0	1	1	0	1	1	1	1	0	1	1
30	Total	6	16	29	29	5	29	29	29	25	24	22	28

Note: In a cell, '1' indicates prevalence of tax and '0' represents absence of tax in the state.

Table 1.3: Percentage Shares of Different Components in States Own Tax Revenue

Year	Total	Taxes on income			Taxes on property and capital transactions				Taxes on commodities and services							
		Total	Agriculture income tax	Profession tax	Total	Land revenue	Stamps and registration fees	Urban immovable property tax	Total	Sales tax/ VAT	State excise	Taxes on vehicles	Taxes on goods & passengers	Electricity duty	Entertainment tax	Other taxes & duties
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
2000-01	100.0	1.7	0.1	1.6	9.5	1.2	8.2	0.1	88.8	62.2	13.6	5.6	1.8	3.8	1.0	0.9
2001-02	100.0	2.4	0.0	2.3	10.1	1.3	8.7	0.1	87.5	60.0	13.4	6.0	2.9	3.7	0.6	1.0
2002-03	100.0	1.5	0.0	1.5	10.9	1.2	9.6	0.1	87.6	60.5	13.4	5.9	2.5	3.7	0.6	1.0
2003-04	100.0	1.4	0.0	1.4	11.4	1.4	10.0	0.0	87.2	61.0	12.3	6.3	2.6	3.5	0.5	1.0
2004-05RE	100.0	1.3	0.0	1.3	11.4	1.3	10.1	0.0	87.3	61.5	12.0	5.8	2.8	3.7	0.5	1.0
2005-06BE	100.0	1.2	0.0	1.2	11.3	1.1	10.2	0.0	87.5	62.5	11.6	5.9	2.7	3.4	0.5	0.8

Source: Computed on the basis of data compiled from RBI, State Finances: A Study of Budgets of 2005-06 (December 2005) and for earlier years.

Importance of states' own nontax revenue sources and of individual sources of nontax revenue can be identified in terms of their shares in total nontax revenue of the states. These shares are computed based on the information compiled from RBI studies on state finances, and reported in Table 1.4.

From Table 1.4, it would be noted that states' own nontax revenue sources account for less than 46 per cent of states' total nontax revenue (column 2). In fact, the contribution of states' own nontax revenue sources has declined over time from about 45 per cent in 2000-01 to about 42 per cent in 2004-05 and was budgeted to further decline to about 37 per cent in 2005-06. On the other hand dependence on the Central grants has been on the rise. The contribution of Central grants has increased from less than 55 per cent in 2000-01 to about 58 per cent in 2004-05 and was budgeted to further increase to about 63 in 2005-06 (column 9).

Economic services is the most important source of own nontax revenue of the states. It accounts for more than 18 per cent of states' total nontax revenue (column 8 in Table 1.4). The other contributors in order of importance are general services and interest receipts (columns 6 and 4 in Table 1.4).

Sales tax (or VAT)

States in India are eligible to tax intrastate trade in goods (not services). Until recently, most of the states had a first point levy on intrastate sale of goods, that is, on sale by manufacturers or importers. On some goods, tax was collected as purchase tax because of convenience in collection of tax. Some states like Delhi and Punjab had a last point levy. The tax structures comprised of many rates, many exemptions, and a variety of industrial incentives, leading to a complex structure.

In the process of reform of sales tax, 21 of the 29 states have switched over to VAT on goods by 1 April 2005. Six of the remaining eight states switched over to VAT by 1 April 2006, and Tamil Nadu did so subsequently. The only remaining state of Uttar Pradesh is expected to switch over to VAT in the near future.

All the VAT states are following the same basic structure with some variations to reflect on varied economic scenario and commodity

Table 1.4: Composition of Nontax Revenue of the States (Percent)

Year	Total	Own nontax revenue						Grants from the centre
		Total	Interest receipts	Dividends and profits	General services	Social services	Economic services	
1	2	3	4	5	6	7	8	9
2000-01	100.0	45.4	16.5	0.2	8.8	3.3	16.6	54.6
2001-02	100.0	42.8	12.2	0.2	10.6	3.4	16.5	57.2
2002-03	100.0	44.0	11.7	0.4	10.8	3.5	17.6	56.0
2003-04	100.0	42.7	9.6	0.4	10.5	3.7	18.5	57.3
2004-05RE	100.0	42.3	10.2	0.3	10.5	2.9	18.4	57.7
2005-06BE	100.0	37.2	6.6	0.3	11.2	2.6	16.5	62.8

Source: Computed on the basis of data compiled from RBI, State Finances: A Study of Budgets of 2005-06 (December 2005), and for earlier years.

sensitivities in the individual states. There are three basic tax rates: 1, 4 and 12.5 per cent. Some goods are kept out of VAT and subject to a first point levy. The floor rate of tax on these goods is 20 per cent. 46 commodities are exempt in all the states. In addition, the states have the option to exempt 10 more commodities from a specified list comprising of goods that are considered sensitive in different states[8].

In addition to the tax on intrastate sales of goods (referred to as General Sales Tax), states collect and retain tax on interstate sales of goods (referred to as Central Sales Tax[9]).

State excise

State excise duty is charged on production of alcoholic liquors such as country liquor (arrack), Indian made foreign liquor (IMFL), beer, and molasses, and on medicinal and toilet preparations containing alcohol, opium, hemp or other narcotic drugs. In addition, the states' excise departments collect some revenue in the process of controlling movement, possession/ stock, and sale of narcotic drugs and psychotropic substances. Some license fee is also collected from retail shops selling liquor.

As discussed earlier, state excise is the second most important source of tax revenue of the states, the first being sales tax/VAT.

Excise duty is generally a mixture of specific and *ad valorem* duties. The duty is based on the alcoholic strength of liquor (Proof litre) and/or per bottle. In some of the states like Andhra Pradesh and Karnataka, the liquor trade is canalized, that is, routed through a governmental organization to avoid evasion, and to exercise control on consumption of liquor in different jurisdictions. In Delhi, Kerala and Tamil Nadu, liquor is sold through retail outlets run exclusively by the state governments. In Andhra Pradesh and Karnataka, all the distillers are required to sell liquid to the government corporations established for this purpose and these corporations sell it to licensed retail shops.

Stamps and registration fees

Stamp duty is essentially a tax on instruments (or documents) recording the transactions including those relating to transfer of property. In addition, a registration fee is levied for the service of conferring a legal status to the document registered. It is the third or fourth most important source of tax revenue of the states.

The Central as well as state governments are empowered to levy stamp duties with exclusive powers in respect of certain documents and with overlapping powers in other cases. The provisions relating to collection of stamp duty are arrived at through agreement between the Central government and the states.

The Central government is empowered to determine "rates of stamp duty in respect of bills of exchange, cheques, promissory notes, bills of lading, letters of credit, insurance policies, transfer of shares, debentures, proxies, and receipts." The state governments are empowered to determine "rates of stamp duty in respect of documents other than those falling in the jurisdiction of the Central government, specified above." The Central and state

[8] For details regarding the structure of VAT in individual states, see the VAT Acts of respective states.
[9] Central Sales Tax (CST) is legislated by the Central government but revenue is collected and retained by an exporting state.

governments have concurrent jurisdiction on determining "stamp duties other than duties or fees collected by means of judicial stamps, but not including rates of stamp duty."

The stamp duty, transfer duty as well as registration fee differ across the states even after rationalization of the rate structure in the early 2000s. For example, stamp duty is 6 per cent in Karnataka, 8 per cent in Tamil Nadu, 4-8 per cent (progressive) in Andhra Pradesh, and 0-8 per cent (progressive) in Maharashtra. Similarly, transfer duty and registration fee are 0.5 and 1 per cent in Maharashtra, 0.56 and 1 per cent in Karnataka, 2 and 1 per cent in Tamil Nadu, and 5 and 0.5 per cent in Andhra Pradesh. Since all these duties could apply to the same transaction, the combined incidence of tax may vary even within a state particularly with a progressive levy such as in Maharashtra.

Taxes on vehicles

A state levies motor vehicles tax (MVT) on vehicles plying in the state for transporting goods and passengers by road. It is generally based on the type of vehicle and the number of seats or the carrying capacity of the vehicle. The payment options include life time, annual, quarterly or monthly. The tax schedule differs with the type of vehicle such as two-wheelers, motor cars, stage carriages, maxi cabs, contract carriages, tourist vehicles, and goods vehicles. The tax structure differs across the states.

The life time tax on cars, jeeps and two-wheelers in 2004-05 was higher of the specified specific levy or 9 per cent of the value of vehicles registered in Andhra Pradesh, higher of specified specific levy or 7 per cent of the value of vehicles registered in Karnataka, and in Maharashtra it was 7 per cent of the value of two-wheelers and 4 per cent of the value of other vehicles. Vehicles registered in another state but temporarily plying in the state are generally subject to different schedule of levy.

In addition to raising revenue, MVT is expected to promote fuel conservation and reduce traffic congestion and pollution. The challenge lies in developing the tax structure so as to serve these objectives.

Electricity duty

Electricity duty is charged on the electricity consumption of the consumers (such as households, and industrial units). Generally it is charged at a flat rate on the electricity bill of the consumers.

Taxes on passengers and goods

These are levied on transport of passengers and goods. On passengers, generally it is a fixed percentage of passenger fare. On goods, it takes different forms - it is levied on the basis of weight, volume, or value of goods.

Some of the states have merged this tax with motor vehicles tax as it overlaps with motor vehicles tax.

Tax on professions, trades, callings and employment

Every person engaged in any profession, trade, calling or employment in a state can be subject to profession tax (PT) by the state. However, profession tax can not exceed Rs.2500 per annum[10]. The word 'person' includes salaried persons, wage earners, all professionals such as

[10] The Constitution of India imposes a ceiling on the profession tax that can be levied by a state. The 60th Amendment Act of the Constitution, in 1985, raised the ceiling on profession tax from Rs.250 to Rs.2500 per annum.

doctors, lawyers, chartered accountants and contractors, Hindu Undivided Families, firms, companies, societies and clubs. Salary and wage earners are generally required to pay the tax monthly while others could pay it annually. Generally, the amount of tax increases with the increase in potential income from a profession, subject to the ceiling of Rs.2500.

Land revenue

It is a tax on land (agricultural or non-agricultural). The incidence of land tax on agricultural land is generally based on the use value of land with due regard to its irrigation status (dry, canal irrigated and wet), productivity, and cropping pattern. Some states charge water cess in addition to or as substitute to land tax. Water cess is generally a graded levy based on the nature of crop and the category of irrigation source (major/medium projects or minor irrigation projects supplying water for a part of the year). Andhra Pradesh abolished land tax but collects water cess.

Some states like Andhra Pradesh (AP) levy non-agricultural land assessment (NALA) on the land used for non-agricultural purposes (that is, industrial, commercial, or residential) and lying outside the defined Municipal areas.

Entertainment tax

Entertainment tax is a tax on services leading to or associated with amusement. It is levied on the fees charged for entry to places of entertainment such as cinema halls, amusement parks, concerts, performances, pageants, games, sports, video games, pool parlours, bowling alleys, discotheques and cabarets. The coverage of the tax base has been narrow and varies across the states. All the states that levy entertainment tax cover cinema shows. The schedule of levy varies across items. It is specific tax on some items and *ad valorem* levy on other items. The rate schedule differs across the states.

Role of Tax Policy at the State Level

Although the prime objective of taxation by any level of government is to raise revenue, generally the tax policies are geared to achieve multi-objectives. The objectives other than revenue that can be achieved by a specific level of government, through its tax policies, depend on the taxes that fall in its jurisdiction. For example, international trade can be monitored by the national level government that has the jurisdiction over taxation of international trade. High tariff rates on imports and exports tend to reduce international trade. Similarly, interstate economic disparity can be monitored by the national government that has the jurisdiction over income tax. A progressive income tax transfers to the government relatively more resources from the richer states, thereby, reducing economic disparity in terms of post tax incomes of the states. On the other hand, intrastate disparities can be influenced by the national as well as state governments through say tax relief in respect of industrial units set up in less developed regions of the states. A government could provide tax relief under the taxes within its jurisdiction, such as exemption of sales tax by the state government and exemption of Central excise by the national government.

The objectives that are generally sought to be achieved through state level tax policies include:

- Raising revenue
- Mitigating intra-state disparities
- Removal of poverty

- Promoting employment
- Promoting economic development
- Promoting stability

Raising revenue

Raising revenue for the government is the primary objective of taxation. All other objectives are secondary and the tax systems are designed so as to achieve other objectives simultaneously. The design characteristics of a tax which facilitate achieving multi-objectives are discussed in the subsequent sections.

Mitigating intra-state disparities

Developing countries generally suffer from large interstate and intrastate disparities in income levels. In India, even the high income states have pockets with very low levels of income. While mitigating interstate disparities has been the focus of the Central government, mitigating intrastate disparities has been the concern of state governments. Mitigation of intrastate disparity is more important for a less developed state as the people living in its less developed areas would generally be worse off as compared to those in the less developed areas of a developed state.

The state governments attempt to design tax policies to support mitigation of intrastate disparities. The available alternative tax policy options include:

- Providing tax relief to the industrial units set up in the less developed regions of the state, such as exemption of sales tax, and entertainment tax.
- Providing direct tax relief to the residents of less developed regions, in the form of exemption or reduced rates of agricultural income tax, property tax, electricity duty, sales tax on items of mass consumption etc.

Removal of poverty

Scenario in respect of poverty is similar to that of regional disparities. A large number of households live below the poverty line in all the Indian states. The Central as well as state governments are making concerted efforts for removing poverty. The least that can be expected from Central and state tax policies is that these are not counter productive. A state could consider negative taxation of the people below the poverty line in addition to the tax policies discussed above in respect of mitigation of intrastate disparities. An alternative option would be to create job opportunities for the poor. This would mean encouraging establishment of projects requiring unskilled or semi-skilled labour, and of institutions for imparting the necessary skills to the concerned sections of the society.

Promoting employment

Unemployment is a concern in developed as well as developing countries. A sustainable level of employment in a region would generally depend on the agricultural and industrial potential of the region. What is required is to identify region specific sectors with growth potential on sustainable basis and encourage development of these sectors such as agriculture (commercial or non-commercial), agro-based industry, other manufacturing, tourism, IT, and horticulture. Wherever considered necessary, initial thrust may be provided through tax relief in respect of select identified activities. The activities that are more labour intensive, by nature, would help create more employment, and hence should be promoted on priority basis.

Some times the policy of differential taxation of products produced by labour intensive and capital intensive techniques is used to promote employment. Relatively lower tax burden on products produced by labour intensive techniques could generate higher employment provided such policies are not inconsistent with growth of the economy. However, in the modern economies, such policies are considered to be discriminatory and inefficiency promoting, and hence not friendly to the growth of the economy.

Promoting economic development

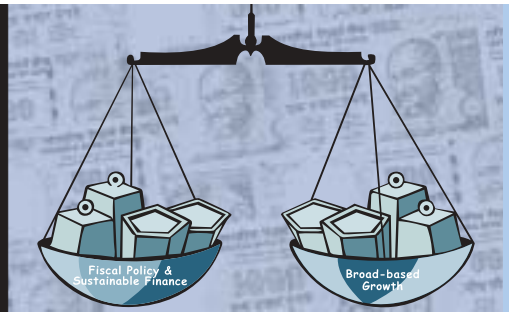
Developing countries generally face the problem of insufficient savings and capital formation that is essential for accelerating growth. Therefore, tax policies are sought to promote savings by curbing unnecessary and conspicuous consumption on the one hand and channeling these savings into priority investments on the other hand. Development of infrastructure is a vehicle for economic development. Therefore, state tax policies should support national tax policies for encouraging development of infrastructure.

Various features of the tax system have potential to encourage investment and hence growth, such as moderate level of taxation, absence of tax discrimination against domestic produce vis-à-vis imports, and neutrality to production processes. The state tax policies imbibing these characteristics, in addition to tax policies discussed in respect of promoting employment, can go a long way in promoting economic development.

Promoting stability

Tax policies, suitably designed, could promote stability in the economy. Certain tax systems serve as built-in-stabilizers such as progressive income tax that leaves lower real disposable income in the hands of households in a period of inflation and a higher real disposable income in a period of depression. This tends to check the extent of rise or fall in prices as the case may be. Similarly, appropriate choice of structure of sales tax at the state level could make a contribution towards stabilizing the economy. For example, *ad valorem* rates as against specific rates tend to check inflation by taking away higher economic resources as tax, in an inflationary period.

In a scenario of rising unemployment, a cut in the tax rates could contribute towards stabilization of employment through demand stimulation following consequential decline in prices of the products.



Section II

Revenue Forecasting Techniques

Part 1: Revenue Forecasting Techniques

Revenue sources of a government include taxes and fees/user charges imposed by the government. A revenue forecast is simply a projection of the level of revenue that is likely to accrue to the Government over a future period of time. It involves the use of analytical techniques to obtain estimates of the inflow of revenue in the future. It requires establishing a cause and effect relationship between revenue (referred to as independent variable) and the factors affecting revenue (referred to as independent variables, such as the tax rate, economic factors, and efficiency and effectiveness of tax administration). Economic factors include the overall health of the economy. With a faster growth of the economy, a government can expect better revenue collection in terms of tax as well as fees.

Revenue forecasting is data driven, and the choice of forecasting technique, generally, depends on the revenue source and the quality of available data. Forecasting revenue from some sources may require more rigorous approaches than others. Generally revenue forecasting by individual sources of revenue is preferred to the aggregate of all sources.

Revenue forecasting techniques could be classified into two broad categories: qualitative and quantitative. The former category includes best judgment based on experience and is generally not supported by statistical analysis of the relevant data. In this case, the forecasts pronounced are individual specific, and it may be difficult to evolve a consensus forecast. The later category includes statistical models that are used for analyzing relevant data. The forecast may differ across the models, and could vary with the alterations in the assumptions.

Scope of Revenue Forecasting

Revenue forecast plays an important role for financial management of a Government. A good estimate of financial resources that will be available is necessary for planning and preparing a meaningful budget for a given period. Revenue forecasting contributes to sound service delivery decisions by reducing uncertainty in decision making.

There is no uniform forecasting model that can be used for projecting revenues under all scenarios. The choice of forecasting technique is generally based on the observed behavior of the revenue series. Further, revenue forecasting techniques are based on certain economic and policy assumptions. Such assumptions need to be explicitly stated for a better understanding of revenue forecasts.

Revenue forecasting techniques could be applied to aggregate revenue series or source specific revenue series (like sales tax, state excise, motor vehicles
tax, etc.).

It is important to note that the domain of revenue forecasting is much larger than just a technical exercise, and has wide ranging political and policy implications. The revenue forecasting process involves many individuals and agencies inside and outside government. Each individual or agency may view the forecast with a different perspective. Finance department may base its expenditure strategy and the need for revenue policy changes on revenue forecasts. Legislators may scrutinize forecasts in an effort to fund new programs or identify deficits. Individual departments may review forecasts to ensure that all relevant

factors are taken into account, forecasts are not over- or under-estimates, and are appropriate for setting revenue collection targets. The concern of rating agencies could be to evaluate the ability of the government to meet its debt repayment commitments in the short and long term. The media may review forecasts to identify and expose, unhealthy politically motivated practices which may be adopted specifically in an election year.

Major Steps in Revenue Forecasting

The process of revenue forecasting involves predicting the future with the help of existing information on the same parameter or other related parameters expected to affect the parameter to be forecasted. The process involves several steps given below:

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- **Problem Definition:** Deep understanding of how the forecasts will be used, who requires the forecasts, and how the forecasting function fits within the organization;
- **Identifying Variables:** Identifying specific economic and policy variables to be used in obtaining revenue forecasts, as well as the time horizon for the forecast;
- **Gathering Information:** Historical statistical data (to construct a model) and accumulated judgement and expertise of key personnel;
- **Preliminary (Exploratory) Analysis:** Visual inspection of the data set. Computation of mean and standard deviation (SD) of a set of variables, and covariance (CV) and Correlation Coefficient (r) for a set of two variables. This information is useful in choosing an appropriate forecasting model;
- **Choosing and Fitting Model:** This involves choosing the model after having the preliminary analysis of the nature of data, and estimation of parameters in the chosen model; and
- **Using and Evaluating a Forecasting Model:** Before using the model for forecasting for the future, it needs to be verified that the model performs well.

Medium-term forecasts are needed mostly for budgeting purposes. Budgeting process requires estimates of government expenditure, liabilities as well as revenue flows. Revenue forecasting is not just a one time activity to be exclusively undertaken only prior to the Budget. It is a continuous process and has to be undertaken at regular intervals particularly to capture the movements in macroeconomic variables which tend to have impact on the resource generation of the government.

Controversies about Revenue Forecasts

Opinions on forecasting are probably as diverse as views on any set of scientific methods used by decision makers. The layperson may question the validity and efficacy of a discipline aimed at

predicting an uncertain future. However, it should be recognized that substantial progress has been made in forecasting over the past several centuries. There are large numbers of phenomena whose outcomes can now be predicted. Despite these advances made in revenue forecasting, controversies may remain due to the following reasons:

- It is not feasible to identify and take into account all factors that affect revenue from a specific source of revenue;
- It is not easy to understand implications of complex forecasting methods;
- A government's economic, political and administrative environment that is vital for forecasting is generally in flux;
- There are no generally accepted forecasting principles and assumptions for specific revenue sources; and
- The motivations of the institutions responsible for the forecast may be questioned for political reasons or otherwise.

Therefore, it is useful to institute processes to evolve consensus on revenue forecasts.

Frequency of Revenue Forecasts

Normally revenue forecast is a process undertaken at a frequency of a year, particularly during the Budget Process. However, forecasting once done is not expected to remain valid indefinitely, particularly when it is based on causal relationships between the dependent and independent variables. This is because the nature of the relationships between variables changes with the changes in circumstances and prevailing social, economic and political scenario. Therefore, there is need to review the forecasts as frequently as may be governed by the changes in the economic and political environment. There are instances in Governments where revenue forecasts are undertaken every month when there are certain changes in policy or administrative mechanism to account for such changes. This helps to revise the collection targets to realistic levels.

As a consequence, there is a need for monitoring the forecasts of revenue. Moreover, there is a need to monitor the effectiveness of decision rules constantly to make sure that they are still appropriate. There is a need to build in the process of learning into the system to avoid running into the risk of applying obsolete rules. Constant monitoring helps in avoiding various biases arising out of inconsistency, conservatism, illusory correlations, availability, optimism, underestimating uncertainty and selective perception.

Suggested Readings:

- Benjamin Uy (2004), "Revenue Estimation: A Practical Guide to the Concept with Techniques," USAID State Fiscal Reform Program, BearingPoint Inc. USA.
- Salomon A Guajardo and Rowan Miranda (2000), "An Elected Official's Guide to Revenue Forecasting," Government Finance Officers' Association of the United States and Canada.

Part 2: Alternative Methods of Forecasting

Broad Categories of Forecasting Methods

Broadly, forecasting could be done either qualitatively or quantitatively.

Qualitative Forecasting is normally used when a little or no quantitative information is available but sufficient qualitative knowledge exists. For example, forecasting how a large increase in oil prices will affect the consumption of oil. Qualitative forecasting methods are broadly of two types — judgmental and consensus.

- All forecasts at some point of time or other rely on expert judgement. **Judgmental methods** tend to work best when background conditions are changing rapidly and it becomes difficult to capture the rapidly changing environment quantitatively. A systematic consideration of expert opinions is what is important in judgmental forecasting.
- Revenue forecasts are created for use in a political environment. **Consensus approaches** bring together representatives of the various groups interested in the forecast and give them a share of responsibility. There is no limitation on methodologies which can be used by the participants. Using this process tends to reduce the overall volatility of the forecast.

Forecasting based on time series methods involves predicting the continuation of historical patterns such as forecasting the future years' revenues based on the growth of the revenue itself or based on the relationship between revenue and an explanatory variable like GSDP. An example of the latter is the use of buoyancy/elasticity6 with respect (with regard to) GSDP for forecasting tax revenues.

Quantitative Forecasting can be used only when sufficient quantitative information is available. These can be broadly categorized into:

- Time Series Methods;
- Input-output Based Methods; and
- Simulation Based Methods.

In this Part only time series methods are discussed. Other methods are discussed in the subsequent Chapters.

Forecasting based on time series methods involves predicting the continuation of historical patterns such as forecasting the future years' revenues based on the growth of the revenue itself or based on the relationship between revenue and an explanatory variable like GSDP. An example of the latter is the use of buoyancy/elasticity[11] with respect (with regard to) GSDP for forecasting tax revenues.

The various time series methods include:

- Forecasts by long term trend and growth rate;
- Forecasts by using buoyancy/elasticity;
- The method of moving averages; and
- Exponential smoothing method.

These methods are discussed in the following Sections.

[11] Buoyancy/elasticity gives a percentage change in tax revenue following a unit percentage change in GSDP.

Forecasting by Long-term Trend or Growth Rate

In this method, only the past trend (linear or nonlinear) in revenues is used to forecast the future. In other words, it assumes that the time variable represents fully the changes in economic variables that may be affecting revenues.

Trend computes values along a linear trend. It involves fitting to the data set a straight line of the type given below and computing values of Y for given new values of X (time variable).

$$Y = a + b X \quad (2.1)$$

where,
a is a constant referred to as an intercept term, and
b = slope of the linear trend line

For n observations on Y in column A and on X in column B in the rows 1 to n, EXCEL formulae for estimating trend and obtaining forecasts for the (n+1)th to (n+3)rd year as follows:

Excel Formula for trend: TREND(B1:Bn,A1:An) (2.2)

Excel Formula for prediction:
TREND(B1:Bn,A1:An,An+1:An+3) (2.3)

Growth rate method involves estimation of exponential growth rate and predicting values of Y based on the growth rate by assuming that the same growth rate will prevail in the future. Growth rate can be obtained by estimating the following equation:

$$Y = a*m\text{^}X \text{ or} \quad (2.4)$$

$$\ln(Y) = a + b X \quad (2.5)$$

Where,
a is a constant
b = ln(m), with m = (1+r), r being the growth rate

For n observations on Y in column A and on X in column B in the rows 1 to n, EXCEL formulae for estimating growth rate and obtaining forecasts for the (n+1)th to (n+3)rd year as follows:

Excel Formula for growth rate:
GROWTH(B2:Bn,A2:An) (2.6)

Excel Formula for prediction[12]:
GROWTH(B2:Bn,A2:An,An+1:An+2) (2.7)

The actual and estimated revenue from sale of arrack in Karnataka from 1990-91 till 2003-04, bases on trend and growth rate equations are given in Table 2.1. The forecasts for 2004-05 and

Table 2.1: Actual Revenue from Arrack in Karnataka and its Estimates of by Trend and Growth Rate Method

(INR Crore)

Year	Actual Revenue	Estimates by Trend Equation	Estimated by Growth Rate Equation
1990-91	304.21	265.10	335.63
1991-92	405.55	330.44	370.42
1992-93	376.18	395.80	408.82
1993-94	473.11	461.13	451.20
1994-95	547.30	526.47	497.97
1995-96	585.72	591.82	549.58
1996-97	608.90	657.16	606.55
1997-98	605.09	722.51	669.43
1998-99	678.80	787.85	738.82
1999-00	799.24	853.19	815.40
2000-01	987.83	918.54	899.92
2001-02	1025.87	983.88	993.20
2002-03	1108.34	1049.23	1096.15
2003-04	1151.55	1114.57	1209.78

[12] General formula for forecasting based on growth rate is GROWTH (known Y's, known X's, new X's, constant).

2005-06 are INR1335.18 crore and 1473.57 crore with a linear trend, and INR1179.91 crore and INR1245.26 crore with growth rate approach.

These estimates could also be plotted for clarity in comparison, as depicted in Figure 2.1.

Buoyancy/Elasticity Method

Unlike in the cases discussed above, the forecasts by buoyancy/elasticity methods presume that the revenue is dependent on the economic performance of the economy that is generally represented by gross state domestic product (GSDP) of the economy. In other words, buoyancy is a measure of the responsiveness of tax revenues to changes in GSDP.

Buoyancy

Buoyancy of a tax can be defined as the ration of percentage change in the tax revenue (historical) following 1 percent change in GSDP. It could also be expressed simply as the ratio of proportional changes in historical tax revenue (T) and GSDP as follows:

$$\text{Buoyancy (b)} = (\Delta T / T) / (\Delta GSDP/GSDP) \quad (2.8)$$

Generally buoyancy is estimated in a double-log linear relationship of the following type:

$$\ln(T_t) = a + b \ln(GSDP_t) \quad (2.9)$$

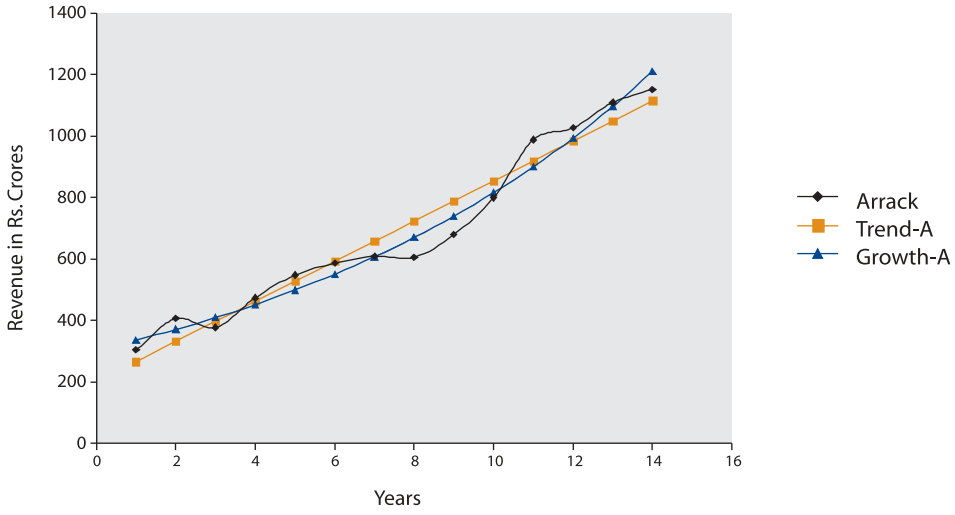
In this formula:

- ln indicates natural logarithm;
- T is the tax receipts from a given source;
- a is a constant term; and
- b coefficient is the measure of buoyancy.

Buoyancy could be estimated with the given set of data on tax revenue and GSDP, through regression analysis by using MS-Excel or EViews. How to perform a regression with MS-Excel is explained in Box 2.1, and use of EView is illustrated in Annexure 4A.4.

Alternatively, for n observations on "T" in column A and on "GSDP" in column B in the rows 1 to n, it

Figure 2.1: Actual and Estimated Revenue from Arrack



Box 2.1: Performing Regression with MS Excel

- To start with by opening MS-Excel, we need to check that the Analysis ToolPak is loaded.
- Subsequently, we click on "Tools"; if Data Analysis appears on the menu, it has already been loaded. If it does not appear, then we click on "Add-In", then click on the box labeled "Analysis ToolPak", then click on "OK".
- Further, we select the Regression tool by clicking on "Tools", the "Data Analysis", then "Regression", then "OK".
- We need to fill out the entries in the Input Section for:
  - The location of the Revenue data (including label)
  - The location of the explanatory variable like GSDP (including label)
- We further "Check" the boxes for the following by clicking on them:
  - Labels
  - Confidence level
- In the Output Options Section:
  - We click on "Inset New Worksheet Ply" to get the results in a separate worksheet in the same Excel file, and name it.
- In the Residuals Section, we "check" the boxes for:
  - Residuals
  - Residual plots
  - Line Fit plots

could be directly obtained by using the following Excel formulae:

Excel Formula for Buoyancy (b):
LINEST(LOG(A1:An),LOG(B1:Bn)) (2.10)

The revenue forecasts based on elasticity assume that there will be no discretionary changes in the tax structure during the projection period. In case some such changes are anticipated then the revenue impact of these changes needs to be separately estimated and added to the forecasts so obtained.

These methods of computation of buoyancy implicitly assume that the buoyancy remains constant at all levels of GSDP.

Application of buoyancy for forecasting tax revenue for the future implicitly assumes that changes in the tax structure similar to those in the reference period would take place in the forecasting period. Generally, forecasting by using buoyancy involves the following steps:[13]

1. Computation of growth rate (r_t) of tax revenue in the t^{th} year based on the buoyancy, that is given by:

$$(r_t) = b\ (\text{Growth rate of GSDP})_t \qquad (2.11)$$

2. Revenue forecast for the t^{th} year can be now obtained by applying the above computed growth rate to the tax revenue for the previous year, as follows:

$$T_t = T_{(t-1)} \cdot (r_t) \qquad (2.12)$$

3. Normally, the forecasting could begin with the $(n+1)^{th}$ year with tax revenue of the n^{th} year as the base. However, if this year is not considered to be a normal year, some other year prior to this year, that is considered to be a normal year can be

[13] For illustrations on estimation and use of buoyancy for forecasting tax revenue see the case studies prepared by state officials/FPAC resource persons in Jharkhand and Uttarakhand. For example, see U S Bisht and B B Mathpal (2006), "Forecasting Trade Tax Revenue of Uttaranchal", June.

taken as the base year, and the forecasting would begin with this year and will be made upto the target year (say n+5).

Elasticity

Elasticity measures responsiveness of tax revenue to changes in GSDP, at a constant tax structure. As discussed earlier, application of buoyancy for obtaining tax revenue projections for the future assumes that changes in the tax structure during the projection period would be similar to those which have taken place in the reference period. When it is not likely to hold good, use of buoyancy for forecasting tax revenue may not be appropriate. In that scenario, it would be appropriate to make the forecasts at a constant tax structure by using elasticity and separately estimate the impact of likely changes in the tax structure in the future.

Elasticity is estimated like buoyancy excepting that the tax revenue series used in the former case is a derived tax revenue series *at a constant tax structure* (and not the historical tax series as used in the latter case). The tax revenue series at a constant tax structure is obtained by removing the impact of changes in the tax structure from the historical tax revenue series.

One of the methods of obtaining the tax series at a constant tax structure is "Proportional Adjustment Method"[14] that is outlined in Table 2.2. As the name suggests, it assumes that the tax revenue (T) at a constant tax structure and additional resources mobilized (ARM) through changes in the tax structure is a year would grow proportionately implying that both T and ARM grow at the same rate.

From Table 2.2, it would be noted that the following steps are involved in cleaning the historical tax revenue series for the ARM undertaken in the reference period:

1. Obtaining the tax revenue series (T*) net of ARM in the same year by subtracting ARM from the historical tax revenue, as is done in column 4.
2. Obtaining the cleaned tax series (T**) by adjusting T* series with reference to ARM undertaken in the preceding years, as is done in column 5. For example, tax revenue for the 3rd year revenue at the tax structure of 1st year ($\mathbf{T_{1,3}}$) is given by:

$$T_{1,3} = (T_{2,3} / T_2) * T_{1,2} \qquad (2.13)$$

In equation 25.13, $\mathbf{T_{2,3}}$ and $\mathbf{T_2}$ are the revenues in the 3rd and 2nd years respectively at the rate structure of 2nd year. Therefore, the ratio of former to the latter gives the revenue growth multiplier in the 3rd year at the constant tax structure. The product of this multiplier and revenue in the 2nd year at the rate structure of first year ($\mathbf{T_{1,2}}$) gives revenue in the 3rd year at the rate structure of first year.

3. By following the above two steps, cleaned tax revenue series can be obtained as shown in column 5. Let us denote it by T**.

Now, elasticity can be estimated by estimating equation 5.9 by replacing T with T**. Let us denote the coefficient of ln(GSDP) by "e" to indicate the

[14] Proportional adjustment method is commonly used method for estimating elasticity. The other methods include "Constant Rate-Base Method", "Divisia Index Method", and "Regression Approach with Inclusion of Tax Policy Variables". For a discussion on these methods see Pawan K Aggarwal (1991), "Income Inequality and Elasticity of Indian Personal Income Tax", Economic and Political Weekly, Vol.26, No.29 (July 20), pp. 1741-48.

Table 2.2 Proportional Adjustment Method of Cleaning the Tax Series for Estimating Elasticity

Year 1	Historical Tax Revenue (T) 2	Additional Resource Mobilization (ARM) 3	Adjusted T for Current Year ARM (Say T*) 4	Adjusted T at the Tax Structure of first Year (Say T**) 5
1	T_1		$T_{1,1} = T_1$	$T_{1,1}$
2	T_2	D_2	$T_{1,2} = T_2 - D_2$	$T_{1,2}$
3	T_3	D_3	$T_{2,3} = T_3 - D_3$	$T_{1,3} = (T_{2,3} / T_2)* T_{1,2}$
4	T_4	D_4	$T_{3,4} = T_4 - D_4$	$T_{1,4} = (T_{3,4} / T_3)* T_{1,3}$
5	T_5	D_5	$T_{4,5} = T_5 - D_5$	$T_{1,5} = (T_{4,5} / T_4)* T_{1,4}$
6	T_6	D_6	$T_{5,6} = T_6 - D_6$	$T_{1,6} = (T_{5,6} / T_5)* T_{1,5}$
7	T_7	D_7	$T_{6,7} = T_7 - D_7$	$T_{1,7} = (T_{6,7} / T_6)* T_{1,6}$
8	T_8	D_8	$T_{7,8} = T_8 - D_8$	$T_{1,8} = (T_{7,8} / T_7)* T_{1,7}$
9	T_9	D_9	$T_{8,9} = T_9 - D_9$	$T_{1,9} = (T_{8,9} / T_8)* T_{1,8}$
10	T_{10}	D_{10}	$T_{9,10} = T_{10} - D_{10}$	$T_{1,10} = (T_{9,10} / T_9)* T_{1,9}$
11	T_{11}	D_{11}	$T_{10,11} = T_{11} - D_{11}$	$T_{1,11} = (T_{10,11} / T_{10})* T_{1,10}$
12	T_{12}	D_{12}	$T_{11,12} = T_{12} - D_{12}$	$T_{1,12} = (T_{11,12} / T_{11})* T_{1,11}$
13	T_{13}	D_{13}	$T_{12,13} = T_{13} - D_{13}$	$T_{1,13} = (T_{12,13} / T_{12})* T_{1,12}$
14	T_{14}	D_{14}	$T_{13,14} = T_{14} - D_{14}$	$T_{1,14} = (T_{13,14} / T_{14})* T_{1,13}$
15	T_{15}	D_{15}	$T_{14,15} = T_{15} - D_{15}$	$T_{1,15} = (T_{14,15} / T_{15})* T_{1,14}$

elasticity. Now steps 2.11 and 2.12 need to be repeated by substituting "e" for 'b' to obtain the revenue forecasts based on elasticity.

The revenue forecasts based on elasticity assume that there will be no discretionary changes in the tax structure during the projection period. In case some such changes are anticipated then the revenue impact of these changes needs to be separately estimated and added to the forecasts so obtained.

Moving Average Method

A time series may follow certain systematic pattern during certain periods. It could be identified by plotting the time series. It would reveal the systematic feature of the data, if any. This systematic pattern could be *a stationary pattern, a seasonal pattern, a cyclical pattern, or a simple time trend* discussed below:

1. **Horizontal Pattern:** Fluctuation of data values around a constant mean- "Stationary Series". For example, consumption of commodities with lower elasticity of demand.
2. **Seasonal Pattern:** Fluctuations in variables influenced by seasonal factors. For example, sale of soft drinks and household electricity consumption reoccur on a regular periodic basis.
3. **Cyclical Pattern:** Fluctuations that are not of a fixed period. Such fluctuations normally occur as a result of economic shocks, and the rises and falls vary in length.

4. **Trend Pattern:** A long-term increase or decrease in the data. For example, GSDP, and Government expenditure and revenue.

It is necessary to identify such systematic fluctuations in the data set and take it into account in the model built for forecasting. Such systematic fluctuations can be identified by plotting the data as shown in Figures 2.2 to 2.5.

Often it is observed that there are significant random fluctuations from year to year within the time series data. For estimating a trend of such a series, it would be necessary to make it smooth by reducing the random variation. The commonly used simple method for smoothing a time series (that is free from cyclicality and seasonality) is Moving Average.

Figure 2.2: Trend

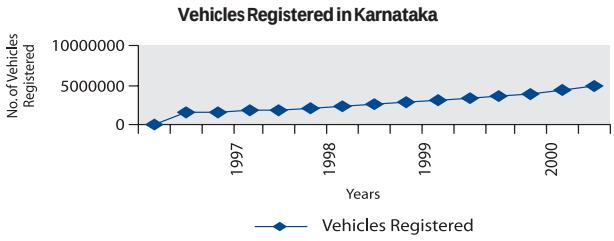


Figure 2.3: Stationarity (With Trend)

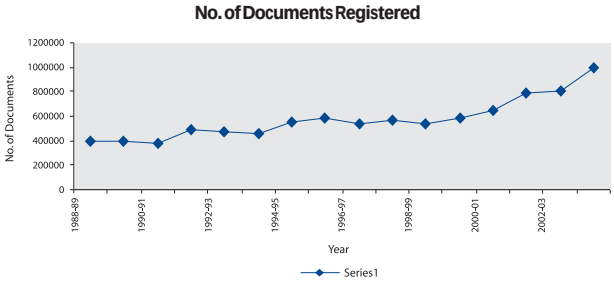


Figure 2.4: Cyclicality

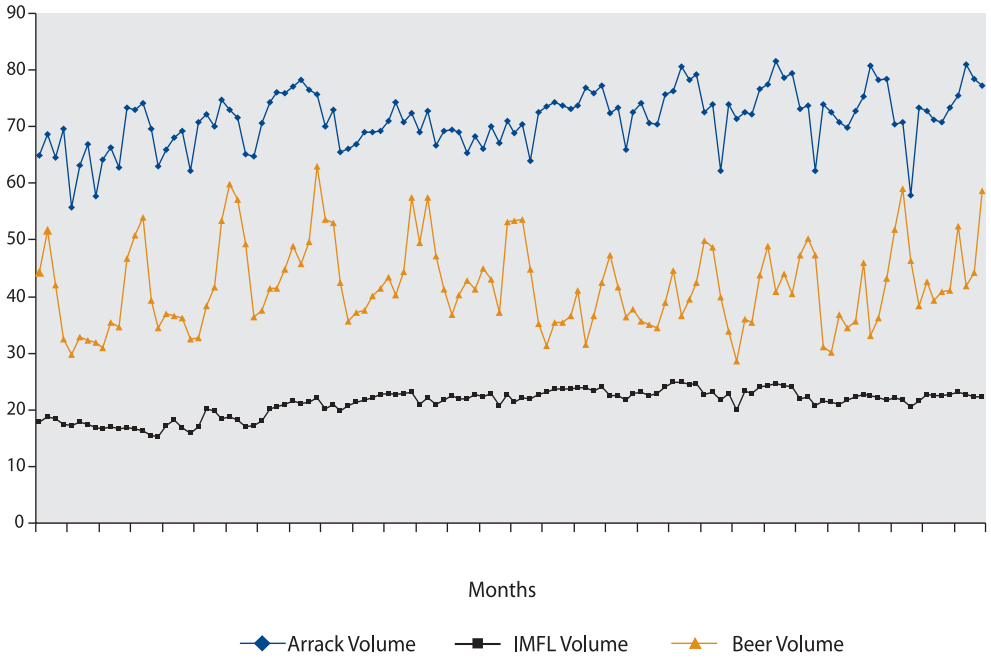
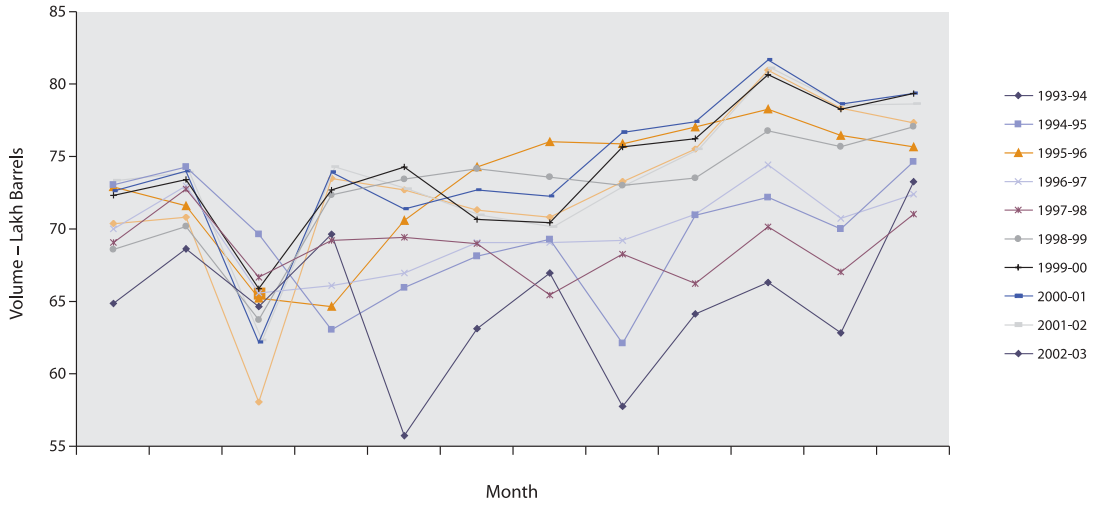


Figure 2.5: Seasonality



The figure has been obtained though a three-yearly MA of the data given below. A moving average of order n (MA-n) involves averaging over n observations. For example, moving averages of order 3 and 5 (MA-3 and MA-5) are as given below:

$$\text{MA-3: } T_t = 1/3\,(Y_{t-1} + Y_t + Y_{t+1}) \qquad (2.14)$$

$$\text{MA-5: } T_t = 1/5\,(Y_{t-2} + Y_{t-1} + Y_t + Y_{t+1} + Y_{t+2}) \qquad (2.15)$$

Taking an average of the points near an observation provides a reasonable estimate of the trend cycle at that observation. The number of observations to be taken for moving average could be decided based on the length of the observed cycle. The computation of MA-3 and MA-5 is illustrated in Table 2.3.

The first panel of Figure 2.6 shows the resulting trend cycle estimate with a three yearly MA and Figure 2.7 shows that resulting trend cycle estimate with a five yearly moving average. While in the first panel, the data loses out on two end points, in five- yearly MA, the data loses out on two data points on each side. One can see that the three yearly MA suits the actual data more. With a smoothened trend line as obtained in the figure, one can have forecasts with the formulae discussed above both for the corresponding values as well as the future value.

Exponential Smoothing Method

Exponential Smoothing Method is a mechanism whereby the time series data is smoothened using various weights with exponentially decreasing weights assigned to observations getting older. There are varied methods of "Exponential Smoothing", however, the one thing common among them is that recent values are given relatively more weight in forecasting than the older observations.

In case of moving averages, the weights assigned to observations are a by-product of the particular MA system adopted. In exponential smoothing, however, there are more smoothing parameters to be determined explicitly and these choices determine the weights assigned to observations. We here remain confined to Single

Figure 2.6: Moving Averages – Example 1

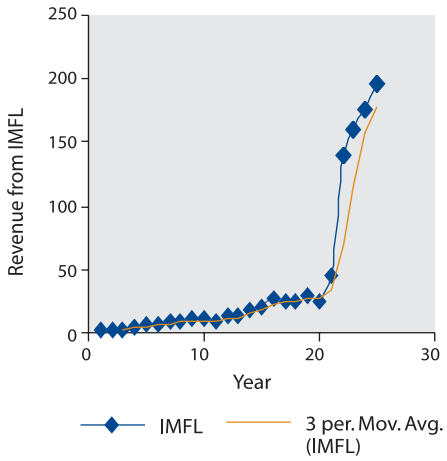
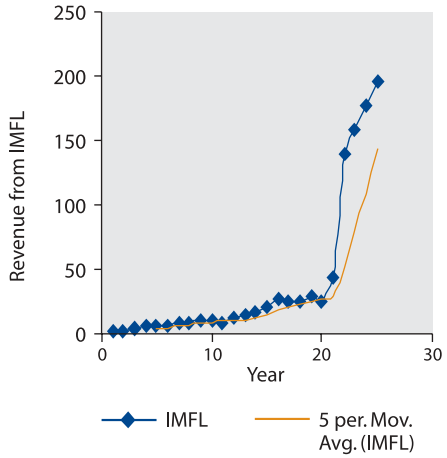


Figure 2.7: Moving Averages – Example 2



Exponential Smoothing.

Suppose we wish to forecast the next value of our time series Y_t which is yet to be observed. Our forecast is denoted by F_t. When the observation Y_t becomes available, the forecast error is found to be $Y_t - F_t$. The method of single exponential forecasting takes the forecast for the previous period and adjusts it using the forecast error. Thus, the forecast for the next period is:

Table 2.3: Moving Averages of Revenue from IMFL in Karnataka

Year	IMFL	MA-3	MA-5
1980-81	2.62		
1981-82	2.44	2.7866	
1982-83	3.30	3.6633	3.922
1983-84	5.25	4.8500	4.740
1984-85	6.00	5.9866	5.990
1985-86	6.71	7.1333	7.082
1986-87	8.69	8.0533	8.072
1987-88	8.76	9.2166	8.978
1988-89	10.20	9.8300	9.414
1989-90	10.53	9.8733	10.290
1990-91	8.89	10.8300	11.456
1991-92	13.07	12.1833	12.854
1992-93	14.59	14.9500	14.774
1993-94	17.19	17.3033	18.422
1994-95	20.13	21.4833	20.816
1995-96	27.13	24.1000	22.884
1996-97	25.04	25.7000	25.336
1997-98	24.93	26.4733	26.326
1998-99	29.45	26.4866	29.784
1999-00	25.08	32.9833	52.550
2000-01	44.42	69.4566	79.378
2001-02	138.87	114.1200	108.752
2002-03	159.07	158.0867	142.8433
2003-04	176.32	176.9756	
2004-05	195.54		

$$F_{t+1} = F_t + \alpha (Y_t - F_t) \qquad (2.16)$$

$$\text{or, } F_{t+1} = \alpha Y_t + (1-\alpha) F_t$$

$$\text{or, } F_{t+1} = \alpha Y_t + (1-\alpha) [\alpha . Y_{t-1} + (1- \alpha) F_{t-1}]$$

$$\text{or, } F_{t+1} = \alpha Y_t + \alpha (1-\alpha) Y_{t-1} + (1- \alpha)^2 F_{t-1} \qquad (2.17)$$

where, α is a constant between 0 and 1. It is clear from equation 2.16 that when á has a value close to 1, the revised forecast will include a substantial

adjustment for the error in the previous forecast. Conversely, when α is close to zero, the revised forecast will include very little adjustment.

By generalizing equation 2.17 for successive previous figures of the forecasts, we get:

$$F_{t+1} = \alpha Y_t + \alpha (1-\alpha)Y_{t-1} + \alpha (1-\alpha)^2 Y_{t-2} + \alpha (1-\alpha)^3 Y_{t-3} + \ldots\ldots + (1-\alpha)^t F_1 \quad (2.18)$$

For $\alpha = 0.2$ (say), weights assigned to $Y_t, Y_{t-1}, Y_{t-2}, Y_{t-3}$ etc. would be respectively, 0.2, 0.16, 0.128, 0.1024 and so on. One can see that the weights get reduced with every previous value of the variable. Moreover, the sum of weights assigned to all the past data on Y approximates to 1.

From equation 2.18, it would be noted that the revised forecast for a year is simply the weighted sum of forecast for the first year and actual values of the variable for all other years in the reference period.

By using our illustration on forecast of revenue from arrack in Table 2.1, based on long term trend method of forecasting, the forecast for the year 2004-05 based on exponential smoothing by using equation 2.18 can be explained as follows. For a value of α of 0.3 (say), computations of weights and weighted sum of values of the variable and the estimated value of the variable in the first year of the reference period are shown in Table 2.4.

Now forecast for the year 2004-05 can be obtained by using equation 2.18, as follows:

$$F_{2004\text{-}05} = 984.4265 + (1\text{-}0.3)^{13} * 265.10 \quad (2.19)$$

where, 265.10 is the estimated revenue for the 1st year, based on the long term trend equation (see column 3 in Table 2.1). By simplifying equation

Table 2.4: Adjustment in Revenue Forecast Based on Exponential Smoothing Method

Year	Revenue from Arrack (Y) (INR Crore)	Weight assigned (for α= 0.3)	Value of the Weight Assigned (w)	w*Y
1990-91	304.21	$0.3*(0.7)^{13}$	0.00290667	0.884238
1991-92	405.55	$0.3*(0.7)^{12}$	0.00415239	1.684
1992-93	376.18	$0.3*(0.7)^{11}$	0.00593198	2.231
1993-94	473.11	$0.3*(0.7)^{10}$	0.00847426	4.009
1994-95	547.3	$0.3*(0.7)^{9}$	0.01210608	6.625
1995-96	585.72	$0.3*(0.7)^{8}$	0.0172944	10.129
1996-97	608.9	$0.3*(0.7)^{7}$	0.02470629	15.043
1997-98	605.09	$0.3*(0.7)^{6}$	0.0352947	21.356
1998-99	678.8	$0.3*(0.7)^{5}$	0.050421	34.226
1999-00	799.24	$0.3*(0.7)^{4}$	0.07203	57.569
2000-01	987.83	$0.3*(0.7)^{3}$	0.1029	101.647
2001-02	1025.87	$0.3*(0.7)^{2}$	0.147	150.802
2002-03	1108.34	0.3*(0.7)	0.21	232.751
2003-04	1151.55	0.3	0.3	345.465
Sum w*Y				**984.4265**

2.19, we get:

$$F_{2004\text{-}05} = 984.4265 + 0.00290667 * 265.10$$

or, $F_{2004\text{-}05} = 984.4265 + 0.770558 = 985.197$

Similarly, it could be computed for other values of α. The quality of forecast in this method however, depends significantly on the selection of the value of α. To be specific, α could be determined by an average of the difference between the actual and the estimated values of the previous years.

Exercises on Buoyancy, Elasticity and Forecasting

Q. 1 Estimate the buoyancy and elasticity of the following major taxes in all the three REFORM states of Karnataka, Uttaranchal and Jharkhand:

- Sales Tax;
- State Excise Duty;
- Stamp Duty and Registration Fee; and
- Motor Vehicles Tax.

Take into account all the Additional Resource Mobilization (ARM) measures adopted by the State Governments for the estimation of elasticity. Also use the estimated buoyancy and elasticity for forecasting the revenue from these taxes for next two years.

Part 3: Monthly Receipts Monitoring and Forecasting Model[15]

Introduction

The tax-receipt forecasting model is a simple, yet functional tool to monitor and project short-term revenues from major taxes, components of a tax, or nontax charges. The purpose of this model is to develop a short-term revenue-forecasting model for each of the major taxes so that the tax agency can monitor the tax revenue collections closely. This simple model provides relatively accurate results that make the model attractive for developing countries. This model requires primarily monthly tax collection data, which are usually available within a tax agency.[16]

The tax-receipt forecasting model uses past seasonal tax collection patterns to predict collections in the following years. The model allows for increased collections due to economic growth, actual collections to date that deviate from the expected growth rate, expected changes in the seasonal pattern, and changes in the effective tax rate between the same months in successive years. The model uses actual monthly receipts data and projected GDP growth — or other tax base proxies (e.g. private consumption or imports) growth — to forecast collection. It allows analysts to account for changes in real GDP, the price level, effective average tax rates, and any behavioral effects that may be associated with changes in tax rates.

For monitoring purposes, the model provides the collections in each month to date, the projected revenues for each month over the remainder of the year, and the estimated revenue surplus or deficit by type of taxes.

While this model is primarily targeted at short-term forecasting and monitoring monthly tax receipts over a financial year, it contains similar features to a simple macro-model for forecasting one-year or medium-term revenues as long as there are no expected major changes in the tax or economic structure over the forecast period.

Methodology

The simplest form of projecting annual tax revenue is given by the following formula:

$$T_y = \tau_y \times B_y \qquad (3.1)$$

where:

T_y : Annual tax receipts for the fiscal year ***y***

t_y : Projected effective average tax rate in fiscal year ***y***; defined as the ratio of tax revenues to the tax base

B_y : Projected tax base in fiscal year ***y***

Projected tax base in fiscal year *y* can be estimated using the actual tax base in the previous year multiplied by a growth factor, and some further adjustment if there are changes in the tax structure changes which may affect the tax base.

Therefore:

$$T_y = \tau_y \cdot B_{y-1} \cdot (1+\delta) \cdot \left(\frac{\tau_y}{\tau_{y-1}}\right)^{\beta} \qquad (3.2)$$

[15] This Part has been prepared by Graham Glenday, GP Shukla, and Rubino Sugana of Duke Center for International Development, Duke University, USA.

[16] Typically, the receipts model is used to track and project monthly receipts, but it can also be used for weekly or quarterly receipts.

where:

τ_{y-1} : Actual effective average tax rate in fiscal year ***y***–1

B_{y-1} : Actual tax base in fiscal year ***y***–1

δ : Growth factor

β : User defined elasticity of the tax base with respect to changes in the tax rate depending on the structure of the tax. Some determinations of β are provided below for various tax structures. A detailed explanation of this elasticity is provided in the Annex to this Part (Annexure 3A.1).

In any given month, annual tax receipts for the fiscal year can be expressed as the sum of two parts: (1) actual revenues collected up to the month for which receipts data are available; and (2) forecasted receipts for each of the remaining months of the fiscal year.

To project the second part of monthly receipts, the model takes into account the actual growth of the year-to-date tax collections as compared with that of the same period in the previous fiscal year, and the projected growth of tax base proxies (e.g. GDP, private consumption, imports, etc.).

The general form of the monthly tax receipt of fiscal year, *y*, is as follows:

$$T_y = \sum_{a=1}^{m} T_{a,y} + \sum_{\substack{a=m+1 \\ i=m+1}}^{12} \tau_{i,y} \cdot B_{a,y-1} \cdot (1+\delta) \cdot \left(\frac{\tau_{i,y}}{\tau_{a,y-1}} \right)^{\beta} \quad (3.3)$$

where:

$T_{a,y}$: Actual monthly tax receipts in fiscal year ***y***, where tax collection data is available

$T_{a,y-1}$: Actual monthly tax receipts in fiscal year ***y***–1

$B_{a,y-1}$: Actual monthly tax base in fiscal year ***y***–1

m : Number of months up to which actual tax receipts data in fiscal year ***y*** is available

$\tau_{i,y}$: Projected effective average tax rate in month ***i*** of fiscal year ***y***

$\tau_{a,y}$: Actual effective average tax rate in month ***i*** of fiscal year ***y***–1

Since last year's tax base is equal to the actual tax collection divided by the effective average tax rate, equation (3.3) can be rewritten as follows:

$$T_y = \sum_{a=1}^{m} T_{a,y} + \sum_{\substack{a=m+1 \\ i=m+1}}^{12} \tau_{i,y} \cdot \left(\frac{T_{a,y-1}}{\tau_{a,y-1}} \right) \cdot (1+\delta) \cdot \left(\frac{\tau_{i,y}}{\tau_{a,y-1}} \right)^{\beta} \quad (3.4)$$

or

$$T_y = \sum_{a=1}^{m} T_{a,y} + \sum_{\substack{a=m+1 \\ i=m+1}}^{12} T_{a,y-1} \cdot (1+\delta) \cdot \left(\frac{\tau_{i,y}}{\tau_{a,y-1}} \right)^{1+b} \quad (3.5)$$

From equation (3.5), we find that at any given month, ***i***, in the current fiscal year, ***y***, the general form of the monthly tax receipt forecasting model is as follows:

$$T_{i,y} = \begin{cases} T_{a,y} \\ T_{a,y-1} \cdot (1+\delta) \cdot \left(\frac{\tau_{i,y}}{\tau_{a,y-1}} \right)^{1+\beta} \end{cases} \quad (3.6)$$

If the actual tax receipts data for month ***i*** is available, then $T_{i,y}$ is equal to the actual tax receipts for that month. Otherwise, $T_{i,y}$ is projected using the actual last year's receipts for the same month multiplied by a growth factor and adjusted by a user-defined elasticity, β, to capture behavioral effect if there were policy changes during the fiscal year which modified the effective average tax rate.

If the seasonal pattern of receipts over a year is expected to change from one year to the next — for example, the timing of required installment tax payments is changed — then adjustment factors

need to be introduced to last year's tax revenues to form the revised basis of projecting this year's pattern of revenues.

Let $\omega_{i,y}$ be the expected share of annual revenues in month ***i*** of year ***y***; and $\Delta\omega_{i,y}$ be the change in the expected share because of the estimated revenue changes in a month, $\Delta T_{i,y-1}$, that would have happened if the new seasonal pattern had applied in the same month last year, then (3.5) becomes:

$$T_y = \sum_{a=1}^{m} T_{a,y} + \sum_{\substack{m=a \\ i=m}}^{12} T_{a,y-1} \cdot (1+\Delta\omega_{i,y}) \cdot (1+\delta) \cdot \left(\frac{\tau_{i,y}}{\tau_{a,y-1}} \right)^{1+\beta} \qquad (3.7)$$

where,

$$\sum_{i=1}^{12} \omega_{i,y} = 1$$

$$\sum_{i=1}^{12} \Delta\omega_{i,y} = 0$$

The Growth Factors

The growth factor, δ, can be measured by a weighted average of two growth factors:

(i) The actual growth of year-to-date receipts in the current fiscal year over that of the same months in the previous fiscal year.

(ii) The expected growth rate of tax base proxies (e.g., GDP) in the current fiscal year.

The weight for the first growth factor is the fraction of the number of months in a fiscal year during which the taxes were actually collected. The weight for the second growth factor is the remaining fraction. If the weight for the first growth factor is α, then the weight for the second growth factor is $(1-\alpha)$. Therefore,

$$\delta = \alpha \cdot \left[\frac{\sum_{a=1}^{m} T_{a,y} - \sum_{a=1}^{m} T_{a,y-1}}{\sum_{a=1}^{m} T_{a,y-1}} \right] + (1-\alpha) \cdot g \qquad (3.8)$$

where,

g : Expected effective growth of a tax base proxy (e.g. GDP, private consumption, imports, etc.) for the current fiscal year[17]

$$: \eta_{TY} \cdot g_R + \pi (1 + g_R) \qquad (3.9)$$

η_{TY} : Tax revenue elasticity with respect to real economic income

g_R : Real economic growth rate

π : Inflation rate

The first term in the above equation represents the growth rate of actual monthly receipts this fiscal year over that of the same period in the previous fiscal year. The weight a can be calculated as (m/12), which varies linearly from 0 (when no tax receipts data is available for any months in the current fiscal year) to 1 (when tax receipts data is available for all of the months in the current fiscal year).

If the real growth rate and/or the inflation rate are expected to accelerate (or decelerate) over the course of a fiscal year, then these growth rates can be varied month-by-month consistent with the expected annual average. Such acceleration (or deceleration) will cause changes in the monthly receipts pattern of tax collected on a monthly or continuous basis. This is typically the case with indirect sales and trade taxes, respectively. In such a case, the annual

[17] The GDP component of the growth factor is generally the ratio of *nominal* GDP in year y to *nominal* GDP in year y-1, because the tax bases for most of the taxes are likely to change both with changes in the price level and with changes in real GDP. In the case of excise taxes, however, the GDP component of the growth factor is the ratio of *real* GDP in year y to *real* GDP in year y-1. Since the excise taxes are imposed on a per unit basis, the excise tax bases are likely to change only with changes in real GDP.

average growth rate, ***g***, in (3.9) is replaced by a rising (or falling) monthly growth rates, $\boldsymbol{g}_i$.

If the growth rate in a month ***i*** from the same month in the previous year is $\boldsymbol{g}_i$, then the annual growth rate over the year is:

$$g = .[\prod_{i=1}^{12}(1-g_i)^{1/12}]-1 \qquad (3.10)$$

Effective Tax Rates

The term $(\tau_{i,y}/\tau_{a,y-1})^{1+\beta}$ in equation (3.5) represents the ratio between projected current year's effective average tax rate over last year actual effective tax rate for the same month adjusted by the elasticity of the base to changes in the tax rate. Effective tax rate for a particular month is defined as the actual tax receipts divided by the effective tax base for that month. If there were no tax policy changes affecting the tax rate or tax base over the fiscal year, this ratio would be equal to 1.

One classification of effective tax rates is whether the tax base is net or gross of tax (or charged on the supply price or the demand price.) Another classification is the tax period over which the tax is defined. Aside from trade taxes, which are charged and collected on a transaction basis, most taxes are typically charged and collected on a monthly, quarterly or annual basis. Typically sales and excise taxes are applied, charged and collected on a monthly basis, while income taxes are charged on an annual basis, but collected in installments (often quarterly) or by withholding (monthly or continuously) over the course of the year.

In the case of sales and excise tax, effective taxes can be calculated on a monthly basis. Typically receipts occur in the month following the charging and collection of the tax by some agent. This means that when a tax rate is amended, it applies with a one-month lag to the following and subsequent months. The collection pattern, aside from the month delay in collections, is determined by the seasonal patterns in demand in the market place.

In the case of income taxes, the effective tax rates generally apply for a full financial year at a time. Hence, the same effective tax rate is applied to all the subperiods in a year. The collection pattern of the annual tax liability will be determined by the installment and withholding rules. In the case of employment taxes with most of the tax collected through monthly withholding, the pattern will primarily follow labor market demand patterns, while for the tax on business, the installment payment requirements (often quarterly) tend to dominate.

The effective tax rate ratio in (3.5) primarily serves to capture legislated changes in the tax structure, especially changes in the statutory tax rates. It is recognized, however, that effective tax rates can be affected by a range of other factors, such as exemptions and the accuracy of the measured tax base, particularly if it is a proxy base. In addition, the effective tax rates can be affected, sometimes in a predictable fashion by non-*ad valorem* tax rates and historical cost accounting rules.

In the case of unit tax rates as customs duty, sales, or excise tax, if the unit tax is not indexed to the price changes in its base, the effective unit tax will change from period to period. In general, the effective tax rate of a unit tax this period depends on the tax rate in the previous period as follows

$$\tau_y = \tau_{y-1} \times \frac{(1+\varphi)}{(1+\pi)\ (1+p_r)} \qquad (3.11)$$

where,

φ : Rate of adjustment of unit tax over period
π : Rate of inflation
p_r : Real change in the price of the goods taxed

For example, if a unit tax remains constant in nominal terms when the nominal price of the taxed good is rising by 10 percent per year (no real change in price), then from (3.11) the effective tax rate falls by about 10 percent per year.

In the case of income taxes, effective tax rates can change because of changes in the rate structure, but otherwise the effective tax rate also varies with changes in the inflation and exchanges because of historical cost accounting, nominally fixed tax structures (such as deductions and tax brackets), taxes falling on the inflation component of returns from financial instruments, and inflation reducing the value of taxes between the time they are charged and paid. For example, in the case of the personal income tax, the two common sources of increases in the effective tax rate rising are inflation-induced bracket creep and taxes charged on the inflation component of interest income and capital gains. In addition, improvements in compliance over time can increase effective tax rates.

In the case of company taxes, aside from the effects of changes in the statutory rates and tax incentives, effective tax rates are affected by a range of economic forces. Inflation can cause effective taxes rates to rise by lowering the real depreciation allowances and costs of goods sold, but also to decline by allowing the deduction of the inflation component of interest costs. Taxable income of companies can also be lowered by real wages rising faster than productivity, increases in real interest rates and by real devaluations of the exchange rate squeezing the domestic value added of companies dealing in traded goods and services.

One classification of effective tax rates is whether the tax base is net or gross of tax (or charged on the supply price or the demand price.) Another classification is the tax period over which the tax is defined. Aside from trade taxes, which are charged and collected on a transaction basis, most taxes are typically charged and collected on a monthly, quarterly or annual basis. Typically sales and excise taxes are applied, charged and collected on a monthly basis, while income taxes are charged on an annual basis, but collected in installments (often quarterly) or by withholding (monthly or continuously) over the course of the year.

To estimate the changes in effective income tax rates due to changes in tax structure require micro simulation models. These models can be used to estimate the effects of macro-variables (e.g., real GDP, inflation, real interest and inflation rates, and real wage rates) on real income tax collections can also be estimated from time series data.

Tax Base and Price Elasticity

The values of β depends the tax structure. The way that changes in tax rates affect the tax base operates through the price effects on supply and demand in the taxed market. Annexure 3A.1 shows these relationships for two general tax structures. In the first case, an *ad valorem* tax rate is charged on the net-of-tax price or supply price as is typical for most sales, excise and trade taxes. In this case, if a tax rate, τ^s, is charged on the supply price in a market with a price elasticity of demand, η, and price elasticity of supply, ε, the elasticity of the tax base with respect to the tax rate, β^s, can be

expressed in terms of the price elasticities of demand and supply and the tax rate (see Annexure 6A.1):

$$\beta^s = \frac{\eta(\varepsilon+1)}{\varepsilon-\eta}\cdot\frac{\tau^s}{(1+\tau^s)} \quad (3.12)$$

If the supply price is fixed as is often the case with tradable goods (or $e = \infty$), then the tax base elasticity simplifies to

$$\beta^s = \frac{\eta\cdot\tau^s}{\tau^s+1} \quad (3.13)$$

or

$$1+\beta^s = 1+\frac{\eta\cdot\tau^s}{\tau^s+1} \quad (3.14)$$

In the second case, an *ad valorem* tax is charged on the gross-of-tax price or demand price such as an income tax collecting tax out of gross income. In this case, if a tax rate, τ^d, is charged on the demand price, the elasticity of the tax base with respect to the tax rate, β^d, can be expressed in terms of the price elasticities of demand and supply and the tax rate:

$$\beta^d = \frac{\tau^d}{1-\tau^d}\times\frac{\varepsilon(\eta+1)}{\varepsilon-\eta} \quad (3.15)$$

If the supply price is fixed (or $\varepsilon = \infty$), then the tax base elasticity simplifies to

$$\beta^d = \frac{(\eta+1)\tau^d}{1-\tau^d} \quad (3.16)$$

or

$$1+\beta^d = \frac{1+\eta\cdot\tau^d}{1-\tau^d} \quad (3.17)$$

Initially, the user-defined elasticity of the tax base with respect to changes in the tax rate, β, is suggested to be set to zero as typically price elasticities of demand, η, tend to be centered around –1. Under this condition, a 1 percent increase, or decrease, in the effective average tax rate, the tax revenue would increase, or decrease, by the same rate. Overtime, as more actual tax receipts data, effective tax rates, real growth rates and inflation rates become available, the tax base elasticity, β, (or price elasticity, η) and revenue elasticity, η_{TY}, can be calibrated by comparing the actual and projected tax receipts figures.

For illustrative purposes, let's assume that the effective average tax rate in July 2004 is lowered by 5 percent from that of 2003, because of the introduction new tax exemptions. Let's also assume that the tax rate is charged on the gross income at rate of 20 percent, and the price elasticity of demand η is –1.5 and of supply ε is 2, then, by (3.15), the elasticity of the tax base with respect to the tax rate, β, is –0.07. This implies that the growth factor, (1+δ), in equation (26.6) would be adjusted downward by approximately 5 percent, since:

$$\left(\tau_{i,y}\Big/\tau_{a,y-1}\right)^{1+\beta} = (0.95)^{1-0.07} \approx 0.95$$

The effective growth factor would become (1+δ) times 0.95. This adjusted growth factor multiplied by the actual monthly receipts in the previous fiscal year in (3.15) generates the forecast revenues for the corresponding months of the current fiscal year. If the price elasticity of demand was higher, say –2, and the supply price fixed, then β is –0.25 or (1+β) is 0.75, and the adjusted tax ratio becomes 0.962.

Application

To show a practical application of this model, a spreadsheet model, *KARNATAKA – Excise Tax Monthly Receipts Forecasting Model.xls*, has been developed in Microsoft Excel using monthly collection data of excise taxes on arrack, Indian-made foreign liquor (IMFL), and beer from the State of Karnataka, India (Table 3.1). In addition, some macro data, such as the nominal and real Gross State Domestic Product (GSDP) and inflation rates for Karnataka, have also been collected (Table 3.2).

Excise taxes in Karnataka are imposed on a "per unit" basis — that is, on the quantity of excisable goods sold, not as percentage of the sale price (Table 3.3). Because the tax is a per unit tax, it does not increase as the price of the excisable goods increases. Over time, as the nominal price of the goods increases, the average effective excise tax rate decreases if the tariff is not adjusted with inflation.

Excel Spread

The sheets Excel file, which is accompanied this Part, consists of 9 worksheets, which are

Table 3.1: Monthly Excise Tax Collection in Karnataka (2000-01–2002-03)

(INR Crore)[15]

Commodity	Arrack			India-made Liquor (IML)			Beer		
Fiscal Year	2000-01	2001-02	2002-03	2000-01	2001-02	2002-03	2000-01	2001-02	2002-03
April	12.15	14.32	12.60	9.28	10.11	11.85	3.35	2.51	2.67
May	12.94	15.10	14.05	14.17	12.50	13.21	2.89	2.90	3.04
June	11.17	14.49	13.43	14.76	12.11	13.11	2.30	1.72	2.17
July	14.53	13.56	14.58	13.22	12.31	12.64	2.12	1.48	1.75
August	13.68	13.80	14.93	14.75	14.30	14.88	1.86	1.59	1.59
September	13.59	12.57	12.98	14.51	15.07	14.32	2.17	1.53	1.74
October	15.18	15.02	15.91	15.36	15.05	15.60	1.91	1.50	1.86
November	14.77	13.89	15.19	16.31	15.45	14.60	2.47	1.72	2.07
December	15.16	14.50	14.91	15.14	15.02	14.71	2.53	1.69	2.09
January	15.50	15.52	14.38	15.58	14.50	13.84	2.30	1.85	1.86
February	15.09	15.18	14.23	14.72	14.19	14.34	2.69	1.86	2.16
March	17.47	18.19	17.45	20.51	14.56	14.75	2.58	2.65	2.78

Source: Department of State Excise, Government of Karnataka.

Table 3.2: Karnataka Macro Data (2000-01–2002-03)

Fiscal Year	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05(Q.E.)
Nom. GSDP (Crores INR)	84,696	93,386	96,230	105,426	115,834	132,198
Pct. Change in GSDP	7.54%	10.26%	3.05%	9.56%	9.87%	14.13%
Nom. GSDP Per. Cap. (INR)	16,345	17,816	18,091	19,576	21,238	23,945
Pct. Change in GSDP/Cap	6.16%	9.00%	1.54%	8.21%	8.49%	12.75%
Inflation (%)	3.14%	3.28%	3.44%	3.63%	3.82%	4.00%

Source: Economic Survey 2005-06, Planning and Statistics Department, March 2006.

[18] 1 crore = 100 lakhs, and 1 lakh = 100,000.

respectively labeled *Actual*, *Macro*, *Growth*, *Baseline, Discretion*, *Projection*, *Graph*, *Chart*, and *Summary*.

Actual Worksheet

The *Actual* worksheet captures the actual monthly collection data. The spreadsheet model has been structured so that the revenue projections are updated automatically every time a new monthly collection data is entered into the *Actual* worksheet. The growth factor, δ, will be automatically adjusted using equation (3.8), and the revenue projections will be recalculated accordingly using equation (3.6).

The *Actual* worksheet also contains the ratio of the current month average effective tax rate and that of the same month in the previous fiscal year for each type of taxes (rows 23–25).

The average effective tax rate ratio is the term:

$$\left(\frac{\tau_{i,y}}{\tau_{a,y-1}}\right)$$

in the equation (3.6). If the *ad valorem* tax rate structure of the current month is the same as that of the same month in the previous year, the effective tax rate ration will be equal to 1. Since excise taxes in Karnataka are imposed on a per-unit basis, the average effective tax rate may decline if the State Government does not index the duty rate to keep pace with inflation. For example, if during Fiscal Year 2001-02 the Government does not adjust the duty rate and the price level in 2001-02 is expected to rise by 3.44 percent and no change to the real change to the price of the commodity, then the effective tax rate ration for the month of April 2002 relative to that of April 2001 can be calculated using equation (3.11):

$$\left(\frac{\tau_{i,y}}{\tau_{a,y-1}}\right) = \frac{1}{(1+3.84\%)} = 0.97$$

As the model currently structured, the average effective tax rate ratio compares the current month tax structure with that of the same month in the previous fiscal year. So, the ratio will be different starting the month when the tax changes are made (say, in April), and will stay constant for the next 12 months if no further changes are made. If there are no more changes, the effective tax rate ratio in the following April will be 1 again since the tax structure at that point is the same as that of in the previous April.

The practical application of equation (3.11) in the model can be seen, for example, in cell O23:

Table 3.3: Excise Tax Rates for Selected Articles

	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05
Arrack						
India-made Liquor						
- Civil (Below INR 350)						
- Civil (Above INR 350)						
- Defence						
Beer						

=1(1+HLOOKUP(O$4,Macro!$C$22:$L$27,5,FALSE)

The function HLOOKUP(O$4,Macro!$C$22:$L$27,5,FALSE) retrieves data from cells $C$22:$L$27 in the *Macro* worksheet and returns the appropriate inflation rate for the fiscal year. The cell O$4 contains the fiscal year for which the inflation rate data is needed. Table 3.4 illustrates how the HLOOKUP() Excel function works.

The above Excel formula will return **5.92** percent. The formula will seek the column with heading "2002-03" (first parameter) within the cell range $B$2:$H$5 (second parameter), and return the value of the cell located on the 3rd (third parameter) row below the column heading (the heading is in row #1). The last parameter "FALSE" ensures that the function will return the correct value even if the column heading is not sorted from left to right. It is always save to put "FALSE" in the last parameter even if the column headings are sorted like in the above example.

Rows 31–33 contain the cumulative annual collection for the fiscal year. The cumulative figure is reset to zero again at the beginning of the fiscal year (the cumulative annual figure equals to the monthly collection by the end of the first month of the fiscal year).

Row 40 contains the sequence number of months in the fiscal year. For example, if the fiscal year begins in April, then the sequence number for April is 1, and it is 12 for March of the following year.

The data in row 41—labeled *Actual Data Available*?— is used to compute the weight, α, which is found in equation (3.8). The cells in row 41 will be equal to 1 if the actual revenue collection for the specific month is available and 0 otherwise. The weight α is obtained by simply summing up row 41 for the specific fiscal year. The computation of α is done in *Macro* Worksheet as described below.

Macro Worksheet

The *Macro* worksheet contains actual and projected macro data and tax base proxies (i.e., GSDP) to be used as the initial growth rate used for estimating the revenue within the year. To use the nominal GSDP growth rate as the estimate for excise tax revenue growth rate, the average tax rate ratio may need to be adjusted using relationship (3.11) as explained in the previous section. Alternatively, the real growth rates of GSDP per capita may be used.

Row 10 calculates the number of month, m, for which the actual collection data is available. The weight $\alpha = m/12$ is calculated is calculated in row 11.

Table 3.4: Reading Inflation Rate Using HLOOKUP() Function

A	B	E	F	G	H
	Inflation Rate				
FY	2001-02	2002-03	2003-04	2004-05	2005-06
GSDP Growth	3.51%	4.55%	5.20%	3.84%	4.00%
Inflation Rate	4.79%	**5.92%**	14.70%	13.22%	10.00%

=HLOOKUP("2002-03",$B$2:$H$5,3,FALSE).

The formula for computing *m* is using the SUMIF() spreadsheet function. Table 3.5 illustrates how the SUMIF() function works.

The above Excel formula returns **8**, the sum all the number in cells B3:Q3 that correspond to cells B1:Q1 which values equal to "02/03".

Just for convenience, the *Macro* worksheet also contains the tax base elasticity with respect to effective tax rate, β, for each of the excisable commodity (rows 37–39). Initially, the β is set to zero. When the β is set to zero, it assumes that the elasticity of revenue with respect to the tax rate is equal to 1.

Growth Worksheet

The *Growth* worksheet is used to estimate the weighted average growth rates, which are used in the baseline projections of monthly receipts of each tax type using equation (3.8):

$$\delta = \alpha \cdot \left[\frac{\sum_{a=1}^{m} T_{a,y} - \sum_{a=1}^{m} T_{a,y-1}}{\sum_{a=1}^{m} T_{a,y-1}} \right] + (1-\alpha) \cdot g$$

The calculation of δ in this worksheet is done in two steps. First, the actual year-to-month growth rate — i.e., the current year cumulative year-to-month collection compared with that of the same period in the previous year (the term inside the bracket in equation 3.8) — is calculated in rows 13–15. The formulas in rows 13–15 only calculate the actual growth rate when the actual collection data is available. If the actual collection data is not available, or it is the first month of the fiscal year, the formulas return zero.

Second, the model calculates the growth rate δ by multiplying the weight α (calculated in row 11 of the *Macro* worksheet) and the results in rows 13–15, plus (1–α) times the expected growth rates of the tax base proxies (rows 17–19 of the *Macro* worksheet).

Baseline Worksheet

The baseline revenue projections are estimated using equation (3.6). If the actual collection data for the month is available, then the formulas in rows 13–15 will return the actual collection data. Otherwise, the formulas will return the revenue projection for the current month based on the collection in the same month of the previous fiscal year using the growth rate δ estimated in the *Growth* worksheet and the average effective tax rate ratio from the *Actual* worksheet rows (23–25).

The formulas in the *Baseline* worksheet beyond the first 12 month of the actual collection data

Table 3.5 Computation of the Number of Month with Actual Collection Data

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	
FY	01/02	01/02	02/03	02/03	02/03	02/03	02/03	02/03	02/03	02/03	02/03	02/03	02/03	02/03	03/04	03/04	
Month	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	
Actual Data Available?	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0

=SUMIF(B1:Q1,"02/03",B3:Q3)

are the implementation of equation (3.6). These formulas look similar to the following:

=IF(O$24=1,Actual!O13,C13*(1+Growth!O21)
*Actual!O23^(1+Macro!$C37))

If the actual collection data is available (O$24=1), then the baseline projection will be equal to the actual data (Actual!O13). Otherwise, the baseline projection will be equal to previous year actual collection for the same month multiplied by the growth factor, and adjusted by the changes in the average effective tax rate.

Measure Worksheet

The *Measure* worksheet provides a facility to include adjustments other than tax rate structure changes into the model. These additional adjustments may be required because of, for example, improvements in the efficiency of the tax administration, special programs to clean up tax arrears, or any other discretionary changes which cannot be easily captured by the relative effective tax rate ratio.

These adjustments can be entered manually into the model as a percentage of the baseline projections. These percentage adjustments must be estimated outside this model using other forecasting techniques, such as micro-simulation or regression analysis. The revised baseline projections are estimated in the *Projection* worksheet.

Projection Worksheet

The *Projection* worksheet modifies the baseline projections using the adjustment factors estimated in the *Measure* worksheet. The formulas for estimating are similar to those used in the *Baseline* worksheet. The formulas for estimating the baseline projections read data from the *Actual* worksheet and use the growth factor calculated in the *Growth* worksheet. The formulas for adjusting the baseline projections read data from the *Baseline* worksheet and revises the projections using adjustment factors calculated in the *Measure* worksheet.

The Receipts Monitoring & Forecasting Model described in this section provides a simple tool, which can be used for tracking and documenting revenue performance of any type of taxes, or nontax revenues. The model also provides relatively accurate results for making short-term projections of stable revenues, and gives the flexibility and control for the revenue analysts to understand the characteristics and seasonal patterns of the revenues.

Graph and Chart

The *Graph* and *Chart,* as shown in Figure 3.1, try to visualize the trends and stability of the actual and projected receipts. Any deviation from the normal seasonal pattern must be evaluated, identified, and documented immediately so that the cause and effect of the abnormal movement can be understood. Only through systematic analysis and continuous data update through institutionalized information flows, the accuracy of the revenue projections can be improved over time.

Concluding Remarks

Although it is critical that every government has a solid understanding of its revenue pattern, building a strong revenue forecasting capacity within the government of developing countries cannot be done overnight. It involves a thorough understanding on how revenues respond to external shocks and discretionary changes. The Receipts Monitoring & Forecasting Model

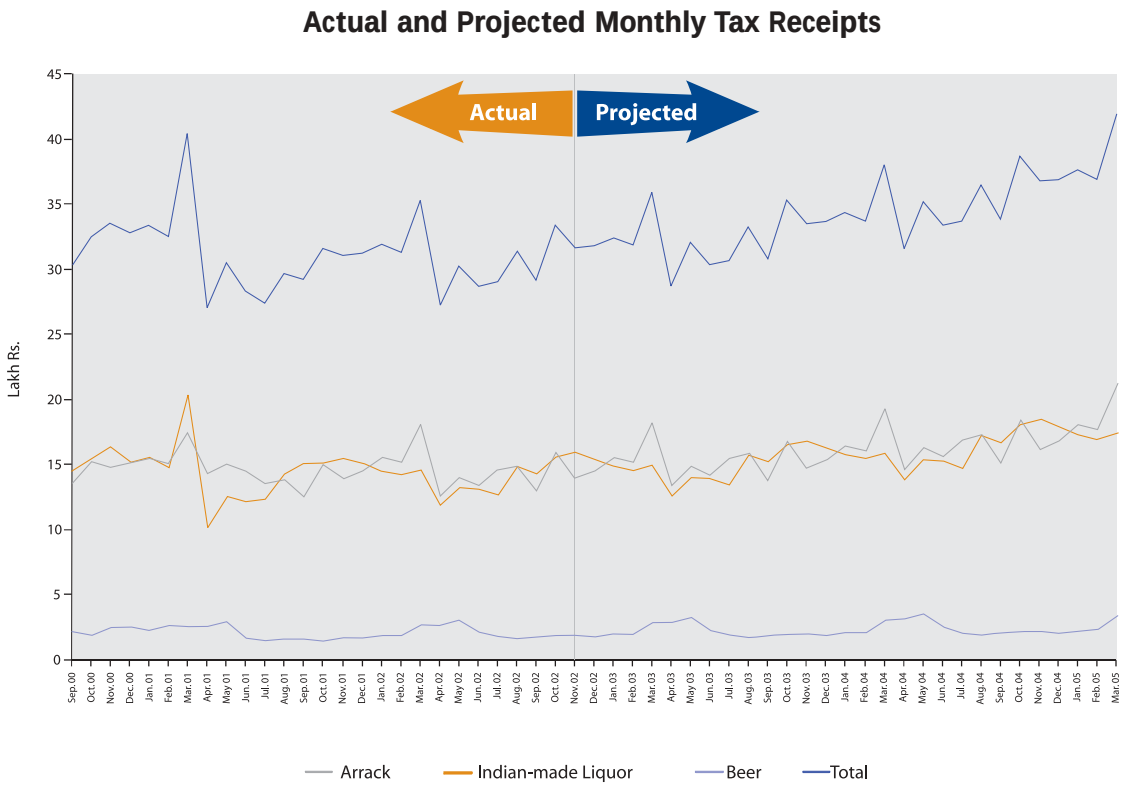
described in this section provides a simple tool, which can be used for tracking and documenting revenue performance of any type of taxes, or nontax revenues. The model also provides relatively accurate results for making short-term projections of stable revenues, and gives the flexibility and control for the revenue analysts to understand the characteristics and seasonal patterns of the revenues.

To continuously improve the accuracy of the model overtime, the analysts must evaluate, identify and document any deviation from the normal pattern, and immediately seek answers as to why the abnormal pattern happens. This can only be done if there are systematic and institutionalized information flows between the revenue agencies and the fiscal and tax policy units.

Suggested Readings

- Glenday, Graham and Rubi Sugana, "*Tax Receipt Forecasting Model*", Duke Center for International Development, Duke University, Durham, North Carolina, February 2005.
- Trautman, William B., "*A Tax Receipt Monitoring & Forecasting Model for Transition Economies*", Harvard Institute for International Development, Development Discussion Paper, June 1999.

Figure 3.1: Actual and Projected Monthly Excise Tax Revenue (2000-01–2002-03)



Annexure 3A.1:

Elasticities of Tax Bases and Tax Revenues to Changes in Effective Tax Rates

A simple formulation of tax revenues, T, is the tax base, B, multiplied by the effective tax rate, τ, or $T = \tau \cdot B$. If the tax rate changes, then revenues can change because of the rate changes, and because of the base changes in response to the tax rate change. This can be expressed as follows:

$$\frac{dT}{d\tau} = \tau \frac{dB}{d\tau} + B = B \cdot \frac{\tau}{B} \cdot \frac{dB}{d\tau} + B = B(\beta + 1) \quad (3A.1)$$

$$\frac{dT}{d\tau} \times \frac{\tau}{T} = \beta + 1 \quad (3A.2)$$

$$\varepsilon_{T\tau} = \beta + 1 \quad (3A.3)$$

where,

$\varepsilon_{T\tau}$: The elasticity of tax revenue with respect to the tax rate
β : The elasticity of tax base with respect to the tax rate

The relationship between the tax rate and its tax base depends upon the structure of the tax and the market conditions. Generally, tax rates can be charged either on top of the net or market supply price, p^s, or out of the gross or the demand price, p^d. The former is typical of a sales tax rate, τ^s, charged on top of the supply price, while the latter is typical of an income tax rate, τ^d, charged on the gross income or demand price. The relationship between demand price and supply price can be expressed as follows:

$$p^d = p^s (1 + t^s) = \frac{p^s}{(1 - t^d)} = \quad (3A.4)$$

The tax bases for the taxes that are charged on the supply price and the demand price are $B = p^s \times Q$ and $B = p^d \times Q$, respectively.

The tax revenues (T) of these two types of taxes can be expressed as:

$$T = \tau^s \times p^s \times Q = \tau^d \times p^d \times Q \quad (3A.5)$$

If the tax revenues in equation (3A.5) are equal, then the relationship between the tax rates is as follows:

$$\tau^s = \frac{1}{(1 - \tau^d)} \quad (3A.6A)$$

or

$$\tau^d = \frac{\tau^s}{(1 + \tau^s)} \quad (3A.6B)$$

Now, the response of revenues to a change in the tax rate can be explore by recognizing that the quantity supplied is a function of the supply price, $Q(p^s)$, and the demand price is a function of the tax

rate as shown in equation (3A.4). Similarly, the quantity demanded is a function of the demand price, $Q(p^d)$.

Tax Rate Charged on Supply Price

Consider the revenue response to a change in the tax rate charged on the supply price, ($d\tau^s$). This revenue response can be expressed as

$$\frac{dT}{d\tau^s} = p^s Q + \tau^s Q \frac{dp^s}{d\tau^s} + \tau^s p^s \frac{dQ}{dp^d} \cdot \frac{dp^d}{d\tau^s} \tag{3A.7}$$

With an increase in t^s, the supply price is expected to drop, the demand price to rise, and the quantity supplied and demanded to decrease. The relative supply and demand elasticities in the market will determine the sizes of these changes in prices and market quantity. First, it is recognized that for the market to return to equilibrium the changes in quantity supplied and demanded are equal, or

$$\frac{dQ}{d\tau^s} = Q \cdot \eta \cdot \frac{dp^d}{d\tau^s p^d} = Q \cdot \varepsilon \cdot \frac{dp^s}{d\tau^s p^s}$$

or

$$\eta \cdot \frac{dp^d}{d\tau^s p^d} = \varepsilon \cdot \frac{dp^s}{d\tau^s p^s} \tag{3A.8}$$

and

$$\frac{dQ}{dp^d} = \eta \frac{Q}{p^d} \tag{3A.9}$$

where,

η : Price elasticity of demand measured at current price and quantity
ε : Price elasticity of supply measured at current price and quantity

Simultaneously, from (3A.4), the supply and demand prices will change in response to the tax rate change:

$$\frac{dp^d}{d\tau^s} = \frac{dp^s}{d\tau^s}\left(1+\tau^s\right) + p^s \tag{3A.10}$$

Substituting (3A.10) into (3A.8), and using (3A.4) we have:

$$\frac{dp^s}{d\tau^s} = \frac{\eta}{\varepsilon - \eta} \cdot \frac{p^s}{\left(1+\tau^s\right)} \tag{3A.11}$$

Using (3A.9), (3A.10) and (3A.11), the revenue response to changes in the tax rate in equation (3A.7) can be simplified to

$$\frac{dT}{d\tau^s} = p^s Q \left[1 + \frac{\eta\left(\varepsilon+1\right)}{\varepsilon - \eta} \cdot \frac{\tau^s}{\left(1+\tau^s\right)}\right] \tag{3A.12}$$

Since $B = p^s Q$, then using (3A.1) and (3A.12) we have:

$$\beta^s = \frac{\eta(\varepsilon+1)}{\varepsilon-\eta}\cdot\frac{\tau^s}{(1+\tau^s)} \tag{3A.13}$$

Tax Rate Charged on Demand Price

Consider the revenue response to a change in the tax rate charged on the demand price, ($d\tau^d$). This revenue response can be expressed as:

$$\frac{dT}{d\tau^d} = p^d Q + \tau^d Q\frac{dp^d}{d\tau^d} + \tau^d p^d \frac{dQ}{dp^d}\times\frac{dp^d}{d\tau^d} \tag{3A.14}$$

Similar to the equation (3A.8), the responses in the market quantities demanded and supplied are equal:

$$\eta\cdot\frac{dp^d}{d\tau^d p^d} = \varepsilon\cdot\frac{dp^s}{d\tau^d p^s} \tag{3A.15}$$

With the tax charged on the demand price, or $p^d(1-\tau^d) = p^s$, the changes in the demand and supply prices in response to the tax rate change can be expressed as:

$$\frac{dp^s}{d\tau^d} = \frac{dp^d}{d\tau^d}(1-\tau^d) - p^d \tag{3A.16}$$

Substituting (3A.16) into 3A.15), we have:

$$\frac{dp^d}{d\tau^d} = \frac{\varepsilon}{\varepsilon-\eta}\cdot\frac{p^d}{(1-\tau^d)} \tag{3A.17}$$

Using (3A.9), (3A.16) and (3A.17), the revenue response to changes in the tax rate in (3A.14) can be simplified to

$$\frac{dT}{d\tau^d} = p^d Q\left[1+\frac{\varepsilon(1+\eta)}{\varepsilon-\eta}\cdot\frac{\tau^d}{(1-\tau^d)}\right] \tag{3A.18}$$

Using (3A.1) and (3A.18), we have:

$$\beta^d = \frac{\varepsilon(\eta+1)}{\varepsilon-\eta}\cdot\frac{\tau^d}{(1-\tau^d)} \tag{3A.19}$$

Consideration of the general results for the tax base elasticity with respect to the tax rate for taxes on the net-of-tax base, β^s, given in (3A.13), and the tax base elasticity with respect to the tax rate for taxes on the gross-of-tax base, β^d, given in (3A.19) gives special case results for some particular price elasticities of supply and demand.

Case I: Perfectly Inelastic Supply

The short-run labor supply, the supply of savings, or the supply of land may be completely price

inelastic, or $\varepsilon = 0$. Typically, low elasticities of supply are more likely in the short-run in the case of income taxes. In the net-of-tax case, the elasticity of the base with respect to the tax rate becomes a constant depending only on the tax rate, while in the case of a gross-of-tax rate, the base elasticity is zero, as follows:

$$\beta^s = -\frac{\tau^s}{(1+\tau^s)} \quad \text{and} \quad \beta^d = 0 \tag{3A.20}$$

Case II: Inelastic, Unitary Elastic, and Elastic Demand

Price elasticity of demand is unitary elastic, or $\eta = -1$, as typically the case for most large bundles of goods in a broad-based consumption tax. For a unitary elasticity of demand, the base elasticities are the same as in the case of inelastic supply. In the net-of-tax case, the elasticity of the base becomes a constant depending only on the tax rate, while in the case of a gross-of-tax rate, the base elasticity is zero, as follows:

$$\beta^s = -\frac{\tau^s}{(1+\tau^s)} \quad \text{and} \quad \beta^d = 0 \tag{3A.21}$$

Whether the demand is inelastic ($\eta > -1$) or elastic ($\eta < -1$) is important in determining the impact of increasing price elasticity of supply on the base elasticity. As illustrated in Table 3A.1, in the case of the base elasticity with respect to the tax rate on the supply or net-of-tax price, for inelastic demand, the base elasticity becomes more inelastic as the supply elasticity increases.

By contrast, for elastic demand, the base elasticity becomes more elastic as the supply elasticity increases. Table 3A.2 shows a similar, but somewhat different pattern for the base elasticity with respect to a tax rate on the demand or gross-of-tax price. For inelastic demand, the base elasticity is positive and grows more so as the supply elasticity increases. By contrast, for elastic demand, the base elasticity is negative and becomes more elastic as the supply elasticity increases.

The base elasticity only becomes noticeably large negative when both supply and demand are elastic. It is also of interest to note that, when the demand is elastic, the base elasticities of the tax rate charged on the supply price are higher and more negative than that for the tax rate charged on the demand price. This arises because an increase in τ^s depresses the supply price, thereby contracting the base value, whereas an increase in τ^d raises the demand price thereby expanding the base. In both cases, however, the quantity traded falls, contracting the base.

Case III: Perfectly Elastic Supply

Price elasticity of supply is perfectly elastic, or $\quad = \alpha$, as is typically the case for the supply of manufactured and traded goods. As the equation (3A.22) shows and Table 3A.1 illustrates, the base elasticity with respect to the tax rate on the supply price is negative and becomes more elastic as the demand becomes more elastic. The base elasticity with respect to the tax rate on the demand price is positive when demand is inelastic, but is negative and becomes more elastic and demand becomes more elastic as illustrated in Table 3A.2.

$$\beta^s = \frac{\eta \cdot \tau^s}{(1+\tau^s)} \quad \text{and} \quad \beta^d = \frac{(1+\eta)\cdot\tau^s}{(1+\tau^s)} \tag{3A.22}$$

Table 3A.1: Base Elasticity with Respect to Tax Rate Charged on Supply Price, $b^s \times t^s = 25\%$

Supply Elasticity, ε	Demand Elasticity, η				
	Inelastic Demand			Elastic Demand	
	0	**– 0.5**	**– 1**	**– 1.5**	**– 2**
0	0	– 0.20	– 0.20	– 0.20	– 0.20
0.5	0	– 0.15	– 0.20	– 0.23	– 0.24
1	0	– 0.13	– 0.20	– 0.24	– 0.27
1.5	0	– 0.13	– 0.20	– 0.25	– 0.29
2	0	– 0.12	– 0.20	– 0.26	– 0.30
5	0	– 0.11	– 0.20	– 0.28	– 0.34
Infinite	0	– 0.10	– 0.20	– 0.30	– 0.40

Table 3A.2: Base Elasticity with Respect to Tax Rate Charged on Demand Price, $b^d \times t^d = 20\%$

Supply Elasticity, ε	Demand Elasticity, η				
	Inelastic Demand			Elastic Demand	
	0	– 0.5	– 1	– 1.5	– 2
0	0.00	0.00	0.00	0.00	0.00
0.5	0.25	0.06	0.00	– 0.03	– 0.05
1	0.25	0.08	0.00	– 0.05	– 0.08
1.5	0.25	0.09	0.00	– 0.06	– 0.11
2	0.25	0.10	0.00	– 0.07	– 0.13
5	0.25	0.11	0.00	– 0.10	– 0.18
Infinite	0.25	0.13	0.00	– 0.13	– 0.25

η
$\left(1-p^{d}{}^{s}\right)\times\lambda\left(p^{s}\right)^{\eta}$

Still in the case of perfectly elastic supply, an alternative approach to estimating the change in revenues with a change in the tax rates is to parameterize the demand function in terms of the demand price.

$$= \lambda\left(p^{d}\right)^{\eta} \qquad (3A.23)$$

where,

λ : Constant

: Price elasticity of demand

Tax Rate Charged on Supply Price

From equation (3A.7) for the case of a tax on the net or supply price:

$$T = = \tau^{s} \times p^{s} \times \lambda\left[p^{s}\left(1+\tau^{s}\right)\right]^{\eta}$$

$$= \lambda\left(p^{s}\right)^{\eta+1} \times \tau^{s}\left(1+\tau^{s}\right)^{\eta} \qquad (3A.24)$$

Using (3A.24), the tax revenues in the current period, T_y, can be compared to those in the previous period, T_{y-1}, as follows:

$$\frac{T_y}{T_{y-1}} = \frac{\lambda_y}{\lambda_{y-1}} \frac{\tau_y^s \left(1+\tau_y^s\right)^\eta}{\tau_{y-1}^s \left(1+\tau_{y-1}^s\right)^\eta} = (1+\delta) \frac{\tau_y^s \left(1+\tau_y^s\right)^\eta}{\tau_{y-1}^s \left(1+\tau_{y-1}^s\right)^\eta} \quad (3A.25)$$

where, δ is the growth rate in the tax base as λ grows.

The first order or straight line approximation gives:

$$\frac{T_y}{T_{y-1}} = (1+\delta) \frac{\tau_y^s \left(1+\eta \cdot \tau_y^s\right)}{\tau_{y-1}^s \left(1+\eta \cdot \tau_{y-1}^s\right)} \quad (3A.26)$$

Tax Rate Charged on Demand Price

Similarly, in the case of a tax on the gross or demand price, tax revenues are:

$$T = \tau^d \times p^d \times \lambda \left(p^d\right)^\eta = \lambda \tau^d \left(\frac{p^s}{1-\tau^d}\right)^{\eta+1} \quad (3A.27)$$

Using (3A.27), the tax revenues in the current period, T_y, can be compared to those in the previous period, T_{y-1}, as follows:

$$\frac{T_y}{T_{y-1}} = \frac{\lambda_y}{\lambda_{y-1}} \frac{\tau_y^d \left(1-\tau_y^d\right)^{\eta+1}}{\tau_{y-1}^d \left(1-\tau_{y-1}^d\right)^{\eta+1}} = (1+\delta) \frac{\tau_y^d \left(1-\tau_y^d\right)^{\eta+1}}{\tau_{y-1}^d \left(1-\tau_{y-1}^d\right)^{\eta+1}} \quad (3A.28)$$

The first order or straight line approximation gives:

$$\frac{T_y}{T_{y-1}} = (1+\delta) \frac{\tau_y^d \left[1-(\eta+1)\tau_y^d\right]}{\tau_{y-1}^d \left[1-(\eta+1)\tau_{y-1}^d\right]} \quad (3A.29)$$

Part 4:VAT Analysis and Revenue Forecasting[19]

Introduction

The value-added tax has increasingly been adopted by countries around the world. Governments in developing countries are replacing turnover tax, sales tax, and some excise taxes by the consumption-type VAT. The main argument for doing so is based on the fact that VAT is a stable source of revenues. It allows an efficient tax collection at multiple stages of production and distribution of goods and services, and minimizes the cascading effect from taxes on inputs of businesses which also pay taxes on sales.

As a country reforms its tax system to adopt VAT, there is a considerable uncertainty and concern regarding the impact on revenue collection. Particularly, the input tax credit under the VAT system, while necessary to avoid the tax cascading effect, makes the estimation of the tax base rather complicated. Thus, the estimation of VAT base and potential revenue is of significant importance to policy makers.

The most prevalent VAT system is a consumption-type multistage sales tax based on the destination principle. The VAT is typically assessed using the credit-invoice method where each firm charges tax on its sales and receives credits for tax paid on its inputs. The VAT based on the destination principle aims at taxing sales of goods and services for the domestic market, regardless of whether they are produced domestically or abroad. This type of VAT is essentially equivalent to the single-stage domestic retail sales tax on final consumption, but administered differently.

The potential VAT revenue depends on whether it is origin- or destination-based, the method of assessment (credit-invoice or subtraction), the scope of exemptions and zero-rating, the level of tax rates, and the degree of tax compliance. Exemption means no VAT on sales and no credit is provided for the taxes paid on inputs. No VAT also applies on zero rating, but the business receives full credit for the taxes on inputs.

Determination of the Tax Payable

Table 4.1 illustrates the determination of the VAT payable by a registered taxpayer, who is selling taxable supplies. It assumes a single tax rate of 10 percent under a credit-invoice method of VAT. It also assumes insurance premiums are exempt from VAT. Tables 4.2 and 4.3 illustrate the determination of the VAT payable by a registered taxpayer, who is selling zero-rated and exempt supplies respectively.

It would be an overwhelming task to develop a revenue forecasting model to estimate a VAT base and its corresponding revenues using data related to each registered taxpayer. Moreover, data on individual taxpayer may not be readily available if the VAT is to replace existing indirect taxes. Fortunately, to estimate the VAT base, the most important thing to know is the information related to the final consumption since the ultimate VAT payer is the final consumer.

VAT through the Production and Distribution Chain

To show the concept that the ultimate VAT payer is the final consumer, it is useful to look at the

[19] This Part has been prepared by Graham Glenday, GP Shukla, and Rubino Sugana of Duke Center for International Development, Duke University, USA.

Table 4.1: Determination of Tax Payable (Taxed Supplies)

	Value	Applicable Tax Rate	VAT Amount	Total Paid by Consumer
Total Sales	**50,000**	**10%**	**5,000**	**55,000**
Total Expenditure	**42,000**		**3,150**	
Goods for Resale	20,000	10%	2,000	
Capital Equipment	7,500	10%	750	
Wages and Salaries	10,000	0%	0	
Advertising	2,500	10%	250	
Insurance	500	0%	0	
Utilities	1,500	10%	150	
Total Tax Collected by Firm			**5,000**	
Total Input Tax Credits Available to Firm			**3,150**	
Net Tax Payable by Firm			**1,850**	
Total Tax Collected by Government			**5,000**	

Table 4.2: Determination of Tax Payable (Zero-rated Supplies)

	Value	Applicable Tax Rate	VAT Amount	Total Paid by Consumer
Total Sales	**50,000**	**0%**	**0**	**50,000**
Total Expenditure	**42,000**		**3,150**	
Goods for Resale	20,000	10%	2,000	
Capital Equipment	7,500	10%	750	
Wages and Salaries	10,000	0%	0	
Advertising	2,500	10%	250	
Insurance	500	0%	0	
Utilities	1,500	10%	150	
Total Tax Collected by Firm			**0**	
Total Input Tax Credits Available to Firm			**3,150**	
Net Tax Payable by Firm			**- 3,150**	
Total Tax Collected by Government			**0**	

application of VAT throughout the supply chain (Table 4.4). At the final stage, the consumer pays to the retailer 1,000 plus VAT of 10 percent, or 100, which is exactly the net total tax collected by the government. The total net tax collected throughout the supply chain is equal to the total tax collected on the final sale, and the total value added is equal to the final sale price paid by the final consumer.

The VAT base depends on the extent and stage of production at which the zero-rating is levied. When zero rating is applied, no VAT is levied on the selling price and the vendor receives a full

Table 4.3: Determination of Tax Payable (Exempt Supplies)

	Value	Applicable Tax Rate	VAT Amount	Total Paid by Consumer
Total Sales	**53,150**	**NA**	**0**	**53,150**
Total Expenditure	**42,000**		**3,150**	
Goods for Resale	20,000	10%	2,000	
Capital Equipment	7,500	10%	750	
Wages and Salaries	10,000	0%	0	
Advertising	2,500	10%	250	
Insurance	500	0%	0	
Utilities	1,500	10%	150	
Total Tax Collected by Firm			**0**	
Total Input Tax Credits Available to Firm			**0**	
Net Tax Payable by Firm			**0**	
Total Tax Collected by Government			**3,150**	

Table 4.4: VAT on Furniture Production and Trade Distribution

	Product	Purchases (Excl. Tax)	Sales (Excl. Tax)	Value Added	Tax on Sales @ 10%	Input Tax Credit	Net Tax
Forester	Log	0	200	200	20	0	20
Logger/Sawmill	Timber	200	300	100	30	20	10
Manufacturer	Furniture	300	700	400	70	30	40
Wholesaler	Furniture	700	800	100	80	70	10
Retailer	Furniture	800	1,000	200	**100**	80	20
Total		**2,000**	**3,000**	**1,000**	**300**	**200**	**100**

Final Tax

Total Net Tax

credit for the VAT paid on the purchase of inputs, including the purchase of capital goods such as plants and equipment. If the zero rating is applied at the last stage (e.g., exporter), no net tax is collected by the government since the exporter is getting a credit equal to the full amount of VAT paid at earlier stages (Table 4.5). However, if the zero-rating applies at the early stages of production (suppose forest products are subject to 0 percent VAT), the government would still collect revenues as the value added at the later stages is still taxed (Table 4.6).

As a common feature of VAT, most countries exempt certain types of goods or services or types of suppliers because of socio-political considerations, technical difficulties, and administrative complexity. Financial intermediation and insurance services are typically exempt due to technical difficulties.[20]

[20] New Zealand and Singapore tax underwriting activities of general insurance. There are methods proposed to tax financial intermediation and insurance services. See, for example, S.N. Poddar and M. English, " Taxation of Financial Services under a VAT: Applying the Cash-Flow Approach", Tax Policy Services Group, Ernst & Young, Toronto, (March 1993); and A. Schenk, "Taxation of Financial Services under a Value-Added Tax: A Critique of the Treatment Abroad and the Proposals in the United States", Tax Note International, (September 1994).

Table 4.5: Zero Rating at the Last Stage of Production and Distribution

	Product	Purchases (Excl. Tax)	Sales (Excl. Tax)	Value Added	Tax on Sales @ 10%	Input Tax Credit	Net Tax
Forester	Log	0	200	200	20	0	20
Logger/Sawmill	Timber	200	300	100	30	20	10
Manufacturer	Furniture	300	700	400	70	30	40
Wholesaler	Furniture	700	800	100	80	70	10
Exporter*	Furniture	800	1,000	200	0	80	-80
Total		**2,000**	**3,000**	**1,000**	**200**	**200**	**0**

* Exporter is subject to 0% VAT.

Table 4.6: Zero Rating at the First Two Stages of Production and Distribution

	Product	Purchases (Excl. Tax)	Sales (Excl. Tax)	Value Added	Tax on Sales @ 10%	Input Tax Credit	Net Tax
Forester*	Log	0	200	200	0	0	0
Logger/Sawmill	Timber	200	300	100	0	0	0
Manufacturer	Furniture	300	700	400	70	0	70
Wholesaler	Furniture	700	800	100	80	70	10
Retailer	Furniture	800	1,000	200	**100**	80	20
Total		**2,000**	**3,000**	**1,000**	**250**	**150**	**100**

* Forest products (i.e., log and timber) are subject to 0% VAT.

Small businesses are also exempt for administrative simplicity and cost efficiency in collection.

Exemptions refer to sales of goods and services that are not subject to VAT. Since there is no VAT liability on sales, vendors of exempt goods are not eligible to receive any credit for VAT paid on inputs. As contrasted from zero-rating, an exemption from VAT will have different revenue implications. When exemption is given to intermediate commodities, subsequent sales in the chain of production will increase both tax base and VAT revenue collections due to the cascading effect. If VAT exemption is imposed at the final stage, the value added of the exempt sector escapes taxation. Effectively two VAT bases emerge: **final consumption** and **taxable inputs to exempt businesses**. This fact becomes the foundation for building VAT analysis and revenue estimation models following the consumption approach. Tables 4.7–4.9, respectively, illustrate the situations when forester (first stage), manufacturer (intermediate stage), and retailer (final stage) are exempt from VAT.

Alternative Methods to Estimate a VAT Base and Revenue

Generally, there are three methods that can be used to estimate the VAT base and its corresponding revenues. These methods assume a consumption-type multistage VAT based on the destination principle. They also assume a credit-invoice mechanism for assessing the VAT.

Table 4.7: Tax Base and Revenue Implications of Exemption at First Stage*

	Product	Purchases (Excl. Tax)	Sales (Excl. Tax)	Value Added	Tax on Sales @ 10%	Input Tax Credit	Net Tax
Forester*	Log	0	200	200	0	0	0
Logger/Sawmill	Timber	200	300	100	0	0	0
Manufacturer	Furniture	300	700	400	70	0	70
Wholesaler	Furniture	700	800	100	80	70	10
Retailer	Furniture	800	1,000	200	**100**	80	20
Total		**2,000**	**3,000**	**1,000**	**250**	**150**	**100**

Final Cons.

* Forest products (i.e., log and timber) are exempt from VAT.

Table 4.8: Tax Base and Revenue Implications of Exemption at Intermediate Stage*

	Product	Purchases (Excl. Tax)	Sales (Excl. Tax)	Value Added	Tax on Sales @ 10%	Input Tax Credit	Net Tax
Forester	Log	0	200	200	20	0	20
Logger/Sawmill	Timber	200	300	100	**30**	20	10
Manufacturer*	Furniture	330	730	400	0	0	0
Wholesaler	Furniture	730	830	100	83	0	83
Retailer	Furniture	830	1,030	200	**103**	83	20
Total		**2,090**	**3,090**	**1,000**	**236**	**103**	**133**

Exempt Bus. Inputs

Final Cons.

* Manufacturers of furniture are exempt from VAT.

Table 4.9: Tax Base and Revenue Implications of Exemption at the Last Stage*

	Purchases (Excl. Tax)	Sales (Excl. Tax)	Value Added	Tax on Sales @ 10%*	Input Tax Credit	Net Tax
Forester	0	200	200	20	0	20
Logger/Sawmill	200	300	100	30	20	10
Manufacturer	300	700	400	70	30	40
Wholesaler	700	800	100	**80**	70	10
Retailer	880	1,080	200	0	0	0
Total	**2,080**	**3,080**	**1,000**	**200**	**120**	**80**

Exempt Bus. Inputs

* Small retailers are exempt from VAT. The value added of the retailers is not in the VAT base.

- **Aggregate (National Accounts) Method.** The aggregate method follows one of the two alternative approaches: (i) production and (ii) consumption. The production method starts with the GDP. To arrive at the value-added included in the VAT base, the GDP needs to be adjusted for imports, zero rating, exemptions, and turnover threshold. Since the VAT is ultimately paid by consumers, the consumption method starts with final consumption and adjusts for zero-rated and exempt goods and services to estimate the VAT base.

- **Disaggregate Method.** The disaggregate method also could follow production or consumption approach. This method requires detailed breakdown of the National Accounts and Input-Output (I-O) Tables, and also information from other sources, such as household expenditure and industrial surveys to estimate the impact of exemptions and zero rating. The production approach computes the tax base by adding up the value added of each industrial sector in the economy to provide the tax base by sector.

  The consumption approach uses the final selling price of all goods and services purchased by final consumers and exempt sectors in the economy. This approach would automatically capture the destination principle of the VAT since the value purchased by final consumers excludes exports and includes imports. Moreover, it allows for an analysis of the incidence and price impact of the VAT on consumers.

- **Microsimulation (Tax Returns) Method** — VAT returns databases ideally provide detailed information on accrued domestic and import VAT liabilities and credits, as well as actual collections, refund payments, and assessment adjustments. Detailed information on imports, and the duty and VAT charged on these imports, provide a strong starting point for estimating VAT revenues.

Aggregate Method

The starting point for calculating the VAT base using the production approach is GDP, which represents the aggregate of value added from production and distribution activities in the economy. The expenditure approach of measuring GDP adds three major categories to get GDP: consumption (C), investment (I), and net exports (exports minus imports) of goods and services ($X - M$).

$$GDP = C + I + X - M \quad (4.1)$$

$$GDP = C_P + C_G + I_P + I_G + X - M \quad (4.2)$$

$$GDP = C_P + G + I_P + X - M \quad (4.3)$$

The subscript "$_P$" in the above equations denotes the private sector while the subscript "$_G$" denotes the government sector.

In the case of a consumption-type VAT, the base (B) can be estimated by subtracting exports and adding imports to reflect the domestic consumption following the destination principle. The base should also be reduced by the amount of gross fixed capital formation since businesses receive input tax credit for their capital investment. If sales of new houses are subject to VAT, residential constructions (I_H), which is part of the gross fixed capital formation, must be added back to the tax base as consumers cannot claim input tax credits. Since residential construction in the national accounts does not include the land value and the VAT base typically includes the land price, I_H must be adjusted accordingly. Thus, if there are no goods or services exempt from the tax, the VAT base would be:

$$B^P = GDP - G_W - I_P + I^*_H - X + M \quad (4.4)$$

where, G_W is government expenditures on wages and salaries. The total government expenditures (G) equal to expenditures on wages and salaries plus consumption of final goods and services (G_C) purchased from the private sector.

$$G = G_W + G_C = C_G + I_G \quad (4.5)$$

Following the consumption approach, the starting point is the amount of private consumption expenditures (C_P) and government expenditures on goods and services. If there is no exemption, the VAT base could be estimated using the following expression:

$$B^C = C_P + G_C + I_H = GDP - G_W - I_P + I^*_H - X + M \quad (4.6)$$

Thus, the production and consumption approaches for estimating the VAT base are theoretically identical. Differences between the two approaches are in the way adjustments are made to estimate the impact of exemptions. To show the impact of exemptions on the tax base, it is useful to start with an expression for the total value of sales (*TS*) in the economy:[21]

$$TS = C_P + G_C + I_P + X + IS \quad (4.7)$$

where, *IS* represents the value (not value added) of intermediate sales, or sales of goods and services which are used as inputs to produce final goods or services. Under the consumption-type VAT based on the destination principle, tax paid on investment expenditure is creditable against tax payable on sales and exports are zero rated. Therefore, the terms I_P and X drop out of the VAT base.[22] When there are no exemptions, intermediate sales *IS* are also excluded from the base, and equations (4.6) and (4.7) become identical. Once certain goods are exempt, some of the VAT paid on intermediate inputs is not creditable. Thus, some intermediate sales must be included in the estimation of the VAT base, for which detailed I-O Tables are often required.

Intermediate sales can be divided into four categories: (i) intermediate sales of taxed goods to taxed sectors; (ii) intermediate sales of exempt goods to exempt sectors (iii) intermediate sales of exempt goods to taxed sectors; and (iv) intermediate sales of taxed goods to exempt sectors. The first two categories of intermediate sales do not affect the estimation of a VAT base. VAT on inputs for transactions within the taxed sectors is fully creditable against the VAT on sales. Intermediate sales within exempt sectors also do not enter into the estimation of the tax base since no VAT is paid on inputs or charged on sales.

For the production approach, the total value of intermediate sales of exempt goods to taxed sectors is part of the VAT base. Because there is no input tax credit, the full value of exempt inputs is transferred to the value added of the taxed sector. Thus, after subtracting the value added of all exempt goods, the total value of sales of exempt goods to the taxed sector must be added back. For the consumption approach, exempt sectors are treated like final consumers. Thus, intermediate sales of taxed goods to exempt sectors must be added to the VAT base (see Tables 4.7–4.9 given above).[23]

Production Approach

For the production approach, the value added of all exempt goods and services and exempt imports must be subtracted from the GDP, while exempt investment expenditures and exempt exports as well as intermediate sales of exempt goods to taxed sectors must be added back to the estimation of the VAT base. Thus, equation

[21] This explanation is suggested by Mackenzie (1991) and Pellechio and Hill (1996).
[22] Adjusted I_H must be added back if sales of new houses are subject to VAT.
[23] Mackenzie (1991) and Pellechio and Hill (1996) provide detailed mathematical formulas for adjusting intermediate sales or inputs of exempt sectors using Input-output Tables.

(4.4) can be expanded as follows:

$$B^P = GDP - G_W - VA_{exempt} - I_p + I_{P,exempt} - X + X_{exempt} + M - M_{exempt} + IS_{exempt,\ taxed} \quad (4.8)$$

where, VA_{exempt}, I_{exempt}, X_{exempt}, and M_{exempt} denote the total value added of exempt domestic production, investment expenditure of exempt sectors, exempt exports, and exempt imports respectively. X_{exempt} could be exports of exempt goods or exports done by unregistered traders. Investment expenditure of exempt sectors must be added to the VAT base since these sectors do not receive input tax credits. $IS_{exempt,taxed}$ is the total sales value — **not the value added** — of intermediate sales of exempt goods to the taxed sectors. Table 4.10 provides detailed framework for making necessary adjustments to GDP to arrive at a tax base of a destination-based, consumption-type VAT implemented with a credit-invoice method.

The production and consumption approaches for estimating the VAT base are theoretically identical. Differences between the two approaches are in the way adjustments are made to estimate the impact of exemptions.

Adjustments to GDP

GDP is the logical starting point for estimating the VAT base following the production approach. GDP represents the sum of all value added in the domestic production of goods and services. This section describes the necessary adjustments to GDP to arrive at the VAT base, assuming only exports are zero rated. The order of the adjustments described below generally follows equation (4.8).

Adjustment A: Government Expenditure

The value of outputs of government services are measured by the amount of its inputs. Government inputs include current and capital spending by all levels of government. Only expenditures on goods and services are included in the VAT base. Civil servants' wages and salaries are not subject to VAT, and hence must be deducted from the tax base. Exempt and zero-rated purchases must also be deducted from the base. However, taxed inputs on exempt government expenditures must be added back due to cascading.

Adjustment B: Exempt Sectors

The sum of all value added of exempt sectors must be removed from the VAT base. Most countries exempt financial and insurance industries due to technical difficulties. Agricultural sector is typically exempt because of administrative and political reasons. To reduce the administrative burden, some developing countries do not subject wholesale and retail sectors to the VAT.

The full value of intermediate outputs of these exempt sectors purchased by the taxed sectors is transferred to the value added of the taxed sector. Therefore, the total value of intermediate sales of exempt goods to the taxed sector must be added back as suggested in Adjustment E.

Adjustment C: Capital Formation

Gross capital formation, which refers to the sum of investment expenditure in the economy, is not taxed under the consumption-type VAT. However, investments in exempt sectors should be added in the VAT base since input tax credits are not given to these sectors. New residential buildings, which are part of capital formation, are typically subject to VAT and should also be

Table 4.10: Framework for Estimating a VAT Base (Production Approach)[1]

	Remarks	Likely Data Source[2]
VAT Base		
= GDP	Sum of all value added of domestic production	NIA
Adjustment A: Government Expenditure		
- Expenditures on Wages and Salaries	Nontaxable expenditure component in NIA	NIA, GOV
Adjustment B: Exempt Sectors		
- Value Added of Exempt Domestic Production (At Factor Costs)	E.g., financial services and farmers are typically exempt from VAT; imputed rents of owner-occupied dwellings are not feasible for taxation Adjustment B does not include exemption threshold adjustment, which is done in Adjustment G	NIA
- Indirect Taxes in Exempt Sectors	This is needed if the national accounts are in producers' prices	NIA, IO
Adjustment C: Private Capital Formation		
- Gross Domestic Capital Formation	For consumption-type VAT, investments are not subject to tax	NIA
+ New Residential Construction, including Land Value	Sales of new houses, including the land price, are typically subject of VAT. Gross capital formation includes new residential construction, but excludes the land value	NIA, TAX
+ Gross Capital Formation in Exempt Sectors	Input tax on investments in exempt sectors is not creditable	NIA, IS
- Change in Inventories	VAT is not charged to unsold inventories	NIA
Adjustment D: Border Tax	For destination-based VAT	
- Exports	Exports are zero-rated	NIA
+ Exempt Exports	No input tax credit is given to exports of exempt commodities	TAX
+ Imports		NIA
- Exempt Imports	Exempt imports are not taxed at the border	TAX
Adjustment E: Intermediate Sales (Cascading)		
+ Output of Exempt Sectors Sold to Taxed Sectors	Including outputs from businesses below exemption threshold	IO
Adjustment F: Final Private Consumption Expenditure		
- Expenditures on Exempt Goods and Services	E.g., basic food items, health and education services, rents	HHS
+ Taxed Inputs in Exempt Goods and Services	Due to cascading	IO
+ Foreign Expenditures in Local Markets	This addition only applies if foreigners are not allowed to claim tax refunds.	NIA
- Expenditures Abroad by Residents	These consumption expenditures should not be in the VAT base	NIA
Adjustment G: Exemption Threshold	For reducing administrative and compliance costs.	GOV, IS
- Value Added of Businesses Below Turnover Threshold		
Adjustment H: Tax Replacement		
- Indirect Taxes Replaced by VAT	Indirect taxes replaced by VAT should not be in the base	NIA, TAX
Adjustment I: Noncompliance		
- Estimated Extend of Leakage	Losses due to noncompliance	GOV, TAX

Notes:
[1] This framework assumes a destination-based, consumption-type VAT implemented with credit-invoice method. Based on Zee (1995).
[2] NIA = National Income Accounts; I/O = Input-Output Tables, GOV = Government Agencies, TAX = Revenue Departments, HHS = Household Survey, IS = Industrial Survey.

added in the tax base since final consumers cannot claim tax credit. It should be noted that the value of land is excluded in both the National Income Accounts and I-O Tables since it does not represent value added. If the basis for charging VAT on the sale of new residential houses includes the land value as part of the purchase price, the capital formation must be adjusted upward to account for the full price of new homes.

Unsold goods, which are reflected in the change in inventories, should be deducted from the VAT base as no VAT has been charged and tax credits may have been claimed for their production.

Adjustment D: Border Tax

A destination-based VAT taxes goods and services at the point where they are consumed, not produced. Therefore, exports are zero rated, but exempt exports must be added back into the tax base to avoid double counting because the value added of exempt domestic production has been subtracted in Adjustment B.

Unsold goods, which are reflected in the change in inventories, should be deducted from the VAT base as no VAT has been charged and tax credits may have been claimed for their production.

Conversely, imports are taxed at the border, but exempt imports are not. Since output of exempt sectors purchased by taxed sectors is added to the VAT base through Adjustment E, exempt imports must be subtracted from the VAT base. If the exempt imports are used for final consumption, no VAT will be collected and they will be automatically excluded from the VAT base.

Adjustment E: Intermediate Sales (Cascading)

As discussed in the previous sections, cascading would result when a taxed business purchases inputs from exempt sectors. Since there is no VAT on inputs, no tax credit is given, and the full value (not only the value added) of the exempt inputs is added to the tax base to assess the VAT on sales. Thus, the total value of intermediate sales of exempt goods to the taxed sector must be added to the VAT base.

Adjustment F: Final Private Consumption Expenditure

Exempt private consumption expenditures (e.g., rents, education, and health services) must be subtracted from the VAT base. However, due to cascading, VAT on inputs in the chain of production of such goods and services must be added. In addition, consumption by foreigners in local markets — assuming the foreigners cannot claim tax refunds at the border — must be added to the base, and purchases by residents abroad must be subtracted from the base. To avoid double counting, addition and subtraction already made in Adjustments B and E should not be included in this adjustment.

Adjustment G: Exemption Threshold

For efficiency reasons, countries around the world exempt small businesses from VAT because the administrative and compliance costs of tax collections may exceed the revenue yield. Small businesses are large in number, but generate relatively small amount of tax revenues. Most countries set a turnover threshold below which businesses are not required to register as a VAT payer. Some countries, however, allow small businesses to register as a VAT payer if their outputs are consistently purchased by other VAT payers.

Value added of the businesses below threshold must be subtracted from the VAT base. Alternatively, the total sales of the businesses below the threshold are subtracted from the VAT base, but the full value of taxed inputs are added back in much the same way Adjustments B and E do.

To estimate the total sales of the businesses below threshold, it is necessary to understand the frequency distribution of the business turnover. Data from industrial surveys provide invaluable source of information for estimating such distribution.

Adjustment H: Tax Replacement

If the VAT under consideration is intended to replace one or more indirect taxes, then the total revenue from those taxes should not be included in the VAT base.

Adjustment I: Noncompliance

The above procedure estimates the potential VAT base and corresponding revenue for the economy. The potential VAT base accrued may not be the same as the actual. This adjustment is necessary to recognize possible leakages primarily due to noncompliance. To estimate the rate of noncompliance, the potential VAT revenue is compared with the actual collection reported by the revenue agency after adjusting for arrears collection and refunds. If VAT is not currently in place, the potential revenue of existing taxes must be estimated first, and compared with the actual collection to compute the compliance rate. The compliance rate of existing taxes can be used as the basis for estimating the compliance rate under VAT.

Consumption Approach

For the consumption approach, the starting point for estimating the VAT base is the final private consumption expenditure and government expenditure on goods and services. Equation (4.6) can be expanded to include adjustments for consumption and intermediate sales of exempt goods and services as follows:

$$B^C = C - C_{exempt} + G_C + I_{exempt} + IS_{taxed,\ exempt} \quad (4.9)$$

Where, *IS taxed, exempt* is the intermediate sales of taxed goods to exempt sectors. In this case, exempt sectors are treated like any other final consumers. Table 4.11 provides the framework for estimating the VAT base following the consumption approach.

Adjustments to Final Consumption

When there is no exemption and zero-rated goods and services, except those for exports, the VAT base is equal to the final private consumption expenditure and government expenditure on goods and services. The adjustments below must be applied to this base to take into account the exemptions and zero rating.

Adjustment A: Final Private Consumption Expenditure

Exempt and zero-rated private consumption expenditure must be subtracted from the VAT base. However, due to cascading as discussed above, the total value taxable inputs into exempted expenditures must be added back in Adjustment D.

Adjustment B: Government Expenditure

Similar to that of private consumption expenditure, exempt and zero-rated government expenditure on goods and services must be subtracted from the VAT base, and the

Table 4.11: Framework for Estimating a VAT Base (Consumption Approach)

	Remarks	Likely Data Source
VAT Base		
= Final Private Consumption Expenditure		NIA
+ Govt Purchases of Goods and Services		NIA, GOV
Adjustment A: Final Private Consumption Expenditure		
– Exempt Final Consumption Expenditure		NIA, HHS
+ Taxed Inputs in Exempt Goods and Services	Due to cascading. Alternatively, this is done through Adjustment D	IO
– Zero-rated Final Consumption Expenditure		NIA, HHS
Adjustment B: Government Expenditure		
– Exempt Government Expenditure		NIA, GOV
– Zero-rated Government Expenditure		NIA, GOV
Adjustment C: Capital Formation		
+ New Residential Construction, Including Land Value	Sales of new houses, including the land price, are typically subject to VAT. Gross capital formation includes new residential construction, but excludes the land value	NIA, TAX
+ Gross Capital Formation in Exempt Sectors	Input tax on investments in exempt sectors is not creditable	NIA, IS
Adjustment D: Intermediate Sales (Cascading)		
+ Input of Exempt Sectors Purchased from Taxed Sectors	Including inputs purchase by businesses below exemption threshold	NIA, IO
Adjustment E: Exemption Threshold		
– Value Added of Businesses below Turnover Threshold	For reducing administrative and compliance costs Alternative computation is to subtract the total sales of businesses below turnover threshold and add back taxed inputs used in these sales	GOV, IS
Adjustment F: Tax Replacement		
– Indirect Taxes Replaced by VAT	Indirect taxes replaced by VAT should not be in the base	NIA, TAX
Adjustment G: Noncompliance		
– Estimated Extend of Leakage	Losses due to noncompliance.	GOV, TAX

total value taxable inputs into exempted expenditures must be added back in Adjustment D. VAT paid by the government sector may not necessarily increase the net government collection, since the VAT also increases the government expenditure.

Adjustment C: Capital Formation

The adjustments for new residential constructions and gross capital formation in the exempt sectors are identical to that in the production approach. Just like in the production approach, land value must be added if it is included in the base for assessing the VAT on residential investments.

Adjustment D: Intermediate Sales (Cascading)

For the consumption approach, exempt sectors are treated like final consumers. Thus, it is necessary to compute the value of taxable inputs purchased by the exempt sectors to be

added to the tax base. This is unlike the production approach, which includes in the VAT base the total sales of exempt goods and services to the taxed sectors.

Adjustment E, F, and G

The adjustments of the VAT base to consider the impact of business turnover threshold, taxes being replaced by the VAT, and noncompliance are identical as that in the production approach.

Disaggregate Method

The disaggregate method is useful to estimate revenues of a VAT system with multiple tax rates. Multiple tax rates are a common feature of some VAT systems in developing countries. Some countries impose lower tax rates to goods or services which are regarded as basic necessities or used in the intermediate production. The latter attempts to minimize the amount of tax refunds paid by the government.

Similar to that of the aggregate method, the disaggregate method could follows either the production or consumption approach. This method greatly relies on I-O Tables. Since the I-O Tables are static in nature, they do not allow for behavioral responses to policy changes. Consequently, the estimation of a VAT base using this method does not take into account behavioral responses due to changes in the tax structure. These behavioral responses can be incorporated in the estimation of the VAT base only if appropriate own- and cross-price elasticities of demand of goods and services can be obtained.

Production Approach

The production approach calculates the tax base by summing up the value added of each industrial sector in the economy. The methodology for estimating the VAT base and its associated revenue for each economic sector can be described in four broad steps. First, the gross output per sector is adjusted for the fact that the VAT is based on the destination principle. The total value of supplies is the gross product plus imports minus exports minus change in inventories. Further adjustments are required to account for exemption and zero rating to arrive at the taxable supply by sector. The taxable supply is the basis for calculating the gross VAT revenues.

Second, the net revenue for each sector is calculated by subtracting input tax credits from the gross VAT revenues. The basis for computing the input tax credits is the intermediate purchases of taxable supplies. The intermediate purchases by sector must be adjusted to account for exempt and zero-rated inputs to arrive at taxable inputs.

Third, the total value of exempt purchases must be added back since no credit is given against these purchases. Finally, gross capital formation is calculated after netting out exempted portions, which have been accounted in the third step.

In summary, the estimation of potential VAT revenues following the production approach

In summary, the estimation of potential VAT revenues following the production approach can be derived as gross VAT on sales minus input tax credit on purchases plus tax embedded in exempt purchases minus tax payable on capital goods. The majority of financial, health, and education services are exempt. Further, it assumes that agricultural production, including processed food in the manufacturing sector and food and beverages in the hotel and restaurant sector, is zero- rated.

can be derived as gross VAT on sales minus input tax credit on purchases plus tax embedded in exempt purchases minus tax payable on capital goods. Table 4.12 illustrates the framework for making such estimation. It assumes that the gross production of books, newspapers, and magazines in the manufacturing sector is *exempt*. In the transportation and communication sector, passenger and international transport is exempt. The majority of financial, health, and education services are *exempt*. Further, it assumes that agricultural production, including processed food in the manufacturing sector and food and beverages in the hotel and restaurant sector, is *zero- rated*.

The *VAT Rate* to calculate the tax revenue is the statutory tax rate when the production data is "tax exclusive," that is, no tax embedded in the value. When the production data is "tax inclusive," the *VAT Rate* would be equal to the statutory tax rate, *t*, divided by one plus the statutory tax rate, or in mathematical terms:

$$VAT\ Rate = \frac{t}{(1+t)} \qquad (4.10)$$

Sales

Gross production data is available from the national accounts. Data on exemptions and zero-rating could be obtained from detailed breakdown of the national accounts and I-O tables. The gross production of books, newspapers, and magazines accounts for USD 120 million. Passenger and international transport accounts for 40 percent of the gross production of the transportation and communication sector. Ninety percent of the financial intermediation and insurance services and 60 percent of other services, which include community and social services such as health and education, are also exempt. The gross production of zero-rated processed food manufacturing is USD 3,026 million.

To estimate the zero-rated component of the hotel and restaurant sector, the proportion of food and beverages out of the total products must be calculated. Hotel and restaurant business associations should be able to provide reliable information to make such calculation. In this example, the food and beverages accounts for 55 percent of the total hotel and restaurant production (Table 4.13).

The trade component of the "Trade, Hotel, and Restaurant" sector is assumed to be essentially comprised of commercial markups in agriculture, mining, and manufacturing activities. After subtracting the gross output of the hotel and restaurant sector, the product of the trade sector is distributed according to the relative size of sector activities. In this example, the relative sizes of the trade sector in the agriculture, mining, and manufacturing activities are 24 percent, 2 percent, and 74 percent, respectively. Of the 74 percent of the manufacturing activities, 22 percent is related to zero-rated food processing activities. The proportion of exports, exemptions, and zero rating in the agriculture, mining, and manufacturing are then applied to derive the exports, exemptions, and zero rating in the trade sector.

Some outputs which affect the change in stocks are exempt and zero-rated commodities. To calculate the amount of change in inventories which are outside the VAT base, first the changes in inventories as a percentage of agriculture, mining, and manufacturing supplies are

Table 4.12: Framework for Estimating VAT Revenues (Production Approach)

Category	Gross Product (1)	Imports (2)	Exports (3)	Total Supply[1] (4)	Exempt (5)	Zero-rated (6)	Change in Stocks (7)	Taxable Supply[2] (8)	Tax Revenue[3] (9)
Sales	**27,007**	**4,416**	**5,959**	**25,952**	**3,755**	**7,660**	**94**	**14,443**	**1,314**
Agriculture	3,074	184	92	3,166	0	3,166	0	0	0
Mining	1,968	258	779	1,447	0	0	20	1,427	130
Manufacturing	10,524	3,017	4,335	9,206	120	3,026	74	5,986	544
Power & Utilities	306	0	0	306	0	0	0	306	28
Construction	2,276	0	0	2,276	0	0	0	2,276	207
Trade, Hotel, Rest.	3,962	185	753	3,882	20	1,468	0	2,394	218
Transp. & Comm.	1,512	307	0	1,819	727	0	0	1,092	99
Financial Services	1,613	314	0	1,927	1,734	0	0	193	18
Other Services	1,772	151	0	1,923	1,154	0	0	769	70
Purchases (Credit)				**13,34**	**1,116**	**3,883**		**8,344**	**759**
Agriculture				803	20	613		170	15
Mining				291	16	4		271	25
Manufacturing				6,771	212	2,305		4,254	387
Power & Utilities				222	8	2		212	19
Construction				1,511	144	60		1,307	119
Trade, Hotel, Rest.				1,705	356	590		759	69
Transp. & Comm.				862	105	108		649	59
Financial Services				709	212	68		429	39
Other Services				469	43	133		293	27
Purchases for Producing Exempt Items						**890**	**81**		
Agriculture								0	0
Mining								0	0
Manufacturing								40	4
Power & Utilities								0	0
Construction								0	0
Trade, Hotel, Rest.								4	0
Transp. & Comm.								274	25
Financial Services								390	35
Other Services								182	17
Gross Capital Formation				**2,691**				**1,856**	**169**
Construction				2,083				1,250	114
Machinery & Eq.				606				606	55
Animal Stock				2					
Total[4]								5,133	467

Notes
[1] Total Supply = Gross Product + Imports – Exports.
[2] Taxable Supply = Total Supply – Exempt - Zero Rated – Change in Stocks.
[3] Tax Revenue = Taxable Supply × VAT Rate ÷ (1 + VAT Rate); VAT Rate = 10 percent.
[4] Total Tax Revenue = Tax on Sales – Tax on Purchases + Tax on Purchases for Producing Exempt Items – Gross Capital Formation.

Table 4.13: Exemptions and Zero-rating in the Trade, Hotel, and Restaurant Sector

Category	Gross Product	Percentage of GP + M[1]			Markups Distribution[2]		
	(1)	Exports (2)	Exempt (3)	Zero Rate (4)	Exports (5)	Exempt (6)	Zero Rate (7)
Trade (Commercial Markups)	**3,004**				**753**	**20**	**941**
Agriculture	721	2.8%	—	97.2%	20	—	701
Mining	60	35.0%	—	—	21	—	—
Manufacturing	2,223	32.0%	0.9%	10.8%	711	20	240
Hotels & Restaurants	**958**				**0**	**0**	**527**
Food & Beverages	527				—	—	527
Other Activities	431				—	—	—
Total	**3,962**				**753**	**20**	**1,468**

Notes
[1] Derived from Table 7.12 (GP = Gross Product, M = Imports). For example, the percentage of the agricultural exports equals to the amount of exports (USD 92 million) over the gross production plus imports (USD 3,074 + USD 184 million).
[2] Markups distribution is the percentage of (GP + M) times the gross product (e.g., 2.8 percent × 721 ≈ 20).

Table 4.14: Stocks Outside VAT Base

Category	Change in Stocks[1] (1)	GP + M (2)	Ch. In Stocks as % of GP+M (3)	Taxable Base[2] (4)	Stocks Outside VAT Base (5)
Agriculture	26	3,258	0.8%	—	—
Mining	30	2,226	1.4%	1,447	20
Manufacturing	131	13,541	1.0%	7,626	74

Note
[1] Source: National Income Accounts.
[2] Taxable Base = Total Supply – Exemption – Zero Rating.

calculated. These percentages are then applied to the sectors' taxable bases which have been calculated so far.

Purchases (Credit)

Data on intermediate purchases by sector is obtained from the I-O tables. Table 4.15 illustrates the estimation of exempted, zero-rated, and taxable inputs of the agriculture sector based on the inputs' sectoral origin. Processed food is zero-rated, while 90 percent of financial services are exempt.

The total intermediate use of hotel and restaurant sector in agriculture amounts to USD 3 million, of which 55 percent is zero rated. The remaining USD 12 million is from trade and is divided according to sector activities: USD 2.9 million (24 percent) is at the zero rate for agriculture; USD 0.2 million (2 percent) is taxed at the standard rate for mining; and the remaining USD 8.9 million for manufacturing is distributed for food processing USD 1.9 million (22 percent) at zero rate and for other manufacturing activities USD 7 million at standard rate. In summary, the intermediate use

Table 4.15: Intermediate Inputs of the Agriculture Sector

Category	Intermediate Input[1] (1)	Exempt (2)	Zero-rated (3)	Taxable Base[2] (4)
Agriculture	379	—	379	—
Mining	0	—	—	—
Manufacturing				
Food, Beverage, Tobacco	227	—	227	—
Other Manufacturing	126	—	—	126
Power & Utilities	1	—	—	1
Construction	24	—	—	24
Trade, Hotel, Rest.	15	—	1.6+4.8	1.4+7.2
Transp. & Comm.	8	—	—	8
Financial Services	22	20	—	2
Other Services	1	—	—	1
Total	**803**	**20**	**613**	**170**

Note
[1] Data from the Use/Input Matrix of the Input-Output Tables.
[2] Taxable Base = Total Supply – Exemption – Zero Rating.

of trade in agriculture amounts to USD 4.8 million at zero rate, and USD 7.2 million at the standard rate. The allocations of exempt, zero rated, and taxable base for the other sectors are calculated in the similar manner.

Purchases for Producing Exempt Items

Some of the input taxes are not creditable when the intermediate goods or services are used to produce exempt items. To remove the noncreditable component from the creditable purchases calculated above, the proportion of exempted sales in the total net-of-tax sales must be deducted from the creditable purchases. The net-of-tax sales, *NOTS*, are defined as:

$$NOTS = GP + M - \Delta INV - R \qquad (4.11)$$

Where,

GP	:	Gross Product
M	:	Imports
ΔINV	:	Change in Inventories/Stocks
R	:	Tax Revenue

The exemption ratio, *EXRATIO*, is the exempt sales, *EXSALES*, divided by the net-of-tax sales:

$$EXRATIO = \frac{EXSALES}{NOTS} \qquad (4.12)$$

In the case of transportation and communication sector, the exempt sales are USD 727 million and the net-of-tax sales are USD 1,512 + USD 307 – USD 0 – USD 99 = USD 1,720 million. Thus, the exemption ratio is USD 727 ÷ USD 1,720 = 0.4227. This ratio is then applied to the creditable purchases (USD 649 million). The exempt portion of the creditable purchases that must be added back is 0.4227 × USD 649 = USD 274 million.

The exemption ratios for manufacturing, financial services and other services are 0.0093, 0.9083, and 0.6228 respectively. These ratios lead to the calculation of the exempt portion of the creditable purchases of USD 40 million in the manufacturing sector, USD 390 million in

financial services, and USD 182 million in other services.

Gross Capital Formation

The consumption-type VAT allows full input tax credit for capital investments. The calculation of taxable supply from gross output includes gross capital formation. Thus, the VAT base must be reduced by the taxable portions of the gross capital formation. The exempt portions of the gross capital formation are already taken out from the taxable sales and the taxed components of the exempt purchases are already added back to the tax base. Therefore, only the taxable portions of the gross capital formation are included here to be credited against the tax on sales.

In this example, constructions of new residential housing, which account for 30 percent of the total gross capital formation in construction, are fully taxable, but no tax credit is given to final consumers.

The size of noncompliance could be estimated by comparing the potential VAT revenue with the actual tax collection. Typically, the tax administration in developing countries does not disaggregate tax collections by economic sector. In such case, the same compliance rate may be applied to each sector to arrive at the estimated revenue. The estimation of revenue impacts due to noncompliance and exemption threshold is discussed in the later section.

Potential VAT Base and Associated Revenue

The potential VAT base can be derived as taxable supply on sales minus creditable purchases plus noncreditable input tax for producing exempt goods or services minus creditable gross capital formation. The potential VAT revenue in the above example is USD 1,314 – USD 759 + USD 81 – USD 169 = USD 467 million.

The potential VAT revenue has not taken into account exemption threshold and noncompliance. To estimate the exemption threshold, the frequency distribution of business turnover and its corresponding value added must be recognized.

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Consumption Approach

Similar to that of the aggregate method, the starting point of the consumption approach using the disaggregate method is the amount of personal and government expenditures on goods and services. However, unlike the aggregate method, which primarily uses data from the National Income Accounts, the disaggregate method following the consumption approach estimates the VAT base using the commodity sales at the final consumer level. This approach relies heavily on the

detailed domestic consumption contained in the *Final Demand Matrix* of the I-O Tables. To estimate the VAT base, the final demand figures must be adjusted to exclude the personal and government expenditures abroad.

As mentioned previously, the alternative data sources to obtain private consumption expenditures include National Income Accounts, I-O Tables, and expenditure surveys. Statistical agencies typically conduct detailed household expenditure surveys to determine consumer price index, poverty level, and other social and economic indicators. Results from these surveys could contain significant amount of detail and can be extrapolated to obtain total expenditure in the economy. However, sample sizes might not be sufficient to capture total expenditures on durables and expenditures of the highest income group. Expenditure surveys are also prone to error in reporting due to the tendency of underreporting consumption (e.g., consumption of alcohol and tobacco). Other problems include dealing with foreign consumption in the domestic markets and the time lags for the data to be available for analysis.

Essential requirements for a VAT revenue model are data related to final private consumption, taxable proportions for each expenditure category, and applicable tax rate. The potential VAT base for each consumption category is estimated by multiplying the final consumption expenditure with the taxable proportion:

$$B_i^C = Final\ Cons_i \times Taxable\ Proportion_i \quad (4.13)$$

The subscript *i* refers to the consumption expenditure of category *i* (e.g., "Food, Beverage, and Tobacco," "Clothing & Footwear," etc.). The corresponding VAT revenue, *R*, can be estimated by multiplying the tax base with the tax rate:

$$Ri = B_i^C \times VAT\ Rate \quad (4.14)$$

The taxable proportion represents the degree to which a given value of expenditures is subject to VAT. The taxable proportion of an expenditure category that is zero rated would be 0. The taxable proportion of a fully taxable expenditure category would be 100 percent. The taxable proportion for a category that includes both zero-rated and taxable expenditures would be between 0 and 100 percent.

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The taxable proportion could also be used to deal with exempt supplies. To account for exempt supplies purchased directly by final consumers, the taxable proportion reduces the VAT base from a final expenditure category. When the exempt supplies are used as inputs to a business sector, the taxable proportion increases the VAT base.

Determining Taxable Proportions

In the VAT structure, not all final expenditure under a certain category is fully taxable. Suppose unprocessed basic food items, which are included in the final consumption category "Food, Beverage, and Tobacco," are zero-rated. To exclude the zero-rated expenditures from the

VAT base, an appropriate taxable proportion must be estimated.

Since the national income accounts data does not typically provide the sufficient detail required to determine the taxable proportion, alternative data sources will have to be explored. These data sources could include household expenditure surveys, industrial production surveys, business and trade associations, or simply an educated guess. Table 4.16 illustrates the computation of taxable proportion for the expenditure category of "Food, Beverage, and Tobacco" using data from household surveys.

The calculation of taxable proportion for exempt expenditures can be done indirectly through final consumption expenditures, or directly through intermediate purchases.

Table 4.16: Taxable Proportion for Food, Beverage, and Tobacco

Type of Expenditure	Avg. Household Expenditure	Zero-rated?
Cereals, Tuber	1,200	Yes
Fish and Shrimp	200	Yes
Meat, Chicken, Eggs, and Other Dairy Products	220	Yes
Vegetables	105	Yes
Other Unprocessed Food Items	200	Yes
Processed Food	125	No
Nonalcoholic Beverage	270	Yes
Alcoholic Beverages	185	No
Tobacco Products	125	No
Total Expenditure	**2,630**	
Total Taxable Expenditure	**435**	
Taxable Proportion	**16.5%**	

Table 4.17 illustrates the cost structure of an insurance company. The taxable inputs of this insurance company amount to roughly 30 percent of its total sales. Since the company cannot claim an input tax credit, 30 percent of consumption expenditures on insurance carry VAT and must be included in the tax base. Thus, after deducting total expenditures on insurance services, 30 percent of these expenditures must be added back. Suppose private expenditures on financial services are under "Business and Personal Services" category, and the survey data indicates that 6 percent of the expenditures under this category are on insurance and 10 percent on other financial services, the VAT base for the insurance category alone must be adjusted downward by about 4 percent (or 70 percent × 6 percent). This is an indirect approach since the adjustment is made through the final consumption, not through the intermediate inputs purchase directly by the exempt business.

Calculating the taxable proportion of exempt expenditures indirectly through final private consumption expenditures is not always feasible. Alternatively, all exempt consumption expenditures are excluded from the VAT base, and taxable intermediate purchases by the exempt sectors are added to the VAT base. The taxable proportion for exempt sectors can be calculated directly based on taxed inputs purchased by the sectors. The *Input* or *Use Matrix* of the I-O Tables provides the basis for calculating the embedded VAT base in the taxed inputs purchased by the exempt industries.

As an illustration, the proportion of taxable inputs for "Finance & Insurance" category can be calculated by looking at the input structure of the industry. From Table 4.17, the proportion of

Table 4.17: Effective Tax Base of Exempt Products

	Value	Applicable Tax Rate	VAT Amount	Total Paid by Consumer
Total Sales	**58,000**	**NA**	**0**	**58,000**
Total Expenditures	**51,200**		**1,700**	
Insurance Underwriting	20,000	NA	0	
Capital Equipment	7,000	10%	700	
Wages and Salaries	12,000	NA	0	
Office Space/Rent	4,000	10%	400	
Repairs and Maintenance	800	10%	80	
Property Tax	1,800	NA	0	
Insurance	400	NA	0	
Advertising	2,800	10%	280	
Vehicle Leasing	1,000	10%	100	
Utilities and Communications	1,400	10%	140	
Total Sales	**58,000**			
Total Taxable Inputs	**17,000**			
Effective Base Content	**29.3%**			

taxable inputs over the total expenditures of the insurance industry is about 33 percent (17,000 ÷ 51,200). If the taxable proportion for financial intermediation is 45 percent and financial intermediation constitute 70 percent of the total "Finance and Insurance" category, the overall taxable proportion for the "Finance and Insurance" sector can be estimated using the weighted average formula. Thus, the taxable proportion, *TP*, for "Finance and Insurance" can be calculated as follows:

$$TP = (70\% \times 45\%) + (30\% \times 33\%) \approx 41\% \quad (4.15)$$

Framework for Estimating VAT Revenues

After the taxable proportion of each expenditure category is estimated, a spreadsheet model can be developed to estimate the potential VAT revenues using equations (4.13) and (4.14). Table 4.18 illustrates the framework for estimating the VAT revenues following the consumption approach.

The example given here is not using the same national accounts and I-O tables as that for the production approach. Accordingly, the results from the two examples are not comparable.

The estimation in Table 4.18 has not considered the exemption below the turnover threshold, which is common in a VAT system to reduce the compliant and administrative costs of serving too many taxpayers. Therefore, two more adjustments are necessary: (i) exemption threshold; and (ii) noncompliance. In addition, the above potential VAT revenue is the accrued tax collection. The actual cash collection is affected by the taxpayer compliance and the efficiency and effectiveness of the tax administration. Businesses may be required to file returns and remit the tax at different time period depending on the type and size of the business.

Table 4.18 Framework for Estimating VAT Revenues (Consumption Approach)

Category	Value (Tax Exclusive)	Taxable Proportion	Tax Rate	Potential Tax Revenues
Private Consumption Expenditure				
Food, Beverage, and Tobacco	21,908	16%	10%	351
Clothing and Footwear	10,253	100%	10%	1,025
Furniture	2,435	100%	10%	244
Chemical Products[1]	3,041	90%	10%	274
Machinery and Equipment	8,894	100%	10%	889
Transportation & Communication[2]	9,050	80%	10%	724
Power and Utilities	6,924	100%	10%	692
Business and Personal Services	37,584	84%	10%	3,157
Other Products & Services	8,562	100%	10%	856
Business Expenditure				
Investment:				
Machinery and Equipment	19,748	0%	10%	0
Residential Construction[3]	9,758	140%	10%	1,366
Non-Residential Construction	23,425	0%	10%	0
Intermediate Inputs Purchased by the Following Industries				
Agriculture[4]	7,710	35%	10%	270
Mining	10,215	0%	10%	0
Manufacturing	95,185	0%	10%	0
Construction	21,905	0%	10%	0
Transportation and Communication[5]	18,925	8%	10%	151
Finance and Insurance	10,810	41%	10%	443
Others	31,340	0%	10%	0
Total	**357,672**			**10,443**

Notes
[1] The impact of zero-rated prescription drugs is assumed to reduce the VAT base by about 10 percent.
[2] The impact of exempt domestic transportation is assumed to reduce the VAT base by about 20 percent.
[3] Residential construction expenditures do not include the land value. To account for the land value, the tax base must be adjusted upward. In this example, the land value increases the VAT base by about 40 percent.
[4] The taxed inputs purchased by the agriculture sector must be added into the VAT base.
[5] The taxable inputs purchased by the transportation sector are assumed to be 4 percent of the total intermediate inputs.

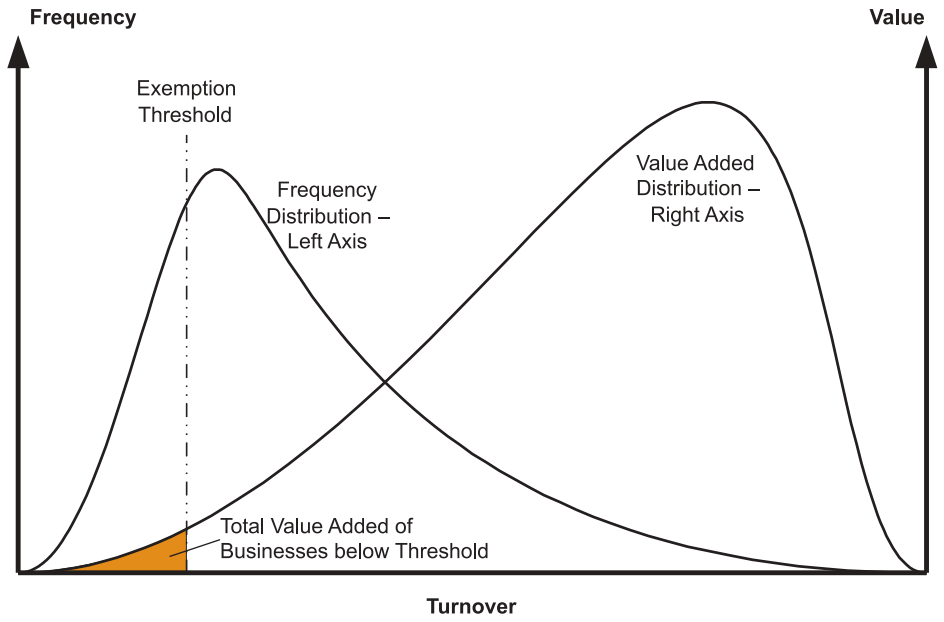
Exemption Threshold Adjustment

The value added of businesses below turnover threshold should be deducted from the VAT base. To estimate this value added, the distribution of value added by business turnover must be recognized. The amount of value added which must be subtracted from the VAT base is the area below the value added distribution up to the turnover threshold as shown in Figure 4.1.

Noncompliance Adjustment

Noncompliance could happen for a variety of

Figure 4.1: Exemption below Turnover Threshold



reasons including failure to register, non-filer of tax returns, underreporting of sales and over-reporting of input tax credits, import smuggling, and other forms of evasion. To estimate the compliance rate or leakage risk factor, the potential VAT revenues are compared with the actual tax collections. Few other adjustments to the actual collections may be necessary, for example, to account for improvement or deterioration in arrears collections and accumulation of unpaid refunds.

If the tax administration provide sectoral breakdown of the revenue collections, different risk factors may be applied to different sectors. Services tend to be more of a problem with tax evasion than goods.

Estimating the Base and Compliance Rate of the Tax Replaced by VAT

Estimating the tax base and associated revenues of the tax replaced by the VAT is useful for: (i) estimating revenue neutral VAT rates; and (ii) estimating the compliance rate of the existing tax, and use the rate to estimate the compliance rate of the proposed VAT. In the case that the existing sales tax, which will be replaced by the VAT, is imposed at the manufacturing level, the tax base of the existing tax for commodity ***i*** can be calculated using the following formula:

$$B_i^E = Final\ Cons_i/(1 + WM_i)/(1 + RM_i) \qquad (4.16)$$

where, WM_i and RM_i is respectively the wholesale and retail margins of commodity ***i*** measured in percentage terms.

The estimated potential tax revenue of commodity ***i***, R_i^P, can be calculated by multiplying the tax base, B_i^c, with the rate of the existing tax. The average wholesale and retail margins for each commodity can be obtained by analyzing the financial statements of typical companies in the sector. The financial data

should be available publicly — in the case of publicly listed companies, or from the income tax return statistics.

The compliance rate of the existing tax for commodity *i*, θ_i, can be estimated by comparing the actual tax collection for the fiscal year with the potential tax revenue:

$$\theta_i = \frac{R_i^{Act}}{R_i^{P}} \qquad (4.17)$$

If the collection data by commodity is not available, the average compliance rate can be estimated by comparing the total actual tax collection with the total potential tax revenue. Typically, compliance rates for services are less than that for goods.

If the domestic expenditures are presented in the purchaser's prices, data on total spending by commodity includes the tax imposed by the existing tax system. Thus, the tax base of the existing tax for commodity ***i*** can be calculated using the following formula:

$$B_i^E = Final\ Cons_i/(1 + WM_i)/(1 + RM_i)/(1 + \theta_i\ Tax\ Rate) \qquad (4.18)$$

where, *Tax Rate* is for the rate of the existing tax.

Since the existing tax will not be in the VAT base when it is replaced by the VAT, if the expenditure data is in purchaser's prices, the tax component embedded in the final consumption must be removed from the VAT base.

Calculating Price-neutral Excise Tax Rate

A broad-based VAT may also cover goods and services which are already subject to excise tax. If the commodity is currently not subject to any other taxes which will be replaced by the VAT, the introduction of VAT may increase the retail price. If, for example, diesel fuel is currently subject to excise tax and will also be included under the VAT, to curb inflation, the existing excise tax must be adjusted so that the retail price of the diesel fuel is expected to remain unchanged.

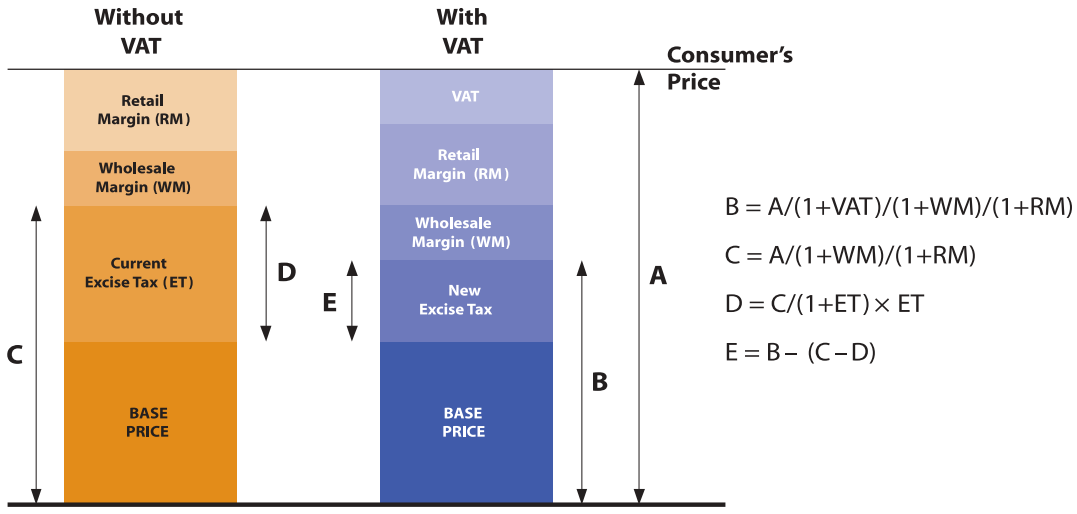
The left panel of Figure 4.2 shows the price structure of a commodity subject to excise tax, but without a VAT. The right panel shows the price structure with a VAT and the new excise tax rate represented by the distance **E**. Since the commodity base price is the same in both situations and the consumer's price will be maintained at the same level, the new excise tax rate can be calculated using the formulas as shown in Figure 4.2.

Incorporating Multiple Rates

As mentioned previously, multiple VAT rates are not uncommon in developing countries, which impose lower tax rates on basic necessities. Multiple rates are incorporated into the model by further breaking down the tax base according to its tax rate. Thus, a more detailed production and expenditure data set is required to properly estimate the VAT revenues.

For the production approach, the taxable supply in column 8 of Table 4.12 must be divided further to arrive at the tax bases for the various tax rates (e.g., 4 percent, 5 percent, 10 percent, and so on). In the case of the consumption approach, for each expenditure category, a separate taxable proportion could be estimated for each applicable tax rate.

Figure 4.2: Excise Tax with and without VAT



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Annexure 4A.1:

Issues in Data Analysis

Macroeconomic forecasting in our country at the Federal level as well as at the state level is largely based on secondary data available from various sources. These sources include: Reserve Bank of India Bulletin, Population Census, Annual Survey of Industries, Agricultural Statistics, Statistics on Banks and Financial Institutions, National Accounts Statistics, and Consumption expenditure data released by National Sample Survey Organization (NSSO). Annual Survey of Industries and National Accounts Statistics are brought out by the Central Statistical Organization (CSO).

These secondary sources provide data both at the Central and the State Level. However, for the data on individual State Government Finances, the major source is the RBI study on State Finances brought out by the RBI every year after all the State Budgets are presented. However, the audited figures for States' Finances are brought out by the Auditor General's (AG's) Office in the publication referred to as "Finance Accounts". The data in this publication are considered to be the most reliable source of data for State Finances. Nevertheless, the data at the disaggregative level may have to carefully examined before use in any meaningful analysis, as the AG's office fails to pay adequate attention to breakups by minor heads. The two-year lag in this publication could also be a cause of concern.

Various volumes of state budgets as well as the Mid-Term Fiscal Plan (MTFP) for the states which have already enacted Fiscal Responsibility Acts, are also reliable sources in absence of the Finance Accounts which are available at a gap of two years. Finance Accounts though a comprehensive document on State Finances often does not capture the complete detail and breakup of various revenue sources, making it difficult for use for analytical purposes, particularly forecasting.

Moreover, for forecasting purposes, in addition to the revenue collected from a particular source, some additional information is required in the form of computing elasticity and buoyancy. Further, there is the need for the monthly detail of the base of taxation for appropriate forecasting and capturing the changes in between. These could be made available only at the state level.

The major issue, however, with the data at the state level is that the states themselves do not have a centralized database which could be utilized by all the Departments concerned for analytical purposes. Moreover, despite the fact that the data is collected in some form or other, these are not maintained properly to be made available in public domain and in a ready-to-use format.

Some of the examples from states of data being collected in raw form but not maintained at regular intervals are as follows:

- Despite the computerization of all the subregistrar's offices across the state for the purpose of registration of documents and subregistrar's offices maintaining daily/ monthly data on the number of documents registered, the SR offices are not networked centrally making it impossible to collect SR officewise/districtwise detail of daily and monthly number of properties registered; and
- The Motor Vehicles Department registers vehicles in various categories based on the

rates of taxes. However, information in the public domain is available only for the number of vehicles registered in two-wheeler category and four wheeler category. Moreover, it is the cumulative number of vehicles registered and kept for use. Anybody trying to arrive at the incremental number of the vehicles faces lot of problem.

Thus, so far as data at the state level is concerned, it is more of a gap arising largely out of not maintaining the data properly rather than its availability. Initially, this could be dome by deputing some analysts from the Directorate of Economics and Statistics to compile the existing data and make it available in soft form at the Central Office.

Sample Data on the detail of food and non- food consumption pattern is published by the NSSO data. This data is used for the purpose of estimation of poverty figures.

Annexure 4A.2:
Sampling Techniques

What is Sampling?

Sampling denotes the selection of a part of the aggregate statistical material with a view to obtaining information about the whole. This aggregate or totality of statistical information on a particular character of all the members covered by an investigation, is called a **population or universe**. The selected part, which is used to ascertain the characteristics of population, is called **Sample.**

A statistical sample is **finite** or **infinite** according to its size. When the number of members of the population can be expressed as definitive quantity, the population is said to be finite, otherwise it is known as an infinite population.

The population of incomes of all persons in a country is an example of **existent population,** because the members of the population really exist, even though they may not be actually known. The population of points in all possible throws of a die is an example of **hypothetical population.**

If a sample of an adequate size is properly chosen and analyzed, it is most likely to reveal the characteristics of the whole population, and the results obtained therefrom can be fairly relied upon as if they were based on all the members of the population.

Why is Sampling Required?

Often it becomes very difficult as well as a costly affair to study the complete population to draw inference or to analyze it statistically. As a consequence, statisticians relied on the method of **sampling** whereby inferences could be drawn on the whole population based on a sample analysis which forms a part of the whole population.

In the study of a population by means of sample observations, we are generally interested in one or more variables. The first requirement towards the analysis of a sample is to form an idea of the "**Probability Distribution"** of the variable in the population. This probability distribution involves some constants (parameters) and consequently **sampling estimates of these parameters based on the available data.**

The second object of sampling is to determine how precise the estimate would be i.e., to state the degree of confidence that we may put on the estimates obtained. Since the sample is only a part of the population and is obtained by chance, any inference regarding the population cannot be 100 percent correct. Some error or discrepancy is inevitable, this is called the **Sampling Error.**

Sampling Methods

Simple Random Sampling: It is also called Random Sampling. It is the process of selection of a group of units in such a manner that every unit of the population has an "equal chance" of being included in the sample. The group of units thus obtained is called Simple Random Sample (or Random Sample only).

The sample could be drawn **"with replacement" (SRSWR)** where the sample member is drawn one by one and replaced before the next one is drawn. It could be drawn **"without replacement" (SRSWOR)** where the sample member is drawn either all at a time or

one by one in such a manner that after each drawing the selected unit is not returned to the population when the next one is drawn.

Purposive Sampling: A sample which is selected on the basis of individual judgment of the sampler, is called **Purposive Sample.** There is no special technique for selecting a purposive sample; but the sampler picks out a typical or representative sample according to his own judgment.

Stratified Sampling: In this case the population is subdivided into several parts called ***strata;*** and then a subsample is chosen from each of them. All the subsamples combined together give the Stratified Sample. If the selection from strata is done by random sampling, the method is known as **Stratified Random Sampling. Stratified Sampling** is generally used when the population is heterogeneous, but can be subdivided into strata within each of which the heterogeneity is not that prominent.

Systematic Sampling: It involves the selection of sample units at equal intervals, after all the units in the population have been arranged in some order. If the population size is finite, the units may be serially numbered and arranged. From the first *k* of these, a single unit is chosen at random. This unit and every *k*-th unit thereafter constitutes a systematic sample.

Annexure 4A.3:

Probability Distribution of Variables

Before getting into the detail of various distributions and their properties, it is desirable to understand what a distribution is? **Random Variable** has been defined as a "function" that which assumes real values on the outcomes of a random experiment, the random variable will in general assume different values with a definitive probability associated with each value or interval of values.

Probability Distribution

Probability Distribution (or simply Distribution) of a random variable is a statement specifying the set of its possible values together with their respective probabilities. When a random experiment is theoretically assumed to serve as a model, the probabilities can be given as a function of the random variable. The probability distribution concerned is then generally known as *theoretical distribution.*

Let us assume an event that a dice is tossed, there will be six possible outcomes 1, 2, 3……..6 with probabilities 1/6 each. **Probability** is defined as the ratio of number of favorable outcomes to total number of outcomes of the event.

Values (x)	1	2	3	4	5	6	Total
Probability (p)	1/6	1/6	1/6	1/6	1/6	1/6	1

Often the probability (p) that the random variable X, i.e, the event, i.e, the tossing of a dice in our example assumes a specified value x (1, 2, 3,…6) can be expressed in terms of a general mathematical expression f(x), where f(x) is the probability that X assumes the value x. **The function f(x) is called the probability mass function or probability function of a discrete variable.**

Generalizing, if an event has n outcomes, say x_1, x_2, x_3, …., x_n with probabilities p_1, p_2, p_3, ……, p_n. Then the **expectation of x, i.e, expected value of x, i.e, E(x)** is given by:

$$E(x) = p_1x_1 + p_2x_2 + p_3x_3 + ……. + p_nx_n$$

$$E(x) = \Sigma p_i x_i \text{ (where, } i = 1, 2, 3, ……n)$$

Mean of a probability distribution, denoted by μ (miu) is the expected value of x or E(x). **Variance**, denoted by σ^2 is the expected value of $(x-\mu)^2$.

If the variable X is a continuous random variable, which can assume any value in the interval (a,b), i.e., $a \leq x \leq b$. Since the number of possible values of x is uncountably infinite, we cannot assign a probability to each value of the variable as is done for a discrete random variable. Thus, in a continuous probability distribution we have to assign probabilities to intervals and not to individual values.

Sampling Distribution of Sample Mean

If $\bar{x}$ represents the mean of a random sample of size n., drawn from a population with mean μ and standard deviation σ, then the sampling distribution of $\bar{x}$ is approximately a normal distribution with mean m and SD which is equal to standard error of $\bar{x}$, provided the sample size is sufficiently large. Usually a sample size of 3 or more is considered a "large sample." We will discuss standard error shortly.

Sample Distribution of Sample Proportion

If p represents the proportion of an item with a specific attribute in a random sample of size n drawn from a lot with proportion of this attribute P, then the sampling distribution of p is

approximately a normal distribution with mean P and standard deviation which is SE of p provided the sample size n is sufficiently large.

Standard Error of a Statistic

Standard Error of a statistic is the standard deviation calculated from the sampling distribution of the statistic:

SE of Sample Mean ($\bar{x}$) = $\sigma/\sqrt{n}$

SE of Sample Proportion (p) = $\sqrt{PQ/n}$,

where, σ denotes the population standard deviation and P the population proportion. If the random sample is drawn without replacement from a finite population, size of N, then the above formulae are modified on multiplication by correction factor $[\sqrt{(N-n)/(N-1)}]$.

Standard Normal Distribution

If a random variable x is normally distributed with mean μ and standard deviation σ, then:

$z = (x - \mu)/\sigma$ = (Normal Variable – Mean) / SD, is called a standard normal variate. The probability distribution of z is called Standard Normal Distribution and is defined by the probability distribution function (pdf)

$p(z) = 1/\sqrt{2\pi} \cdot e^{-z2/2}$ $(-\infty < z < \infty)$

Chi- square (χ^2) Distribution

A random variable x is said to follow Chi- square distribution if its pdf is of the form:

$f(x) = k. e^{-x/2}.x^{(n/2)-1}$; $(0 < x < \infty)$

where, k is a constant. The parameter n, a positive integer is called the number of degrees of freedom. A variable that follows chi- square distribution is called χ^2 variate.

Student's t- Distribution

A random variable is said to follow Student's t distribution or simply t- distribution, if its pdf is of the form:

$f(t) = K. (1+t^2/n)^{-(n+1)/2}$; $(-\infty < z < \infty)$

where, K is a constant. The parameter n (positive integer) is called the number of degrees of freedom (d.f). A variable which follows Student's distribution is denoted by the symbol t.

If z and y are independent random variables, where z follows standard normal distribution and y follows chi- square distribution with n degrees of freedom, then:

$t = z/\sqrt{y/n}$, follows student t distribution with n degrees of freedom.

Snedecor's F Distribution:

A random variable is said to follow F distribution with degrees of freedom (n_1, n_2) if its pdf is of the form:

$f(t) = K. F^{(n_1/2)-1} (n_2 + n_1F)^{-(n_1+n_2)/2}$; $(0 < x < \infty)$

where, K is a constant. If y_1 and y_2 are independent χ^2 variates with n_1 and n_2 degrees of freedom respectively, then:

$$F = \frac{y_1/n_1}{y_2/n_2}$$, follows F distribution with (n_1, n_2) d.f.

Confidence Interval and Level of Significance

The objective of sampling is to study the features of the population on the basis of sample observations. A carefully selected sample is expected to reveal these features, and hence we shall infer about the population from

a statistical analysis of the sample. This process is called ***Statistical Inference.***

Point Estimation

Many functions of sample observations may be proposed as estimators of the same parameter. For example, mean, median or mode of the sample values may be used to estimate the parameter ì of the Normal Distribution with pdf $p(z) = 1/\sqrt{2\pi}.e^{-(x-\mu)2/2}$ $(-\infty < z < \infty)$. This is referred to as $N(\mu, \sigma^2)$. In the theory of point estimation any unknown parameter is estimated by a single quantity. A single estimator of this kind, however good it is, cannot be expected to coincide with the true value of the parameter, and may in some cases differ widely from it.

Interval Estimation

We get into the detail of interval estimation, without going into the various methods of point estimation as interval estimation is in significant use in current econometric analysis and also due to the reason mentioned above. In the theory of ***Interval Estimation,*** it is desired to find an interval which is expected to include the unknown parameter with a specified probability.

Confidence Interval

Let $x_1, x_2, \ldots x_n$ be a random sample from a population of a known mathematical form which involves an unknown parameter θ. We would try to find two functions t_1 and t_2 based on sample observations such that the probability of θ being included in the interval (t_1, t_2) has a given value, say "c" i.e, $P(t_1 \leq \theta \leq t_2)$. Such an interval, when it exists, is called a ***Confidence Interval*** for θ.

The two quantities t_1 and t_2 which serve as the lower and upper limits of the interval are known as ***Confidence Limits.*** The probability "c" with which the confidence interval will include the true value of the parameter is known as ***Confident Coefficient*** of the interval. The value of probability with which the confident coefficient lies within the confidence interval is called the ***Level of Significance.***

The significance of the confidence limits is that if many independent random samples are drawn from the same population and the confidence interval is calculated from each sample, then the parameter will actually be included in the intervals in "c" proportion of cases in the long run. ***Thus, the estimate of the parameter is stated as an interval with a specified degree of confidence.***

Approximate Confidence Limits (large samples) for mean (μ)

These are:
95% CL = $\bar{x} \pm 1.96$ (SE of $\bar{x}$)
99% CL = $\bar{x} \pm 2.58$ (SE of $\bar{x}$)
Almost sure limits = $\bar{x} \pm 3$ (SE of $\bar{x}$)

Illustration: A random sample of 100 ball bearings selected from a shipment of 2000 ball bearings has an average diameter of 0.354 inch with a SD of 0.048 inch. Find the 95 percent confidence interval for the average diameter of these 2000 ball bearings.

Soln.: If a random sample of large size n is drawn without replacement from a finite population of size N, then the 95 percent confidence limits for the population mean (μ) are $\bar{x} \pm 1.96$ (SE of $\bar{x}$), where $\bar{x}$ denotes the sample mean and:

SE of $\bar{x} = \sigma/n. \sqrt{(N-n)/(N-1)}$, σ denoting the SD of the population.

Here in our example, n = 100; N = 2000; $\bar{x}$ = 0.354 and S = 0.048. Since σ is not known, an approximate value of σ is obtained on replacing the population SD by sample SD (S)

Thus, SE of $\bar{x}$ = σ/n. √(N-n)/(N-1) = 0.048/√100. √(2000-100)/(2000–1) = .0047

Approximate Confidence Limits (large samples) for proportion (p)

These are:
95% CL = p ± 1.96 (SE of p)
99% CL = p ± 2.58 (SE of p)
Almost sure limits = p ± 3 (SE of p)

Illustration: A sample of 600 screws is taken from a large consignment and 75 are found to be defective. Estimate the percentage of defectives in the consignment and assign limits within which the percentage lies.

Soln.: There are 75 defectives in a sample size of n = 600. Thus, the sample proportion of defectives is p = 75/ 600 = 1/8 = 12.5%.

This may be taken as the estimate of the percentage of defectives (P) in the whole consignment (point estimation).

The limits to the percentage of defectives refer to the confidence limits, which may be given as p ± 3 (SE of p)— Interval Estimation.

Here, SE of p = √PQ/n = pq/n, approximately, since the population proportion is not known = √1/8(1-1/8)/600
= 0.0135.

The limits to the percentage of defectives in the consignment, i.e, P are 1/8 ± 3 * 0.0135 = .125 ± .0405 = .1655 and .0845, i.e, 16.55% and 8.45%

Exact Confidence Limits (Any Sample Size) for Mean (μ) When SD Known

These are:
95% CL = $\bar{x}$ ± 1.96 (σ/√n)
99% CL = $\bar{x}$ ± 2.58 (σ/√n)

Illustration: A random sample of size 10 was drawn from a normal population with an unknown mean and a variance of 44.1 square inch. If the observations (in inches) are: 65, 71, 80, 76, 78, 82, 68, 72, 65 and 81. Obtain the 95 percent confidence interval for the population mean.

Soln.: We have in our example, n = 10, σ^2 = 44.1 and Σx_i = 738. Therefore, $\bar{x}$ = 738/10 = 73.8. Since the population SD σ is known, the 95 percent confidence interval for μ is given by:

95% CL = $\bar{x}$ ± 1.96 (σ/ √n)
= 73.8 ± 1.96 (√44.1/√10)
= 73.8 ± 4.1 = 77.9 and 69.7

The 95 percent confidence interval for μ is therefore 69.7 and 77.9 inches.

Exact Confidence Limits (Any Sample Size) for Mean (μ) When SD Unknown

In random samples from a Normal Population N (μ, σ^2)

$$t = \frac{\bar{x} - \mu}{S/\sqrt{(n-1)}}$$

follows t distribution with (n-1) df, where S is the sample SD. If $t_{.025}$ denotes the upper 2.5 percent point of t distribution with (n-1) df, then 95 percent confidence interval for μ is obtained from:

$-t_{.025} \leq (\bar{x} - \mu)/S/\sqrt{(n-1)} \leq t_{.025}$

Hence, for the population mean μ

95% Confidence Limits $= \bar{x} \pm t_{.025}\ (S/\sqrt{n-1})$
99% Confidence Limits $= \bar{x} \pm t_{.005}\ (S/\sqrt{n-1})$

Illustration: A random sample of 10 students of class II was selected from schools in a certain region, and their weights (in pounds) recorded are shown below: 38, 46, 45, 40, 35, 39, 44, 45, 33 and 37. Find the 95 percent confidence limits within which the mean weight of all such students in the region is expected to lie. ***(Given $t_{.025}$ = 2.262 for 9 df and 2.228 for 10 df).***

Soln.: From the given data, $\bar{x} = 402/10 = 40.2$. To calculate the SD (S), we take deviations from the mean, i.e, 40, i.e, d = x – 40. Thus, the deviations are –2, 6, 5, 0, –5, –1, 4, 5, – 7, –3.

$\Sigma d = 2$ and $\Sigma d^2 = 190$
Thus, $S^2 = \Sigma d^2/ n - (\Sigma d/n)^2$
$S^2 = 190/10 - (2/10)2 = 18.96$
$S = \sqrt{18.96} = 4.35$

Since the population SD σ is unknown, the 95 percent confidence limits for μ are $\bar{x} \pm t_{.025}\ (S/\sqrt{n-1})$, i.e., $40.2 \pm 2.262 * 4.39/\sqrt{9}$ (df = 9)

$= 40.2 \pm 3.28 = 36.92$ and 43.48

The 95 percent confidence limits for the mean weight (in pounds) are 36.9 and 43.5.

Exact Confidence Limits (Any Sample Size) for Variance (σ^2) When Mean is Known

In random samples from N (μ, σ^2) population, $\Sigma(x - \mu)^2/\sigma^2$ follows chi- square distribution with n df. If χ^2 0.975 and $\chi^2$0.075 denote the lower and the upper 2.5 percent points of chi- square distribution with n df, then with probability 95 percent, we have:

$$\chi^2_{0.975} \leq \Sigma(x - \mu)^2/\sigma^2 \leq \chi^2_{0.025,}$$

and the 95 percent confidence interval for σ^2 is:

$$\Sigma(x_i - \mu)^2/\ \mu^2_{0.025} \leq \sigma^2 \leq \Sigma(x_i - \mu)^2/\chi^2_{0.975}$$

Exact Confidence Limits (Any Sample Size) for Variance (σ^2) When Mean is Unknown

In this case $nS^2/\ \sigma^2 = \Sigma(x_i - \bar{x})^2/\ \sigma^2$ follows chi-square distribution with (n-1) df . Using the lower and upper 2.5 percent points of chi-square distribution with n-1 df, we have probability 95 percent the following inequalities

$$\chi^2_{0.975} \leq nS^2/\sigma^2 \leq \chi^2_{0.025},$$

Thus, the 95 percent confidence interval for σ^2 is
$nS^2/\chi^2_{0.025} \leq \sigma^2 \leq nS^2/\chi^2_{0.975}$

Illustration: The SD of a random sample of size 12 drawn from a normal population is 5.5. Calculate the 95 percent confidence limits for the SD (σ) in the population. ***(Given $\chi^2_{0.975}$ = 3.82 and $\chi^2_{0.025}$ = 21.92 for 11 df).***

Soln.: Here n = 12 and the sample SD (S) = 5.5. Substituting the values in the formula mentioned above, the 95 percent confidence interval for σ^2 is

$12^* (5.5)^2/ 21.92 \leq \sigma^2 \leq$" $12 * (5.5)^2/ 3.82$
or, $16.56 \leq \sigma^2 \leq 95.03$;
or,
$4.1 \leq \sigma \leq 9.7$

Thus, the 95 percent confidence limits for the population SD are 4.1 and 9.7.

Exercises on Sampling

Q.1 A random sample of 10 students of call II was selected from schools in a certain region and their weights recorded in lbs. are 38, 46, 45, 40, 35, 39, 44, 45, 33, 37. Find the 95 percent confidence limits within which the mean weight of all such students in the region is expected to lie. (Refer any standard statistics book for theoretical values of various distributions).

Q.2 A random sample of 100 ball bearings selected from a shipment of 2000 ball bearings has an average diameter of 0.354 inch with a standard deviation of 0.048 inch. Find the 95 percent confidence interval for average diameter of these 2000 ball bearings. (Refer any standard statistics book for theoretical values of various distributions).

Q.3 In a big city 325 men out of 600 were found to be smokers. Does this information support the conclusion that the majority of the men in the city are smokers? The answer should be based on stating the hypothesis clearly and then drawing conclusion. (Refer any standard statistics book for theoretical values of various distributions).

Q.4 A manufacturer claimed that at least 90 percent of the components which he supplied, confirmed to specifications. A random sample of 200 components showed that only 164 were upto the standard. Test the claim of the manufacturer at 1 percent level of significance. (Refer any standard statistics book for theoretical values of various distributions).

Q.5 A machine produced 20 defective articles in a batch of 400. After overhauling it produced 10 defectives in a batch of 300. Has the performance of the machine improved? (Refer any standard statistics book for theoretical values of various distributions).

Q.6 In a certain city 100 men in a sample of 400 were found to be smokers. In another city, the number of smokers was 300 in a random sample of 800. Does this indicate that there is a greater proportion of smokers in second city than in the first. (Refer any standard statistics book for theoretical values of various distributions).

Annexure 4A.4:

Applications of EViews Econometric Package

The first step in most projects will be to read your data into an EViews workfile. EViews provides sophisticated tools for reading from a variety of common data formats, making it extremely easy to get started. Before we describe the process of reading a foreign data file, note that the data for this demonstration have been included in both Excel spreadsheet and EViews workfile formats in your EViews installation directory ("./Example Files/Data"). If you wish to skip the discussion of opening foreign files, going directly to the analysis part of the demonstration, you may load the EViews workfile by selecting File/Open/Foreign Data as Workfile... and opening DEMO.WF1.

The easiest way to open the Excel file DEMO.XLS, is to drag-and-drop the file into an open EViews application window. You may also drag-and-drop the file onto the EViews icon. Windows will first start the EViews application and will then open the demonstration Excel workfile. Alternately, one may use the File/Open/EViews workfile... dialog, selecting Files of type Excel and selecting the desired file.

The first page of the wizard includes a preview of the data found in the spreadsheet. In most cases, you need not worry about any of the options on this page. In more complicated cases, you may use the options on this page to provide a custom range of cells to read, or to select a different sheet in the workbook. The second page of the wizard contains various options for reading the Excel data. These options are set at the most likely choices given the EViews analysis of the contents of your workbook. In most cases, you should simply click on Finish to accept the default settings. In other cases where the preview window does not correctly display the desired data, you may click on Next and adjust the options that appear on the second page of the wizard.

Use of EView 5.1

EViews 5.1 is the latest version of EViews that is available currently in the Market. EViews is used for all econometric analysis required for forecasting and other purposes. All econometric applications are possible using EViews, and it makes statistical computations simple as compared to MS-Excel. Further, with EViews it is possible to derive the correlation coefficients of all the variables with each other, and the same could not be obtained with MS-Excel.

Once the software is loaded, EViews 5.1 version can directly use data from Excel files, that was however, not possible with EViews 3.1, where there was a need to import the data from Excel. For opening an Excel File in EViews, we go to Icon- "File" and then click "open." There will be four other alternative options along with "Foreign Data as Workfile." We click this and the browser appears. Here we select the folder and click on the file. Now it displays the data in the file.

From this dataset that appears in the EViews now, we do the required computation. To do this, we click the "View" menu in the menu list, a list of computations that could be performed drops and we can click the required one.

For illustrating OLS estimation with EViews, let us consider the data set on consumption of beer and the three explanatory variables, namely Urbanization (% of urban population to total

population), purchasing power (PCNSDP) and size of the market (total population), as given in Annexure 4A.4.

For performing OLS regression with the help of EViews, we first develop the workfile and then from the menu, we go to "proc", where we get the option "Make Equation". It will reveal various option of making equation including "OLS (NLS and ARMA)" which will provide the OLS estimates of the explanatory variable in the model when regressed on the independent variable. The EViews regression output is shown in Table 4A.1.

One can interpret these results as normally done for the results obtained from OLS estimates done with MS-Excel. As mentioned earlier, the EViews provides several other statistics in addition to what is provided for in the MS-Excel Regression results. DW Watson statistic that helps in identifying the presence/absence of autocorrelation is also made available. In our example, one can see that the DW statistic (0.798) is significantly lower than two, implying that there is existence of positive autocorrelation in the model.

Table 4A.1: EViews Regression Output

Dependent Variable: Beer				
Method: Least Squares				
Date: 08/14/06 Time: 13:09				
Sample: 1 25				
Included observations: 25				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
UPTP	-1140.094	330.361	-3.451055	0.0025
PCNSDP	-0.030518	0.038109	-0.800806	0.4327
TP	-4558.158	1583.855	-2.877889	0.0093
TUP	19951.32	6473.037	3.08222	0.0059
C	28148.6	8227.472	3.421294	0.0027
R-squared	0.85791	Mean Dependent Var		238.0041
Adjusted R-squared	0.829491	S.D. Dependent Var		339.7354
S.E. of Regression	140.2858	Akaike Info Criterion		12.9021
Sum-squared Resid	393602.3	Schwarz Criterion		13.14587
Log Likelihood	-156.2762	F-statistic		30.18886
Durbin-Watson Stat	0.79812	Prob(F-statistic)		0

Annexure 4A.5:

Alternative Functional Forms for Estimating Buoyancy/Elasticity

OLS method of estimation requires that the regression model be linear in terms of the variables involved implying that the marginal impact of the independent variable remains unchanged or is constant at all level of the independent variable that is depicted by β_1 in our model. Mathematically, it can be given as:

$$\frac{\Delta Y}{\Delta X} = \beta_1$$

This means that a one unit change in X will always change Y by units:

$$e_{Y,X} = \frac{\Delta Y}{\Delta X}\frac{X}{Y} = \beta_1 \frac{X}{Y}$$

If theory suggests only a direction of change in Y when X changes and nothing else (like no peak for the relationship) then a linear function form should be used unless the evidence suggests otherwise.

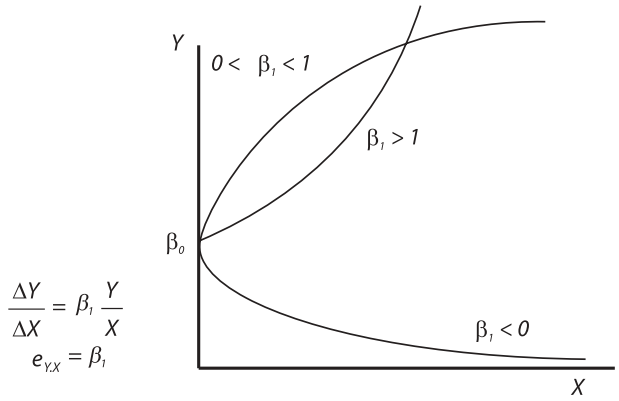
Double-log Linear Function Form

At times, OLS method is applied to a transformed linear equation of a nonlinear functional form, such as:

$$\ln Y = \beta_0 + \beta_1 \ln X + \varepsilon$$

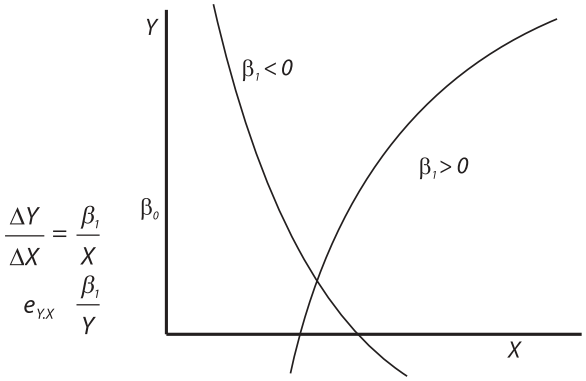
The double-log functional form is the opposite of the linear form in the sense that the marginal effect on Y of a change in X is not constant, while the elasticity of Y with respect to X is constant

Double-log models are good if you are specifically interested in elasticities and can live with them being constant. This functional form cannot be used if any of your variables take on nonpositive values (0 or negative) because the natural log of such numbers cannot be taken. A



case in point: If your model includes dummy variables, do not try to log them.

$$Y = \beta_0 + \beta_1 \ln X + \varepsilon$$



The semilog functional form is good for situations where the effect of a change in X on Y is expected to increase, but at a decreasing rate.

Example: Engel's law states that the proportion of income spent on food will decline as income goes up. So we might try log of income as an independent variable in a demand for food. It is also possible for the semilog model to be reversed. That is, the log of Y is taken rather than X. this is useful if a one unit change in X brings

about a constant percentage change in Y.

Example: Log income regressed on years of education. The slope is an estimate of the rate of return to schooling.

Polynomial Functional Form

A polynomial of order two can be expressed as:

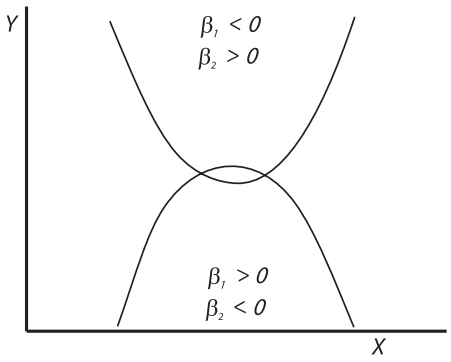
$$Y = \beta_0 + \beta_1 X + \beta_2 X^2 + \varepsilon$$

The slope is given:

$$\frac{\Delta Y}{\Delta X} = \beta_1 + 2\beta_2 X$$

is The elasticity given by:

$$e_{Y,X} = \beta_1 \frac{Y}{X} + 2\beta_2 \frac{X^2}{Y}$$



Example: Corn yields increase with fertilizer use, holding everything else constant. However, as fertilizer is increased its effect reaches a maximum (ceteris paribus) and subsequent increases in fertilizer will be counterproductive.

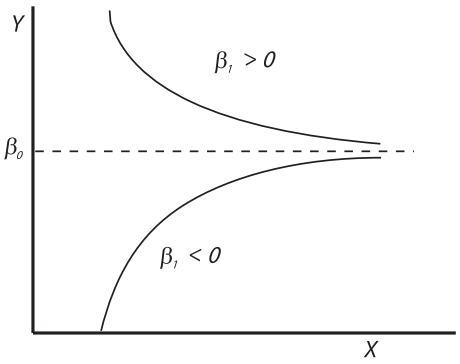
Inverse Functional Form

In such a functional form, inverse of the independent variable is used, like:

$$Y = \beta_0 + \beta_1 (1 / X) + \varepsilon$$

The slope is given by:

$$\frac{\Delta Y}{\Delta X} = -\frac{\beta_1}{X^2}$$



The elasticity is given by:

$$e_{Y,X} = -\frac{\beta_1}{XY}$$

The inverse form would be appropriate if there exits a natural limit on the dependent variable that can not be achieved. For example, impact of inflation on unemployment as depicted in the Phillips curve.

Part 5: Fiscal Capacity and Tax Effort

Fiscal capacity of a region refers to its tax potential, that is, the maximum tax revenue that can be raised from the region. On the other hand, tax effort refers to the tax revenue that is actually raised from the region, that is, the extent to which tax potential of the region/country/state has been exploited. Tax effort that leads to full exploitation of tax potential of the state could be interpreted as normal effort. A deficiency in effort at raising taxes would mean less than full exploitation of the state, and an extra effort at raising taxes would lead to over exploitation of potential of the state. In this sense, both the fiscal capacity and tax effort are relative terms. And it is not feasible to define these concepts in absolute terms.

These concepts are useful in comparing fiscal (taxable) capacities and tax efforts among the states or over time within a state. In India, The Finance Commissions are expected to give due weight to taxable capacities and tax efforts of the states, while recommending transfer of resources from the Centre to the states. This is done with a view to reward the better performing states. In practice, however, measuring relative taxable capacities and tax efforts of the states is not easy.

Measuring tax efforts of the states is important also from the point of view of being aware of as to the relative tax performance of the state. Some of the deficient states could be expected to make a little extra tax effort as they learn about the unutilized tax potential in their jurisdictions.

Determinants of Fiscal Capacity

The factors affecting a state's fiscal/taxable capacity include:

- Gross state domestic product (GSDP) of the state;
- Composition of GSDP;
- Distribution of income and wealth;
- Consumption pattern;
- Degree of industrialization;
- Degree of urbanization;
- Degree of monetization of the economy;
- Fiscal policies of the state; and
- Government policies in the field of foreign trade, capital flows, and technology transfers.

In general, the higher the GSDP of a state the higher would be its taxable capacity. Composition of GSDP is important as some sectors are relatively easy to tax and some are relatively difficult to tax because of the nature of commodity, trade or trader. It is easier to tax manufactured products as compared to agricultural produce. It is easier to tax large traders as compared to small trades. The larger the nonagricultural sector or higher the degree of industrialization the larger would be the taxable capacity of the state. Similarly, the larger the size of dealers the larger would be the taxable capacity of the state. Higher inequity in income and wealth distribution also contributes to taxable capacity of the state, because of the resultant consumption pattern.

An increase in the degree of urbanization results in a change in the pattern of consumption in favor of high value manufactured goods implying an enhanced taxable capacity of the state. Therefore, the higher the degree of urbanization the higher would be the taxable capacity of the

state. Monetization of the economy induces voluntary compliance with the tax laws by reducing scope for tax evasion, implying an increase in taxable capacity of the state.

Fiscal policies, specifically the expenditure policies have a significant impact on the taxable capacity of the state. The expenditure policies such as those, facilitating capital formation, employment, social services, use of better technology, and higher productivity tend to enhance taxable capacity of the state.

Government policies to attract investment and new technology in the state also enhance its taxable capacity through higher level of employment and income.

Determinants of Tax Effort

Tax effort is the actual exploitation of potential tax revenue. It depends mainly on:

- Political will;
- Tax structure: Coverage, exemptions and rate schedules; and
- Administrative efficiency.

Political will is very important in exploiting taxable capacity. This requires observing strict fiscal discipline such as not giving tax sops to different lobby groups. Political will also influences the tax structure that has a bearing on its coverage and revenue yield. A tax structure that is perceived to be rational and has moderate rates finds acceptance by masses. This could lead to higher level of compliance with the tax laws that is also influenced by administrative efficiency.

The quality of tax administration is as important as the tax structure. A good tax system may not give good results if not administered efficiently. The tax administration to be effective in enforcing the tax laws efficiently should adopt modern techniques of administration. The effectiveness of tax administration also depends on the simplicity and rationality of the tax structure.

Measuring Fiscal Capacity and Tax Effort

As discussed above, the Finance Commissions take into account fiscal capacity and tax effort of the states in recommending central transfers to the states. The Ninth Finance Commission advocated two alternative approaches to estimate relative taxable capacities and tax efforts of the states. These are:

1. Aggregate regression approach.
2. Representative tax system approach.

The aggregate regression approach relies on indicators of taxable capacity such as income, composition of income, and degree of industrialization. The representative tax system approach relies on some bench mark of taxable capacity such as average tax rate or tax-to-income ratio of all states. These approaches are briefly discussed below.

Aggregate Regression Approach

It is a regression technique in which the tax yield is regressed on the indicators of taxable capacity of the state. The dependent variable is a selected variable representing tax yield, such as

- Total tax revenue;
- Per capita tax revenue; and
- Tax-to-income ratio.

The explanatory variables are selected indicators of taxable capacity, such as:

- Per capita income or consumption
- Level of urbanization
- Level of monetization
- Interpersonal distribution of income
- Structure of the economy (that may be represented by share of nonagricultural income in total income of the state)

The relationship between a dependent variable and explanatory variables could be of linear or log-linear variety. Plotting the dependent variable against explanatory variables could indicate the possibility of linear or nonlinear relationship. However, the final choice would depend on the statistical significance of the estimated parameters and explanatory power of the estimated relationships (equations).

In general, the higher the GSDP of a state the higher would be its taxable capacity. Composition of GSDP is important as some sectors are relatively easy to tax and some are relatively difficult to tax because of the nature of commodity, trade or trader. It is easier to tax manufactured products as compared to agricultural produce. It is easier to tax large traders as compared to small trades. The larger the nonagricultural sector or higher the degree of industrialization the larger would be the taxable capacity of the state. Similarly, the larger the size of dealers the larger would be the taxable capacity of the state. Higher inequity in income and wealth distribution also contributes to taxable capacity of the state, because of the resultant consumption pattern.

The taxable capacity of a state is estimated by substituting actual values of the explanatory variables in the selected estimated equation. The ratio of actual to estimated value of the dependent variable (tax revenue, per capita tax, or tax ratio) for a state is taken to indicate its tax effort. This is illustrated in Table 5.1, where dependent variable is taken to be tax amount (T), explanatory variables are represented by "B", estimated taxable capacity (tax potential) is represented by "C" and relative tax effort (Actual tax/Potential tax) is represented by "R".

A value of relative tax effort (R) less than one would indicate deficiency in tax effort, and greater than one would indicate over exploitation of taxable capacity in the state.

The merit of this approach is that it can be used with limited disaggregation of data.

Representative Tax System Approach

In this approach, relative taxable capacity (Tax potential) of all states is estimated by each tax separately. For a selected tax, first of all, the all-state average tax rate is obtained by dividing total tax amount by total tax base of all states. Second, the taxable capacity/tax potential of each state is estimated by multiplying its tax base with the all-state average tax rate. Third, the relative tax effort of the state is obtained as the ratio of actual tax collected by the state to its estimated taxable capacity/tax potential. This process is illustrated in Table 5.2.

A value of relative tax effort (R) less than one would indicate deficiency in tax effort, and greater than one would indicate over exploitation of taxable capacity in the state.

Table 5.1: Illustration of Regression Approach in Measuring Relative Tax Effort

Year	Indicators of Taxable Capacity	Tax Amount	Taxable Capacity (Tax Potential) Estimate*	Relative Tax Effort (3/4)
1	**2**	**3**	**4**	**5**
1	B_1	T_1	C_1	$R_1=T_1/C_1$
2	B_2	T_2	C_2	$R_2=T_2/C_2$
3	B_3	T_3	C_3	$R_3=T_3/C_3$
4	B_4	T_4	C_4	$R_4=T_4/C_4$
5	B_5	T_5	C_5	$R_5=T_5/C_5$
6	B_6	T_6	C_6	$R_6=T_6/C_6$
7	B_7	T_7	C_7	$R_7=T_7/C_7$
8	B_8	T_8	C_8	$R_8=T_8/C_8$
9	B_9	T_9	C_9	$R_9=T_9/C_9$
10	B_{10}	T_{10}	C_{10}	$R_{10}=T_{10}/C_{10}$
11	B_{11}	T_{11}	C_{11}	$R_{11}=T_{11}/C_{11}$
12	B_{12}	T_{12}	C_{12}	$R_{12}=T_{12}/C_{12}$
13	B_{13}	T_{13}	C_{13}	$R_{13}=T_{13}/C_{13}$
14	B_{14}	T_{14}	C_{14}	$R_{14}=T_{14}/C_{14}$
15	B_{15}	T_{15}	C_{15}	$R_{15}=T_{15}/C_{15}$

Note: * Estimated through regression exercise.

Table 5.2: Illustration of Representative Tax System Approach in Measuring Relative Tax Effort

State	Tax Base	Tax Amount	Average Tax Rate (3/2)	Taxable Capacity (Tax Potential) (A*(2))	Relative Tax Effort (3/5)
1	**2**	**3**	**4**	**5**	**6**
1	B_1	T_1	$A_1=T_1/B_1$	$A*B_1$	$R_1=T_1/A*B_1$
2	B_2	T_2	$A_2=T_2/B_2$	$A*B_2$	$R_2=T_2/A*B_2$
3	B_3	T_3	$A_3=T_3/B_3$	$A*B_3$	$R_3=T_3/A*B_3$
4	B_4	T_4	$A_4=T_4/B_4$	$A*B_4$	$R_4=T_4/A*B_4$
5	B_5	T_5	$A_5=T_5/B_5$	$A*B_5$	$R_5=T_5/A*B_5$
6	B_6	T_6	$A_6=T_6/B_6$	$A*B_6$	$R_6=T_6/A*B_6$
7	B_7	T_7	$A_7=T_7/B_7$	$A*B_7$	$R_7=T_7/A*B_7$
8	B_8	T_8	$A_8=T_8/B_8$	$A*B_8$	$R_8=T_8/A*B_8$
9	B_9	T_9	$A_9=T_9/B_9$	$A*B_9$	$R_9=T_9/A*B_9$
10	B_{10}	T_{10}	$A_{10}=T_{10}/B_{10}$	$A*B_{10}$	$R_{10}=T_{10}/A*B_{10}$
11	B_{11}	T_{11}	$A_{11}=T_{11}/B_{11}$	$A*B_{11}$	$R_{11}=T_{11}/A*B_{11}$
12	B_{12}	T_{12}	$A_{12}=T_{12}/B_{12}$	$A*B_{12}$	$R_{12}=T_{12}/A*B_{12}$
13	B_{13}	T_{13}	$A_{13}=T_{13}/B_{13}$	$A*B_{13}$	$R_{13}=T_{13}/A*B_{13}$
14	B_{14}	T_{14}	$A_{14}=T_{14}/B_{14}$	$A*B_{14}$	$R_{14}=T_{14}/A*B_{14}$
15	B_{15}	T_{15}	$A_{15}=T_{15}/B_{15}$	$A*B_{15}$	$R_{15}=T_{15}/A*B_{15}$
All	B	T	A=T/B		

Alternatively, the same process could be performed by using tax-to-income ratio of all states in stead of average tax rate.

Some of the characteristics of this approach, which could be interpreted as its limitations are:

- It requires data at the disaggregate level: data on tax base and tax yield by individual taxes. It is not easy to estimate the bases of individual taxes for each state;
- It implicitly assumes that all-state tax effort equals all-state taxable capacity whereas, in reality, a particular tax may be overexploited or underexploited;
- Also, it assumes that, all-state average tax rate multiplied by tax base of an individual state gives taxable capacity (Tax potential) of the state whereas, in reality, the tax rate could vary across the states due to variation in taxable capacities of the states, such as level and composition of income; and
- It ignores interstate variations that affect taxable capacity such as income composition, income distribution, industrialization, and urbanization.

Stochastic Frontier Production Function Approach

There can yet be a third approach to the estimation of taxable capacity of States in a Federal System based on a technique analogous to the Stochastic Frontier Production Function Approach (Cornwell, Schmidt and Sickles, 1990). Given the observed values of a set of correlates of the aggregate taxable capacity, this approach presumes that each State would have its observed tax revenue values in the neighborhood of a tax capacity frontier and the level of the frontier may vary from State to State. Thus, by comparing the levels (i.e. the values of intercept) of the State-wise estimated taxable frontiers, one may derive relatives indices of taxable capacity for individual States. It should be noted that one needs to be careful in using this approach, because the concept of a frontier may not necessary be applicable in the case of a comparative analysis of taxable capacity across States. To be precise, in case of production analysis based on firm-wise cross sectional production data, the frontier approach presumes that individual firms (being profit maximizing firms) would always try to be on the frontier, so that an observed point lying below the frontier would signify inefficiency of the firm concerned. In other words, the phenomenon of profit maximization implicit in a given set of production data makes the use of frontier approach in production analysis meaningful. In contrast, States in a federal set up need not necessarily be under compulsion of maximizing tax revenue collection, and if that were the case, it may not be straight forward to meaningfully estimate taxable capacity of Indian States using the frontier approach (Jha, Mohanty and Chatterjee, 1995).

Concluding Remarks

The concepts of taxable capacity and tax effort are useful in judging the performance of individual states in raising revenue from taxes. At the same time, the states become aware of the extent of unexploited tax potential that could be exploited and utilized for the welfare of the states.

It is important that the Finance Commissions appropriately take into account the tax efforts of the individual states so that the non-performing states do not get rewarded in the process of revenue transfers from the Centre to the states. This would tend to encourage fiscal discipline.

Measuring taxable capacity of a State is essential for formulating a tax policy. However, in practice, obtaining such measurement may be an extremely tricky job. This is primarily because one has to exercise great caution in making such measurement and interpreting the results. More importantly, one may have to make important value judgments in deciding which factors (among those explaining adequately the observed variation in tax revenue data across States or over time) should be regarded as explanatory variables for taxable capacity. For example, the sectoral composition of a State economy, along with other variables, explains variation in tax revenue across the States. One may argue that this variable should be treated as a correlate of taxable capacity since the structure of a State's economy would determine

the level of income (which, in turn, influences the willingness and ability to pay State taxes) of the residents. On the other hand, if a State Government (in order to be popular) promotes a relative expansion of a tertiary sector of the State economy by pursuing a policy of promoting employment through expansion of small scale service oriented activities (which might create a smaller taxable capacity in the State economy), then should the sectoral composition variable be treated as a correlate of taxable capacity or tax effort?

Part 6: Revenue Management Implementation

The implementation of revenue management practices is paramount if the foregoing discussion of revenue forecasting techniques is to have any practical value. Essentially, there are three dimensions to revenue management implementation:

1. Organizational Structures.
2. Operational Protocols.
3. Database Tools.

The following pages discuss the key issues and techniques related to the above dimensions of revenue management practice.

Organizational Structures

The key organizational structure recommended on the basis of practical field experience is the Fiscal Policy and Analysis Cell (FPAC). As discussed in the *Fiscal Policy and Analysis Cell Implementation Guide* (See Section 1, Annexure x) a FPAC must operate with a comprehensive view of government and it should be equipped to advise decision makers on any issue that may arise related to the management of government finances. Functional assignments within the cell should cover all the elements of government.

The key functional areas that must be represented among the FPAC membership are those related to Expenditure, Revenue, Debt, and Project Appraisal Management. With respect to revenue management, the FPAC membership needs to include experts in revenue forecasting techniques, statistical analysis and tax policy formulation and implementation. All of the revenue management-focused FPAC members must have clear job descriptions inclusive of reporting relationships and research scope — *i.e.*, responsible sectors such as tax, nontax, user fee, etc….

Table 6.1 provides a description of the job responsibilities and desired background for FPAC Revenue Analysts.

Finally, any research overlap with other FPAC

Table 6.1: Revenue Analysts

Job Description	• Monitor revenue collections, analyze revenue and macroeconomic indicators, trends and tax expenditures
	• Prepare complex analyses for use in planning and decision-making
	• Produce final reports
	• Ensure that results are integrated with outputs from other models
	• Present analyses and final reports to decision makers and nontechnical audiences
Desired Background	• Skill, experience or special training in applied mathematics, mathematics, statistics, economics, finance, or accounting
	• Experience with economic and/or mathematical modeling
	• Knowledge of relevant tax laws and analytic techniques that are applicable to fiscal policy issues
	• A graduate, and preferably with a masters level degree
	• Basic computer skills
	• Knowledge of the derivation of the input data that is used in analyses
	• Ability to communicate on tax issues to nontechnicians

members must be accompanied with a protocol for completing and finalizing research findings and suggestions — *i.e.*, a dispute resolution process.

Operational Protocols

(Please decide if the FPAC Implementation Roadmap is relevant for revenue management. Otherwise, kindly provide some structured process that addresses how revenue management forecasting and analysis should be handled.)

Recommended Protocol and Roadmap

In connection with the desire to initiate the FPAC as expediently as possible, the REFORM team recommends these initial steps. The major categories and subcategories can be viewed as indicators of progress in implementing the roadmap.

Step 1. Preimplementation Planning

- Obtain the concurrence of the key decision makers in the Department of Finance. Buy-in is critical.
- Determine conditions for the operation of the FPAC. Examples of these conditions could include requiring a term of 3-5 years for each posting, protecting the postings from job transfers and job rotations.
- Decide the elements to be included in the FPAC such as the extent of including debt management in the cell.

Step 2. Roll-out FPAC

- Issuance of a Government Order as soon as possible will establish the FPAC formally. The order should define any special conditions that accompany its creation.
- Appoint the FPAC Director.
- Finalize job descriptions and position qualifications.

Step 3. Staffing Activities

- Develop strategies for filling positions. Examples of these strategies could be to recruit or assign people from within the Finance Department or from within state government, from public financial agencies.
- Decide strategy for filling positions such as reassignment, deputation, recruitment, and recruitment from outside state government.
- Develop a timetable for staffing the FPAC.
- Establish the vehicle for contracting staff, for use on a case-by-case basis, primarily for appointments from entities outside the Government structure.
- Find suitable candidates and create a list of candidates.
- Develop short lists and make final appointments.

Step 4. Initiate Networks

- Identify state-based academic, institutes, professional associations that can assist in FPAC research activities.
- Officially invite organizations identified above to nominate a member to serve as a FPAC resource person.
- Determine compensation package for resource persons.

Step 5. Initial Training

- Develop training plan for each employee.
- After collaboration with training facilities for appropriate course work, schedule

employees for training according to their needs and training plan.

Step 6. Make Assignments for FPAC Members

- Department assignments for Expenditure Budget Analysts.
- Assignments to DIMC.
- Assignments to Tax Analysis wing.
- Assignments to Revenue Forecasting Wing.
- Officially appointments a resource persons.

Step 7. Formal Government Order Issued

- Defines scope of the FPAC.
- Defines relationship to state government.
- Officially appoints the FPAC Director.
- Appoints membership positions.
- Describes reporting protocol.
- Defines study protocol.
- Allocates budget line, offices, furnishings, and equipment.

Step 8. FPAC Operationalized

- Operationalize FPAC/DIMC with formal "kickoff" ceremony.
- Ensure regular — at least once a fiscal year — reporting to the state legislature and cabinet.

Step 9. Hold Regular Meetings

- Establish meeting protocol regarding a quorum and venue.
- Ensure circulation of meeting agenda in advance of meetings.
- Schedule regular meetings of FPAC members and resource persons.
- Ensure participation of Finance Secretary or his designate in meetings.
- Prepare and circulate detailed minutes with clear follow-up action.

Step 10. Prepare Regular Reports

- Establish report format and periodicity — *e.g.*, biannual reports. (See Annexure No. 8 for Karnataka example.)
- Determine report recipients.
- Post on Web site under the *Right to Information* (RTI) legislation.

Step 11. Publish Completed Studies

- Establish a publication format and periodicity — *e.g.*, annual reports.
- Determine circulation list, which should include — at a minimum – the Chief Minister, his cabinet, principal departmental secretaries, and all state legislators.
- Post on Web site under the *Right to Information* (RTI) legislation.

Finally, once the decision-making protocol for undertaking, and finalizing recommendations on revenue forecasts is determined, an information protocol must also be finalized.

Revenue data or information is essential to effective revenue forecasting analysis. Systems support should provide access to a variety of sources of information. For instance, access to current macroeconomic and tax department information is essential for future revenue projections. In addition, revenue analysis depends on not only tax and nontax revenue data but, also, expenditure plans and actual budget execution. In order to project possible revenue streams, current economic data is

indispensable. The critical information databases that can provide this macroeconomic and socioeconomic data are macroeconomic databases and input-output tables on state economic activity.

Database Tools

The two most common and useful databases for accessing socioeconomic data on a state are a Macroeconomic Database and an Input-output Table. It was this set of tools that was developed and introduced in the three partner states of the REFORM Project to assist them in improving their revenue management practices. The following sections discuss the content, benefits, and process for using these database tools.

Macroeconomic Database

Database Purpose

The purpose of an integrated Macroeconomic Databases is to facilitate data sharing amongst different state government departments and to leverage in fiscal decision-making. The specific state government departments needed to in developing such a database are Finance, Planning and Statistics and Commercial Taxes. These departments have the critical fiscal and socioeconomic data required to develop and operationalize a robust and integrated Database. For a list of the data fields, please see Annexure x for the recommended **Variable list**.

The Database initiative must be designed to enable the following general fiscal management activities:

- Assess and describe the current economic health of the state economy;
- Project major components of the economy over a three year simulation period (with Year 1 to be more detailed than Years 2 and 3);
- Project expenditure levels for non-discretionary spending;
- Project tax revenues;
- Estimate the impact of changes in nondiscretionary spending and tax laws;
- Provide projections for a maximum of five years for major macro economic variables of SDP and Fiscal Accounts;
- Identify State's priorities for the improvement of economic and social objectives, *e.g.*, employment, income, education and health;
- Estimate the contribution of various sectors to overall growth of the State;
- Identify the State's attractiveness to particular sector and growth potential of a sector;
- Assess the suitability of the sectors given the State's priorities; and
- Identify strategies for increasing the State's attractiveness to entrepreneurs.

When updated and used on a regular basis the Macroeconomic Database will enable the following revenue management activities:

- Help estimate sectorwise growth levels and revenue projection;
- Enable each variable to be examined in sufficient detail adequately through statistical analysis such as trend analysis;
- Cater to the different State Departments to monitor their programs by enabling them to use the data for projection; and

- Evaluate project key parameters of the state's economy using trend analysis.

Table 6.2 describes the users, uses, and utility of the macroeconomic database to various state government officials and departments.

Data Sources and Interlinkages with National-level Data Sets

The following table describes the macroeconomic data sources, interlinkages and update availability.

Table 6.2: Macroeconomic Database: Usage

Macroeconomic Database (1993-94 to 2003-04): Functions	Who Uses the Database	When to Use the Database	Why is the Database Used	How to Use the Database
Informs comprehensive overview of macroeconomic conditions for the State Provides projections for a maximum of five years for major macroeconomic variables of SDP and Fiscal Accounts	State Departments such as: • Department of Commercial Taxes • Department of Planning and Statistics • Finance Department • Fiscal Policy Analysis Cell (FPAC)	• While examining performance of various sectors • While examining the relative growth performances of various sectors	• To identify State's priorities for the improvement of economic and social objectives, e.g., employment, income, education and health • To estimate the contribution of various sectors to overall growth of the State • To identify the State's attractiveness to particular sector and growth potential of a sector • To assess the suitability of the sectors given the State's priorities • To identify strategies for increasing the State's attractiveness to entrepreneurs	Using the following methods: • By graphs • Trend analysis • Growth and ratio analysis • Regression analysis

Table 6.3: Macroeconomic Database – Data Management

Data Source	Data-type	Update Availability
ASI	Registered Manufacturing Sector Data	
NSSO	Consumption, Enterprise Survey and Employment and Unemployment Data	
CSO	Investment, Capital Stock and SDP Account Data	
Department of Finance	Fiscal Account Data	
Department of Planning and Statistics	Government Consumption, SDP Account Data	
Department of Taxation	Tax Revenue Data	
CAG	Fiscal Management Data	

Macroeconomic Database Maintenance

The following are the key operations required to maintain a macroeconomic database:

IT Infrastructure

- The recommended software to host the database is *Microsoft SQL Server Database Enterprise Edition* with a multi-user licence;
- In terms of network accessibility, we advise use of LAN/MAN/WAN facility depending on the resources and needs of the departments;
- Each department is to be a stake holder and maintain their relevant datasets in the Database;
- Departmentwise capacity to maintain and update their datasets is necessary;
- Different departments can take benefit of the Database with an appropriate network (*e.g., MS SQL Server*);
- The nature of the network (LAN, WAN etc.) would depend on area under coverage; and
- Such a network needs to be built by state governments to make use of integrated database.

Backup

In order to safeguard the database, regular backups are required. These backups should be performed every month and can be handled in one or more of the following ways:

- A copy of the data that is stored somewhere other than in the hard drive of the computer, usually on some type of tape; or
- Stored on a hard drive on another computer connected over a local area network; or
- Setting up the IT infrastructure at a centralized location for the *MS SQL Server 2000* — this would be the location from where the Database can be retrieved by different departments of the State Governments.

Personnel

- Nomination of the officers that would take charge of the SQL Server 2000 Database Administrator/s (DBA);
- Nomination of the officers who would use the Database the SQL Server 2000 Database; An assessment by each state government is recommended for identifying the exact need and span of training that would be necessary for using the SQL Server 2000 Database;
- A relevant networking system may be put up through an agency like VSNL, MTNL, Reliance, etc., the state IT department would be able to advise on these issues;

- Officers (3-4) from the Departments of Planning and Statistics and Finance can be nominated to take charge of the SQL Server 2000 Database and formed into a special cell; and
- Identification of a partner institute in the State who would help in training and troubleshooting in the use of the Database.

Input-output Tables

The value of an Input-output Table is in its ability to provide state government departments with current data on the state economy with respect to production output and employment analysis. It also enables scenario-building by which the impact (output) of anticipated or planned changes in an input variable can be assessed.

In addition, the Input-output Table enables better tax and revenue analysis, based on economic trends. Thus, the relationship(s) between projected revenue expenditure and revenue collection can be examined in order to control and reduce state revenue and fiscal deficits.

More specifically, an Input-output Table enables the following general fiscal management activities:

- Enables policy makers to see the importance of a sector in the economy in terms of how much employment, income and taxes are generates and how much capital and inputs are requires for economic growth;
- Impact analyses on how the impact of changes in various policy instruments (*e.g.*, changes in private and public consumption, investment and taxes on the different sectors of the economy) affect overall economic productivity;
- Highlights any inconsistencies gaps and redundancies in the statistical system of an economy — *i.e.*, it provides a comprehensive detailed and consistent framework for organizing economic statistics;
- The state economic structure can be analyzed from the detailed final demand and value-added data for its various components;
- Shows the flows of goods and services from each branch (called sectors) of the economy to different branches of the economy over a specified period of time (usually a year);
- For producing the output in any sector different types of raw material inputs and capital equipment along with labor are required;
- The outputs produced are utilized both for intermediate and final use;
- Total gross output used as input for further production of goods and services may be termed as intermediate good; and
- Remaining gross output is directly utilized by final users.

When updated and used on a regular basis Input-output Tables enable the following revenue management activities:

- Impact analysis can examine the impact of changes in sectoral level investment, exports and imports on revenue collection using both sales tax and VAT and other tax on sectoral level employment, output and gross value added;
- Provide a detailed framework for projecting indirect taxes by year;
- Analyze the revenue impacts of proposed indirect tax policies by creating or changing

tax law parameters to compute resulting tax liability; and

- Allow the user to specify alternative tax policies for most indirect taxes, including changing such parameters as tax rates by product, coverage rates, evasion rates (through nonregistration), and commerce margin rates.

Use of State-level Input-output Tables

An Input-output approach can be used for various policy level analysis focusing on a particular industry or agricultural sector.

Table 6.4 describes the users, uses, and utility of the macroeconomic database to various state government officials and departments.

Data Sources and Interlinkages with National Level Data Sets

Table 6.5 describes the Input-output Table data sources, interlinkages and update availability.

At this point, it is important to point out that It takes three to five years after the reference period

Table 6.4: Input-output Table: Usage

Input-output Table Functions:	Who Uses an Input-output Table	When to Use an Input-output Table	What is an Input-output Table	How to Use an Input-output Table
• State domestic accounting at a relatively disaggregated level compared to the SDP Reports • Creates a production recipe • The IO Table construction process reveals data gaps, inconsistencies, and redundancies in the statistical system of an economy • Helps in designing future data collection • Information on the production, employment and consumption for demand-side of an economy • A system by which revenue collection (through various types of indirect taxes) on a sectoral basis can be estimated for the base year and for projected years	State Departments such as: • Department of Commercial Taxes • Department of Planning and Statistics • Finance Department • Fiscal Policy Analysis Cell (FPAC)	• For policy decision-making • At the time of making new investment	• To understand the health of the economy • To understand the employment situation in the State • To understand the importance of a sector in generating employment, income and taxes • To estimate tax revenue both in the base year and for the projected years	• By using the coefficient of the base year IO Table to construct updated IO Tables for short-term (one or two years). • By constructing different IO coefficients through a hybrid method (secondary+ primary data collection method) • By constructing various multipliers, — output, employment, income, and tax multipliers.

Table 6.5: Input-output Table: Data Management

Data Source	Data-type	Update Availability
ASI	Registered Manufacturing Sector Data	
NSSO	Consumption, Enterprise Survey and Employment and Unemployment Data	
CSO	Investment, Capital Stock and SDP Account Data	
Department of Finance	Fiscal Account Data	
Department of Planning and Statistics	Government Consumption, SDP Account Data	
Department of Taxation	Tax Revenue Data	
CAG	Fiscal Management Data	

for most countries to compile a new input-output Table, because of the large amount of data required and the complexity of the tasks involved.

Technological change does not occur very rapidly in most sectors, so that it is possible to obtain reasonable results for the latest year even though the latest input-output tables may be a few years old.

Input-output Table Use

The IO analysis furnishes important information on interrelationships that exist among sectors, final users (households, government, and exports), and factors of production within an economy. This information can be used to determine the role and relative importance of each sector in terms of its output, value added, income, and employment contributions and to analyze intersectoral linkages in the economy. Specifically:

- An input-output (IO) table depicts a comprehensive and detailed set of accounts of sales and purchases of goods and services among the producing sectors, final consumers (households, exports, and government), and resource owners (generally labor, capital, and land) during a particular time period (usually a year) for a specific economy or state; and,
- The information from the IO model is presented in a format called the IO Table.[24]

A very general and simplified overview of sector-by- sector IO table is presented in the following table. As depicted in Table 6.5, a standard IO table can be viewed as consisting of three major components (also known as blocks or quadrants):

- **Block A**, which describes intersector transactions;
- **Block B**, which describes final demand; and
- **Block C**, which describes the value added.

Each of these blocks consists of a series of rows and columns. The producing or selling sectors are shown in rows and they are often called as "row" sectors. Similarly, the purchasing or buying sectors are shown in columns and hence, they are called as "column" sectors. More precisely:

- **Block A**, the intersector transactions portion of the table, accounts for intermediate sales and purchases of goods and services among the producing sectors in the economy. Reading across a row of the transactions table shows the intersector sales by the row sector to the various column sectors. Similarly,

[24] This framework was developed by Wassily Leontief in the 1930s, for which he was awarded the1973 Nobel Prize in Economics.

reading down a column shows the inter-sector purchases by the column sectors from the various row sectors;

- **Block B** shows the sales of commodities and services by each row sector to final users, namely households (personal consumption expenditures or PCEs), federal, state and local government units (government expenditures), (investors private investment), and exports. The elements in Block B are final demands of goods and services produced within the economy; and
- **Block C** shows primary payments to the owners of factors production. These include payments to the primary factors of production (*e.g.*, labor, land, and capital), and tax payments to government.

In addition, there are four interrelationships in Input-output Table and these are:

1. Sectors purchase from other sectors.
2. Sectors sell to other sectors.
3. Sectors sell outside the state economy.
4. Sectors buy outside the state economy.

Finally, an Input-output Table follows an accounting framework in which the total receipts of sellers must balance the total expenditures of buyers. By that convention, total output (sales, including final demands) is equal to total input (purchases, including final payments to owners of factors of production) for each producing sector in the economy.

Input-output Table Maintenance

The following are the key operations required to maintain an Input-output Table:

Data Updating:

- Identification of a partner institute in the State who would help in training and troubleshooting in the use and maintain of the Input-Output Tables' Various Departments such as the Department of Planning and Statistics, Departments of Commercial Tax and Finance need to provide data for use in IO Tables;
- State level Statistics Departments should link with CSO to get regular update on data development and usage of IO tables at the Central level;
- Departments of Commercial Taxes, Planning and Statistics, Finance Department, Fiscal Policy Analysis Cell (FPAC) need to use be Input-output Tables for projection and simulation exercises;
- State level Statistical offices need to collate state level data every year;
- The Department of Planning and Statistics and Finance need to maintain the IO Table and update this every four to five years; and,
- Identification of a partner institute in the State who would help in training and troubleshooting in the use of the Database.

Personnel:

- Regularly sensitize policy makers to understanding impact of alternative policy changes on sectoral output and employment;
- Nominate officers that would take charge of the updating and maintenance of the Input-output Tables on time to time basis; and
- Appoint officers for identifying the exact need and span of training necessary to maintain and update the Input-output Tables.

Table 6.6: Input-output Table Summary

	Industries	**Final demand Sectors**	**Total**
Industries	Block A InterindustryTransactions	Block B Final Demand (Sales for Consumption by Households and Government, for Investment, and For Exports)	Total Industry Output (Sales)
Final Payments Sectors	Block C Primary Payments (Payments for Labor, Capital, Land, Loans, and Taxes)		Total Payments
Total	**Total Industry Input (Purchases)**	**Total Expenditures**	

Part 7: Emerging Issues in Revenue Management

Taxation of Services: Goods and Services Tax

Currently, States in India are not allowed to tax services. Therefore, State VAT is levied only on goods and hence on less than a comprehensive tax base. Centre levies service tax on select services but the same is not integrated with Central VAT (CENVAT). As discussed in Part 3, these taxes are expected to be replaced by a comprehensive Goods and Services Tax (GST) by 2010. Empowered Committee of State Finance Ministers is developing a roadmap for introduction of GST by 2010. The main issues that the Committee needs to consider are:

- Efficiency in taxation;
- Competitiveness of business enterprises in domestic as well as international markets;
- Cost of compliance and administration;
- Revenue needs of different tiers of government;
- Autonomy of different tiers of government;
- Tax rate(s) for goods and services; and
- Trade-off between different aspects of taxation such as between efficiency in taxation and autonomy of different tiers of government.

The design options being considered include: (i) the Centre will have complete power to levy and collect tax and will distribute it to states according to a predefined formula, (ii) a dual levy, one by the Centre and another at the states, on a common base, and (iii) dividing the right to tax goods and services between the Centre and the states.[25] The consensus seems to be emerging around the second option.

Keeping in view the report of the Joint Working Group on GST and the views of the States, it has been learnt that the Empowered Committee of the State Finance Ministers has recommended a duel GST with defined functions and responsibilities of the Centre and the States. The Model recommended by the Empowered Committee, as reported, is highlighted below:

- The GST shall have two components — Central GST and State GST. Rates for Central GST and State GST should be prescribed appropriately, reflecting revenue consideration and acceptability;
- The Central GST and the State GST would be applicable to all transactions of goods and services; HSN classification for goods should be used both for the Central GST and the State GST. A classification of services should be evolved by examining international practices, keeping at the same time, in view the particular characteristics of India's services sector;
- The Central GST and State GST are to be credited to the account of the Centre and the State separately;
- Since the Central GST and State GST are to be treated separately, taxes paid against the Central GST shall be allowed to be taken as input tax credit (ITC) for the Central GST and could be utilized only against the payment of Central GST. The same principle would be applicable for the State GST;
- Cross-utilization of ITC between the Central GST and State GST should not be allowed;
- Ideally, the problem related to credit accumulation on account of refund of GST, in the particular cases where input tax exceeds

[25] For a detailed discussion of the alternative options and their implications see NIPFP (1994).

output tax ,should be avoided both by the Centre and the States;

- Procedures for collection of both the Central GST and State GST should be uniform;
- Under the proposed model, the production/ distribution chain for goods with regard to manufacturers having gross turnover of more than INR 1.5 crores would belong to both the Centre and the State. The same limit would apply to service providers. For a given dealer the turnover of goods and services should always be aggregated to decide whether that dealer has crossed the limit of INR 1.5 crores. However, keeping in view the prevailing taxpayer base and the availability of the administrative machinery with the Centre and the States, the remaining taxpayers for goods will be assigned exclusively to the States for the purpose of registration, collection, ITC matters etc., for both the Central GST and State GST;
- The present thresholds prescribed in the State VAT Acts below which VAT is not applicable, may also be adopted under the GST. For this purpose the cumulative turnover of goods and services should be considered. In a given State the cumulative turnover will apply for the purpose of both the State and the Centre. There should, however, be an upper limit on the threshold turnover. The threshold for services should also be applicable to goods in different States;
- The taxpayer would need to submit one periodic return with one copy given to the Central GST authority, and the other to the State GST authority concerned;
- Each tax payer should be allotted a PAN-based taxpayer identification number, with two additional digits to distinguish between the Central GST and the State GST, a total of 13 digits. This would bring the GST PAN based system in line with the prevailing PAN based system for income tax, excise duties and service tax, facilitating data exchange and tax payers compliance;
- Keeping in mind the need of taxpayers convenience, the functions such as assessment, enforcement, scrutiny and audit should be undertaken by the authority which is collecting the tax , with information sharing between the Centre and the States; and
- Composition/compounding scheme for the purpose of GST should be designed keeping in view the present threshold limits followed by different States under VAT. It should also have a floor on rate of tax and there would be a cap on the upper limit of the Composition/ Compounding Scheme.

Currently, States in India are not allowed to tax services. Therefore, State VAT is levied only on goods and hence on less than a comprehensive tax base. Centre levies service tax on select services but the same is not integrated with Central VAT (CENVAT). As discussed in Part 3, these taxes are expected to be replaced by a comprehensive Goods and Services Tax (GST) by 2010. Empowered Committee of State Finance Ministers is developing a roadmap for introduction of GST by 2010.

On the issue on the Central and State taxes to be subsumed under GST, the Empowered Committee has made the following recommendations:

The various Central, State and Local levies were examined to identify possibility of being subsumed under GST. While identifying, the following principles were kept in mind:

- Taxes or levies to be subsumed should be primarily in the nature of indirect taxes, either on the supply of goods or on the supply of services.
- Taxes or levies to be subsumed should be part of the transaction chain which commences with import manufacture/ production of goods or provision or services at one end and the consumption of goods or provision of services at one end and the consumption of good and services at the other.
- The subsumation should result in free flow of tax credit in intra and inter State levels.
- The fees that are not specifically related to supply of goods and services should not be subsumed under GST.
- Revenue fairness for both the union and the State individually would need to be attempted.

On application of the principle, it is recommended that the following Central Taxes should be, to begin with, subsumed under the Goods and Services Tax:

- Central Excise Duty
- Additional Excise Duties
- Service Tax
- Additional Customs duty, commonly known as countervailing duty (CVD)
- Surcharges

Ideally, cesses should be merged with the GST. However, since these are levied under the different Acts, therefore, a final view about them, i.e. whether they should be subsumed or not under the GST could only be taken after they Ministry of Finance is above to take a view in this regard in consultation with the concerned Ministries.

Following Sate taxes and levies should be, to begin with, subsumed under GST:

- VAT/Sales tax.
- Entertainment tax (unless it is levied by the local bodies).
- Luxury tax.
- Taxes on lottery, betting and gambling.
- State Cesses and Surcharges in so far as they relate to supply of goods and services.
- Entry tax not in lieu of octroi.
- Some of the States are levying purchase tax, octroi or entry tax in lieu of octroi. Ideally all these should also be subsumed under GST. However, keeping in view the specific requirements of the concerned States and the interest of the local bodies, it was decided that for the time being these taxes may not be included in the GST. It was, however, clarified that in case the rate of purchase tax and octroi are such that they do not affect the GST rates then there can be no objection to their subsumation in GST.

With regard to taxation of services, the Committee has recommended that the States should be given the power to levy taxes on all services. Regarding the collection of service tax, the States may collect tax on services of the intra-State transaction of services both for

Central and State GST. Likewise, the Centre may collect tax for services of the Inter-State nature/ inter-State trasactions both for Central and State GST. An arrangement to transfer the Central portion of GST on intra-State services/ transactions to the Centre, and the State portion of the GST on inter-State services/transaction collected by the Centre to States, may be worked out based on destination principle.

However, it is required to be noted here that the above road map is still very much recommended in nature and much depends on the policies to be adopted by the Centre and the individual States in future.

The implementation of GST in India is still contingent on several key issues. While there is clarity that the tax would be in the form of dual VAT, that is the only detail about the tax that is available in the public domain. Assuming that the country is heading towards substantial tax reforms in the near future, it is only fair on the tax payers that the details be worked out well in advance so that preparations for a smooth transition to the new regime can be made. A second concern relates to the need to integrate tax administration at the two levels so as to maximize on the efficiency of administration. Since there are options available , a final choice needs to be made. Finally, the impact of the tax on different States is likely to be different. Careful assignment of tax powers is crucial for the new regime to be acceptable in the interest of the effectiveness. In the absence of the same, the transition to the new regime would require some other revenue transfers.

Tax Expenditure

Tax expenditure refers to revenue losses incurred by a government due to special tax relief provisions like tax exemption, tax credit, reduction in tax rate, and tax deferral, that are otherwise not part of a normal tax structure. In other words, tax expenditure is the revenue foregone because of departure from the generally accepted tax structure to give a favourable treatment to some activities or taxpayers.[26]

Tax expenditures could be interpreted as indirect expenditures that generally escape scrutiny by the legislature. Therefore, some of the tax expenditure provisions continue to exist even when they have outlived their utility.

Tax expenditures need to be estimated and subject to rigorous review like direct expenditures. Many countries have found this exercise useful for government budgeting and policy analysis. In late 1960s, Germany and the United States started reporting tax expenditures, and beginning in the late 1970s, other OECD countries began publishing tax expenditure reports. Some countries are legally obliged to produce tax expenditure reports, while others link them with the budget process. Countries like Austria and Germany include the tax expenditures in a wider subsidy report.

States in India, struggling to manage their finances, need to estimate tax expenditures and review these implicit costs against the benefits accruing from the incentive provisions. The issues that need to be addressed in this regard include:

[26] Organization for Economic Cooperation and Development, Tax Expenditures: A Review of the Issues and Country Practices, OECD, Paris, 1984.

- Which of the tax law provisions can be regarded as tax expenditure?
- How to estimate tax expenditures?[27]
- How to estimate benefits accruing to the society due to tax expenditures?
- How frequently the tax expenditures be estimated?
- Could all tax expenditures be withdrawn with ease? Recently, Supreme Court passed a judgment that tax incentives awarded to attract industry in specified areas could not be withdrawn as this will be unjust to the industry that has set up industrial units in those jurisdictions because of these incentives?
- Should tax expenditure budget be made part of normal annual budget of the state governments?
- Is it feasible to obtain estimates tax expenditure before announcing such tax incentive provisions to facilitate a policy analysis?

User Charges

Governments provide a variety of goods and services to its citizens who pay specified user charges for availing these facilities. Many of publicly provided goods and services are subsidized to a varied degree for achieving certain economic and social objectives such as industrial growth, controlling cost push inflation, and helping the poor. It is more so in a democratic country like India.[28] Given the economic, social and financial importance of user charges, these need to be paid more

The growing importance of e-commerce, however, poses challenges for tax administration. Re-engineering of the tax administration becomes essential to meet the challenges thrown by the changing style of doing business. Tax rules and tax administration need be modified

attention and determined comprehensively by taking note of implications of alternative sets of user charges.

Pricing public utilities or fixing user charges is a complex issue. It requires dealing with various issues such as:

- Economic efficiency effects of pricing public sector services;
- Distributional and basic needs effects;
- Incentive effects and risk allocation;
- Financial sustainability of subsidies implicit in user charges;
- Trade-off between quality and low user charges;
- Choice between discriminatory and uniform user charges for all;
- Within discriminatory user charges, choice between multiple part user charges, rising or declining user charges;
- User charges set by competition versus fixed user charges; and
- Indexed versus non-indexed user charges.

The choices regarding the structure of user charges result in different economic, social and

[27] See Part 18 for some illustrations on estimating tax expenditure.
[28] In some of the states, the politicians have not refrained from reducing the user charges to nil on electricity and/or irrigation water for farmers, to develop their vote banks.

financial implications. Determining user charges in general and particularly for irrigation, energy, and transportation is very complex issue specifically in the context of a developing economy. This is also the key issue in the regulatory arrangements of public-private partnership (PPP) contracts/concessions. This is also important in the corporatization and commercialization of the public sector as they affect the ability to raise capital, the demands on the government revenues, and the risk allocation in a project or program.

It is recognized that there is a merit in fixing low user charges for public utilities such as medical care, education, drinking water, irrigation, electricity, transport and housing, but the perception in India is that these are too low that affects both the supply and quality of public utilities and tends to defeat the objective of low user charges. The need for a thorough review of user charges has been recognized. The Kelkar Task Force on Implementation of the Fiscal Responsibility and Budget Management Act (GOI, 2004) as well as state government bodies like the Karnataka Revenue Reforms Committee (2003), have emphasized that revenue potential of user charges needs to be exploited more intensely.

E-commerce and Taxation

E-commerce (electronic-commerce) refers to business over the Internet. Electronic commerce is the paperless exchange of business information using electronic data interchange (EDI), e-mail, electronic bulletin boards, fax transmissions, and electronic funds transfer. It refers to Internet shopping, online stock and bond transactions, the downloading and selling of "soft merchandise" (software, documents, graphics, music, advertising etc.). The concept of e-commerce is all about using the Internet to do business better and faster. The two major forms of e-commerce are Business-to-Consumer (B2C) and Business-to-Business (B2B).

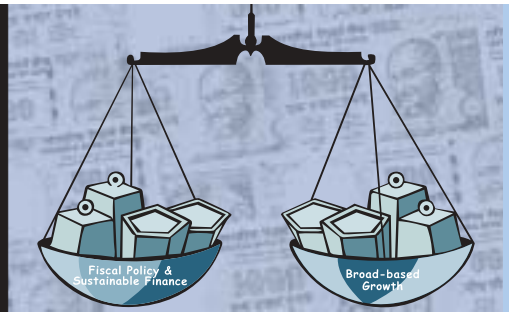
E-commerce is viewed as an efficient and effective way of doing business. It facilitates a paperless and cost-effective transaction. The delivery is fast and involves much less risk to the product delivered. With the development of technology e-commerce is growing at a faster pace. It allows the people to serve themselves. On the part of the vendors, it requires serious online effort and integrating web site with the heart of business.

The growing importance of e-commerce, however, poses challenges for tax administration. Re-engineering of the tax administration becomes essential to meet the challenges thrown by the changing style of doing business. Tax rules and tax administration need be modified by taking into account the following issues associated with e-commerce:

- It becomes difficult to monitor a transaction where there is no paper trail of the transaction. For example, purchase of music, software, documents, and graphics, and advertising where the products can be downloaded and payment can be made through electronic transfer of money;
- Regional borders loose significance and tax jurisdiction can be shifted through proper planning;
- Physical establishment in the business jurisdiction not necessary that nullifies tax rules based on physical business establishment;
- Scope of conflict regarding tax jurisdiction.

For example, product developed in Maharashtra, order received in Andhra Pradesh, delivered from a server in Karnataka to a customer in Uttarakhand who uses the product all over India; and

- Scope of tax competition among different regions if a region could grave the tax base by reducing the tax rate in the region.



Annexures

Annexure 1:

Macroeconomic Background

The combined revenue deficit of the Centre and the States were 3.6 percent and 6.3 percent of GDP respectively in the years 1994-95 and 1999-00. the main reasons generally attributed for this all round fiscal deterioration include the revision of salaries and pension s in the wake of the recommendations of the Fifth Pay Commission, erosion in the buoyancy of central indirect taxes and the high interest rates towards the end of nineties. However, due to initiatives of both the Centre and the State Governments coupled with subsequent strong and sustained growth of the Central and State taxes, there has been considerable progress towards the fiscal consolidation.

The Twelfth Finance Commission has recommended debt consolidation and write-off for the States on the condition that they voluntarily implement their own Fiscal Responsibility and Budget Management (FRBM) Acts for correcting their budget imbalances. This, it is believed, would improve the fiscal health of the States. It is expected that when the Centre and the States wipe out the Revenue Deficit it would result in providing an impetus for healthy growth. With the scaling down of a large deficit, the national investment could rise substantially (estimated beyond 30 percent of the GDP) and it would be possible to sustain economic growth beyond 8 percent annually. Moreover, the outcome would be benign for price stability and the growth of the capital market.

If the Revenue Deficit could be wiped out, the Fiscal Deficit would be down to 3 percent or so, fiscal space would be there for incremental capital outlay. Public spending on capital account has become, to a large extent, rather necessary because it makes available State finance for those investments which the private sector would be reluctant to undertake. A question hangs over primary education and health care: if these are to be financed from the Fiscal Deficit, how much should be overdrawn? Governments would have to ensure that investment contributes to national well being even if they become[29] commercially viable only over the long term. The concern about the deficit is for real and it is important that the are respected. For a developing country there is always a reason to generate revenue surplus and incur in a small fiscal deficit to fund socially desirable investment. Hence, the fiscal situation needs to be examined and monitored to ensure that this meets the long-term economic goals of Governments. An important aspect of monitoring the finances of the State Governments is with respect to revenue projections. However, while developing a methodology for revenue projection, it is important to build a system that helps in monitoring the State's overall economic performance. Such an analysis should keep in view the following aspects:

- Identifying the region's priorities for economic and social objectives like employment, income, and other outcomes such as education and health;
- Estimating the potential contribution of various industries to the criteria included in the State's priorities;
- Identifying the region's attractiveness to particular industries and growth potential of

[29] Based on CSO advanced estimate for the year 2004 -05 and reported in the Economic Survey, 2004-05.

these industries (which would include demand from within the State, outside the State and outside the country);

- Assessing the suitability of the sectors given the State's priorities; and
- Identifying strategies for increasing the region's attractiveness to entrepreneurs. There is a requirement of detailed data sets for assessing the performances of the State Governments. In this report we are focusing on developing a Database for assessing the major indicators of the State's economy particularly with reference to monitoring the fiscal position of the State Government and the related macroeconomic situation of the State.

The Twelfth Finance Commission has recommended debt consolidation and write-off for the States on the condition that they voluntarily implement their own Fiscal Responsibility and Budget Management (FRBM) Acts for correcting their budget imbalances. This, it is believed, would improve the fiscal health of the States. It is expected that when the Centre and the States wipe out the Revenue Deficit it would result in providing an impetus for healthy growth. With the scaling down of a large deficit, the national investment could rise substantially (estimated beyond 30 percent of the GDP) and it would be possible to sustain economic growth beyond 8 percent annually.

One of the REFORM states, for example Karnataka also suffered from fiscal imbalance in 1990s. In the1980s, the macroeconomic fundamentals of the states were indeed strong and it had witnessed robust growth. But, in the 1990s, the fiscal health of the state deteriorated. There were many reasons for such a situation:

- The state's own tax revenue came down and the average tax buoyancy was 0.91 for the decade 1990s.Various Tax and Nontax concessions and exemptions offered to attract investments also had a role in dampening the revenue growth;
- Nontax revenues in the form of user charges (water rate, royalty on minor minerals etc.) were not revised for a long time. Recovery atmosphere was very bad. As a result, Nontax revenues fell from 2.2 percent in 1980s to 1.7 percent of GSDP 1990s; and
- The devolution of Union Taxes fell as a percentage of GSDP from 2.8 percent in 1980s to 2.2 percent in 1990s.

To tackle the financial situation, both Centre and state governments have under taken various fiscal measures. On recommendation of the Eleventh Finance Commission the GoI set up a scheme called State's Fiscal Reforms Facility (2000-05) to incentivise the States to draw up a monitorable fiscal reforms program for fiscal consolidation. On recommendation of the Twelfth Finance Commission GoI has put in place a Debt Consolidation and Relief Facility (2005-10) to institutionalize the reforms program of the States and incentivise the States through debt relief. Barring a few , most of the State Governments have enacted the Fiscal Responsibility and Budget Management Act and drawn up a fiscal correction path to eliminate the revenue deficit and bring down the fiscal deficit to 3 percent of the GSDP by 2008-09 in tandem with the targets set in the Fiscal Responsibility and Budget Management Act (FRBM) passed by the Centre in 2004 subject to the revision in the medium term fiscal plan in each year. On revenue front, the centre advised all the states to implement a new tax system called the Value Added Tax (VAT) replacing the

existing sales tax with effect from 1.4.2005.

Such tax system has already produced good results — the tax revenue of VAT implementing states has shown an increase of 27.1 percent during the first quarter of 2005-06 over the same quarter of last fiscal year (IRIS, 23 August 2006)[30]. One of the REFORM states, for example Karnataka state has done commendable job in fiscal management during the recent past by controlling the rising fiscal deficit in the 1990s. The fiscal deficits increased marginally from 4276.5 crores in 1999-00 to 6032.8 crores in 2003-04. The reason could be due to that the revenue deficit of the state was declined by 8 percent during the same period (2325.3 crores in 1999-00 to 2135.3 crores in 2003-04). To raise the revenue potentiality, Jharkhand implemented VAT from 1st April 2006, Karnataka from with effect from 01-04-2005 and Uttarakhand from 1st October 2005.

A change in the regime in recent times from cascading types sales tax to taxes based on input-tax credit within taxation of goods, as well as the adoption of a uniform rates of tax has resulted in buoyant revenues. However, the reform agenda is far from complete. If the VAT is considered as a major improvement over the preexisting central excise duty at the national level and the sales tax at the State level, then the goods and services tax (GST) will be a further significant improvement- next logical step towards a comprehensive indirect tax reforms in the country. Keeping this perspective in view Government of India has made announcement to introduce the GST with effect from 1st April, 2010. The Empowered Committee of the State Finance Ministers would work with the GoI to prepare a road map for introduction GST in India.

Interestingly, the Thirteenth Finance Commission which has been constituted in 2007 by the Govt. of India, has been mandated to make recommendation on the impact of the proposed implementation of GST with effect from 1st April 2008 together with its impact on the country' foreign trade. However, the recommendation of the Finance Commission may not be available before end of February 2010.

[30] Parthasarathi Shome, Advisor to the Union Finance Minister wrote in IRIS, 23 August 2006.

Annexure 2:

Basic Statistical Concepts

"Statistics" is a familiar word nowadays. It has two different meanings. In the plural sense, the word implies a set of numerical figures, usually obtained by measurement or counting. These are also collectively known as **data**. In singular sense "statistics" refers to the subject of scientific activity which deals with the theories and methods of collection, analysis and interpretation of such data.

For a simple and meaningful comparison of different data sets it is desirable to represent these data sets by some summary parameters which could be easily comprehended. Some such measures/concepts are discussed below.

Measures of Central Tendency

Generally, observations on a variable have the tendency to concentrate around a value of the variable, and such a value could be used to represent the set of observations on this variable. Based on this analogy, certain measures of central tendency have been identified for representing a whole set of observations on a variable. It is a single figure which describes the entire series of observations with their varying sizes. Since a typical value usually occupies a central position, so that some of the observations are larger and some smaller, these typical values are referred to **measures of central tendency**.[31] According to G.U. Yule, the desirable properties of a satisfactory measure of central tendency are:

- It should be rightly defined;
- It should be based on all observations;
- It should be readily comprehensible;
- It should be easily calculated;
- It should be affected as little as possible by sampling fluctuations; and
- It should readily lend itself to algebraic treatment.

There are three measures of central tendency — Mean, Median and Mode which are discussed below.

Mean or Arithmetic Mean

Arithmetic Mean (AM) of a set of observations is defined as their sum, divided by the number of observations. Arithmetic mean is of two types- simple and weighted. For example, simple AM of first ten natural numbers, i.e., 1, 2, 3, …… 10 will be:

(1+2+3+4+5+6+7+8+9+10)/10 = 55/10 = 5.5

Mean is usually denoted by $\bar{x}$ = sum $(x_i)/n$, where, n is the number of observations and in our example, i= 1, 2, ….. 10.

Similarly, weighted AM of the outcomes of first 15 tosses of a dice will be:

[(1*3)+(2*2)+(3*1)+(4*1)+(5*5)+(6*3)]/15 = 54/15 = 3.6,

provided the event occurrence is as given below, i.e., in terms of outcome and frequency of outcomes.

It is usually denoted by $\bar{x} = \Sigma (f_i x_i)/\Sigma (f_i) = \Sigma(f_i x_i)/N$, where N is the sum of the frequencies of occurrence of each outcome.

MEAN estimates the AVERAGE of a variable based on a set of observations. Excel formula for

[31] These measures of central tendency are also referred to as averages.

Table A2.1: Arithmetic Mean Example: Rolling Dice Frequency

Dice Outcome (xi)	Number of Occurrences (fi)(Frequency)
1	3
2	2
3	1
4	1
5	5
6	3

computing mean of n observations in column A and rows 1 to n in an Excel Worksheet is given by:

Excel Formula for Average: AVE (A1:An)

Median

Median of a set of observations is the value of the middle-most item when they are arranged in order of magnitude. **For example,** the median of first five natural numbers 1,2,3,4,5 will be 3, as it is the most centrally located, even if the extreme values change, i.e., say, 5 is replaced by 10, the Median will remain unchanged at 3.

For a simple frequency distribution table given below, the median is derived by determining (N+1)/2. Here it is 8 and it is greater than the cumulative frequency corresponding to x = 4, but smaller than the next cumulative frequency corresponding to x = 5, hence, the median is 4.

Table A2.2: Arithmetic Mean Example: Rolling Dice Cumulative

Dice Outcome (Xi)	Number of Occurrences (Fi) (Frequency)	Cumulative Frequency
1	3	3
2	2	5
3	1	6
4	1	7
5	5	12
6	3	15 (=N)

In other words, median is the value of x corresponding to cumulative frequency 8. This implies that when all the 15 observations are arranged in order of magnitude, median will be just midway, i.e., eighth observation.

Median for a variable with grouped frequency distribution is given by:

$$\text{Median} = 1_1 + \frac{(N/2) - F}{f_m}\,(c)$$

Where 1_1 is the lower boundary of the median class, N is the total frequency, F is the cumulative frequency preceding the median class (corresponding to 1_l), f_m is the frequency of the median class and "c" is the width of the median class.

Thus, Median gives the value of the middle observation in a set of values. Excel formula for computing median of n observations in column A and rows 1 to n in an Excel Worksheet is given by:

Excel Formula for Median: MEDIAN(A1:An)

Mode

Mode of a set of observation is that value which occurs with the maximum frequency. It is the most typical or fashionable value and at times represents the true characteristic of the frequency distribution as a measure of central tendency.

In case of simple frequency distribution mode can be found by simple inspection only. For example, mode of the observations 2, 5, 8, 4, 3, 5, 4, 2, 4 will be 4 as 4 occurs maximum number of times, i.e., 3. Similarly, for the set of observation 5, 3, 6, 3, 5, 6, there will be no mode as all the

observations occur for the same number of times. Further, for the set of observation 5, 3, 6, 3, 5, 10, 7, 2, there will be two modes, i.e., 3 and 5.

Mode for a grouped frequency distribution is given by:

$$\text{Mode} = 1_1 + \frac{d_1}{d_1 + d_2}\,(c)$$

Where, 1_1 is the lower boundary of the modal class, d_1 is the difference of frequencies in the modal class and the preceding class, d_2 is the difference of frequencies in the modal class and the following class and c is the common width of classes.

Thus, Mode estimates the most frequently occurring, repetitive value in an array or range of data. Excel formula for computing median of n observations in column A and rows 1 to n in an Excel Worksheet is given by:

Excel Formula for Mode: MODE(A1:An)

Measures of Dispersion

The word dispersion is used to denote the "degree of heterogeneity" in the data. It is an important characteristic indicating the extent to which observations vary among themselves. The dispersion of a given set of observation will be zero only when all the observations are same. The wider the discrepancy from one observation to another, the larger will be the dispersion.

Measures of dispersion could be broadly categorized into *Absolute Measures* and *Relative Measures. Range*, *Mean Deviation* and *Standard Deviation/Variance* are some of the mostly used absolute measures of dispersion. On the other hand, *Coefficient of Variation* is the most commonly used relative measure of dispersion. These measures of dispersion are discussed below.

Range

Range is the difference between the largest and the smallest observations. It is simple to compute. However, not very frequently used as it does not take into account all the observations in the set.

For the observations 6, 4, 1, 6, 5, 10, 3, the maximum and the minimum values are respectively 10 and 1. **Hence the range is 9 (=10-1)**.

Mean Deviation

It is also termed as the Mean Absolute Deviation. It is the arithmetic mean of the absolute deviations (i.e., differences) from mean or any other specified value. Although it takes into account all values unlike Range, neglecting the signs makes its algebraic treatment difficult.

Mean Absolute Deviation (MAD) is the average of the sum of absolute deviations from the mean. Symbolically, for n observations on a variable, MAD can be expressed as:

$$\text{Mean Absolute Deviation} = \Sigma\,|X - \bar{X}|/n$$

Excel formula for computing MAD of n observations in column A and rows 1 to n in an Excel Worksheet is given by:

Excel Formula for MAD: AVEDEV(A1:An)

For the data set: 6, 4, 1, 6, 5, 10, 3, the mean is 35/7(= 5) and deviations from the mean are 1, -1, -4, 1, 0, 5, -2, so that absolute deviations (deviations without sign) are 1, 1, 4, 1, 0, 5, 2. **The arithmetic**

mean of these absolute deviations is mean deviations, i.e., 14/7 (= 2).

Standard Deviation

Standard Deviation (SD) is the **square root** of the arithmetic mean of the squares of deviations from the arithmetic mean (AM). The arithmetic mean of the squares of deviations from the AM is referred to as variance. Accordingly, SD is the square root of variance. SD is most useful among all the absolute measures of dispersion because of its several advantages.

SD gives the **root mean square deviation** of a variable while Variance gives the **mean square deviation** of a variable. Symbolically, for n observations on a variable x, Variance and SD can be expressed as:

$$\text{Variance} = \{1/n \, \Sigma \, (x_i - \bar{x})^2\}$$

$$\text{Standard Deviation} = \sqrt{\{1/n \, \Sigma (x_i - \bar{x})^2\}}$$

For the data set 6, 4, 1, 6, 5, 10, 3, the mean is 35/7 = 5 and deviations from mean are 1, -1, -4, 1, 0, 5, -2. **Therefore, Variance and the Standard Deviation will be-**

$$\text{Variance} = \{1^2 + (-1)^2 + (-4)^2 + 1^2 + 0^2 + 5^2 + (-2)^2\}/7 = \{48/7\} = 6.86$$

$$\text{SD} = \sqrt{\text{Variance}} = \sqrt{\{6.86\}} = 2.6$$

Excel formulae for estimating Variance and SD of a variable with n observations in column A and rows 1 to n in an Excel Worksheet are given by:

Excel Formula for Variance: VAR(A1:An)
Excel Formula for SD: STDEV(A1:An)

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Coefficient of Variation

Coefficient of Variation (CV) is the ratio of standard deviation and mean. It can also be expressed in percentage terms by multiplying it by 100, as given below.

Coefficient of Variation = SD/Mean * 100

CV is independent of the unit of measurement. Therefore, it can be used for comparing the dispersion of two or more distributions even when these distributions are expressed in different units, such as observations on one variable in Rupees thousand and on another variable in Rupees million. On the other hand, absolute measures of dispersion cannot be used for comparing the dispersion of two or more distributions given in different units. Moreover, where the means of distributions are widely different, although given in same unit, a relative measure will be more meaningful.

For the data set 6, 4, 1, 6, 5, 10, 3, the mean is 35/7 = 5 and standard deviation is 2.6. Therefore, the Coefficient of Variation will be

CV = (SD/Mean) * 100 = (2.6/5)* 100 = 52

Measures of Association

Till now the discussion was focused on observations on a single variable.[31] We now proceed to measure the relationship or association between two variables. The two mostly used measures of association between two variables are: Covariance and Correlation Coefficient which are discussed below.

Covariance

Covariance is often termed as "conjoint variance" as it captures joint variation of two variables. It would be noted that the covariance of a variable with itself is the same as the variance of the variable. Covariance of two variables x and y is generally denoted by Cov(x, y), and is expressed as follows:

$$\text{Cov}(x, y) = 1/n \, \Sigma \, (x_i - \bar{x})^2 (y_i - \bar{y})^2$$

Mathematically, it is the average of the products of deviations from mean of every data point. Covariance can be positive, negative or zero, while variance is always positive as it is sum of squares as shown below.

$$\text{Variance of } x = \{1/n \, \Sigma \, (x_i - x)^2\}$$
$$\text{Variance of } y = \{1/n \, \Sigma \, (y_i - y)^2\}$$

Excel formulae for estimating Covariance of variables x and y with n observations respectively for x and y in columns A and B, in rows 1 to n in an Excel Worksheet is given by:

Excel Formula for Covariance: COVAR (A1:An,B1:Bn)

Correlation Coefficient

Correlation (also referred to as correlation coefficient) is a measure of the degree of association between two variables. It is usually denoted by alphabet "r". If two variables x and y are so related that variations in the magnitude of one variable is accompanied by variations in the magnitude of the other variable, they are said to be correlated.

If y tends to decrease as x increases, the variables in question are said to be negatively correlated ($r < 0$), as depicted in Figure A2.1. If y tends to increase as x increases, the variables are said to be positively correlated ($r > 0$), as depicted in Figure A2.2. If values of y are not

Figure A2.1: Negative Correlation

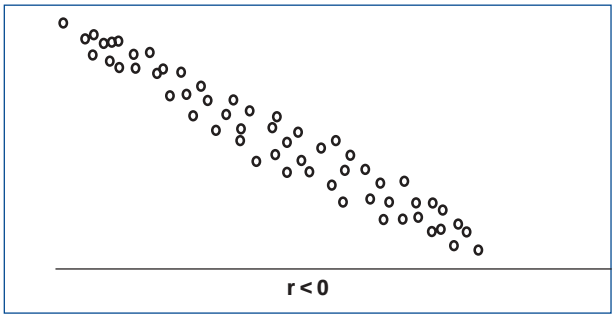
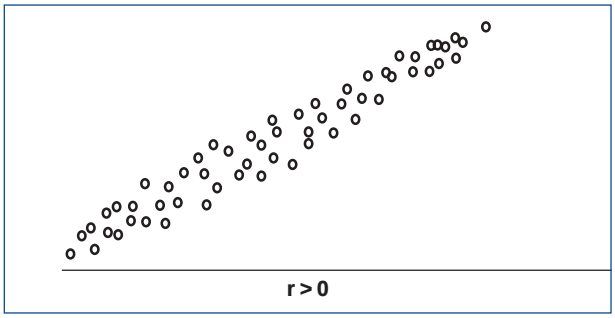


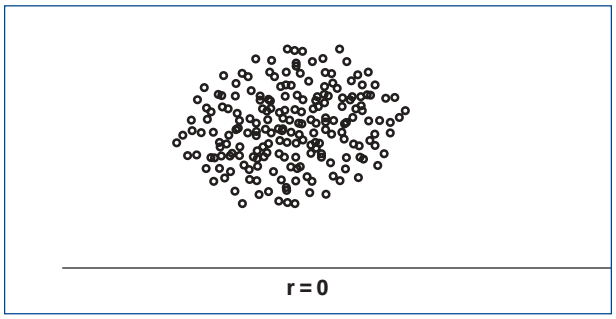
Figure A2.2: Positive Correlation



[31] The statistics developed based on observations on a singe variable are referred to as univariate statistics where just a single variable is involved in the process.

affected as a result of the change in the value of x, they are said to be uncorrelated (r = 0), as depicted in Figure A2.3.

Figure A2.3: No Correlation



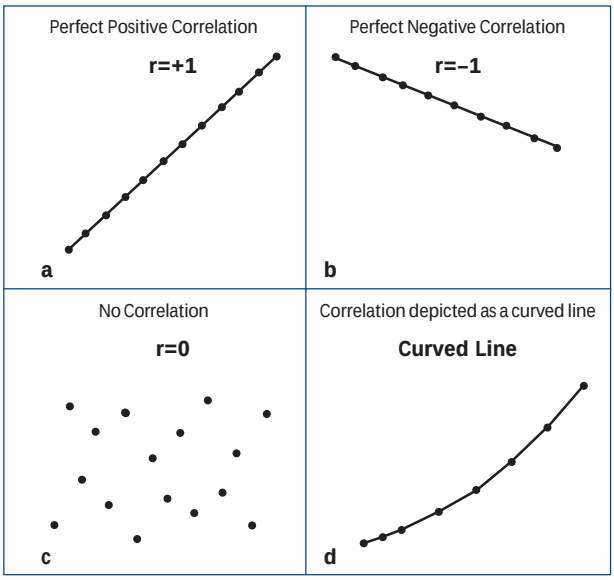
Symbolically, correlation coefficient of x and y can be expressed as:

$$\text{Correlation Coefficient } (r) = \frac{\text{Cov}(x,y)}{\text{SD}(x) * \text{SD}(y)}$$

The above expression is known as Pearson's Product Moment Formula and is used as a measure of linear correlation between x and y. Correlation coefficient is usually denoted by "r", and it is a pure number that is independent of the choice of scale and origin. For example, if u = (x-c)/d and v = (y-a)/b, then correlation coefficient between x and y will be the same as the correlation coefficient between u and v. Thus, it is independent of the units of measurement. The value of correlation lies between (+1) and (-1), i.e., $-1 \leq r \leq 1$.

As depicted in Figure A2.4, when the correlation takes value (+1), the variables are said to be have a perfect positive correlation. Similarly, when the correlation takes value (-1), the variables are said to be have a perfect negative correlation.

Figure A2.4: Scatter Diagram Relationship Types



Excel formulae for estimating Correlation between variables x and y with n observations respectively for x and y in columns A and B, in rows 1 to n in an Excel Worksheet is given by:

Excel Formula for correlation: CORREL (A1:An,B1:Bn)

Exercises on Basic Statistical Concepts

Q.1 Calculate the weighted mean price of a commodity from the following data, assuming that the weights are proportional to the number of units of the commodity sold.

Price per Unit of Commodity	36	40	44	48
No. of Units Sold	14	11	9	6

Q.2 The consumption expenditure of households in 1947, on eight commodities, was found to be as follows: food-348; rent-88; clothing- 97; fuel-65, HH durable goods-71; miscellaneous goods-

35; services-79; drink and tobacco-217. The percentage increase in price for these commodities during 1947 and 1950 was 25, 1, 22, 18, 14, 13, 11 and 4 respectively. Calculate the average percentage increase in the price for the households.

Q.3 The Standard Deviation calculated from a set of 32 observations is 5. If the sum of the observations is 80, what is the sum of squares of these observations?

Q.4 Calculate the Mean Deviation of the following series both from its mean as well as median.

X	10	11	12	13	14
Frequency	3	12	18	12	3

Q.5 The mean and standard deviation of 20 items is found to be 10 and 2 respectively. At the time of checking it was found that the value of one item that was taken to be 8 was incorrect. Calculate the Mean and standard deviation, if

(a) the item with wrong value is omitted, and

(b) the item with wrong value is replaced by 12.

Q.6 Compute the Standard Deviation of household size from the following frequency distribution of 500 households.

Household Size	1	2	3	4	5	6	7	8	9
No. of Households	92	49	52	82	102	60	35	24	4

Annexure A3:

Regression Analysis: Ordinary Least Squares Estimation

Regression analysis is *the process of constructing a mathematical model or function that can be used to predict or determine one variable by another variable*. A simple regression involves two variables and is also called as bivariate (two variables) linear regression. In this most elementary regression models we have a dependent variable, *the variable to be predicted*, usually denoted by *Y* and an independent variable, *the predictor or explanatory variable*, usually denoted by *X*. For predicting the values of Y based on the values of X, the relationship between Y and X needs to be estimated, such as a linear relationship of type:

$$Y = \beta 0 + \beta 1X + \varepsilon \qquad \text{(A3.1)}$$

In this relationship, if values of "β0" and "β1" are estimated, then it could be used for predicting values of Y for given vales of X, by substituting given values of X in this equation. In this specification of the relationship between X and Y, "β0" is referred to as "constant", "β1" is referred to as coefficient of X, and u is an error term. Both "β0" and "β1" are referred to as parameters. A commonly used method of estimating parameters "β0" and "β1" in such relationships is referred to as "Ordinary Least Squares Method" that is discussed below.

Ordinary Least Squares Method (OLS Method)

OLS method of estimation of a relationship between two variables obtains the estimates of parameters of a linear equation such as equation A3.1. In this process of estimation, observations on X and Y are used, and the process minimizes the sum of squares of deviations of the observed points from the estimated line. It is for this reason that this method is known as least squares method of estimation. The underlying idea of least squares is explained below diagrammatically through the Figures A3.1 to A3.3. The line which minimizes the sum of squared deviations is the best fit and is depicted in Figure A3.2.

Before discussing the mathematical formulae for OLS method of estimation, for the sake of clarity, let us take a specific problem to which we intend to apply this technique of analysis. Let us estimate the relationship between tax revenue (say the dependent variable X) and Gross State Domestic Product (GSDP — say the independent or exogenous variable Y) for a state economy. Table A3.1 gives observations on tax revenue and GSDP for the years from 1990 to 2001. It would be noted, by plotting the observations as shown below in Figure A3.4, that tax revenue increases with increase in GSDP, that is, tax revenue depends upon GSDP.

To estimate this relationship between tax revenue (X) and GSDP (Y), we specify a simple

Figure A3.1: Least Squares Example 1

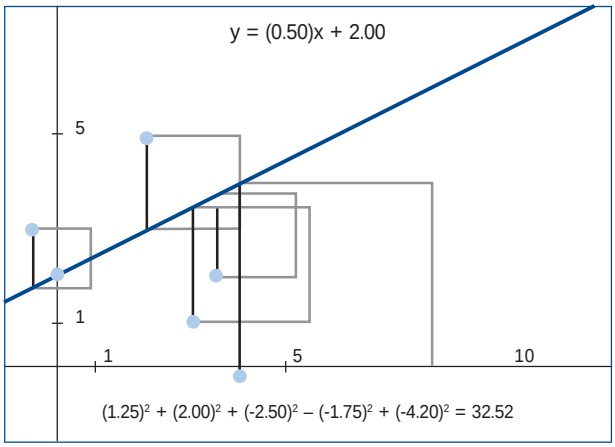


Figure A3.2: Least Squares Example 2

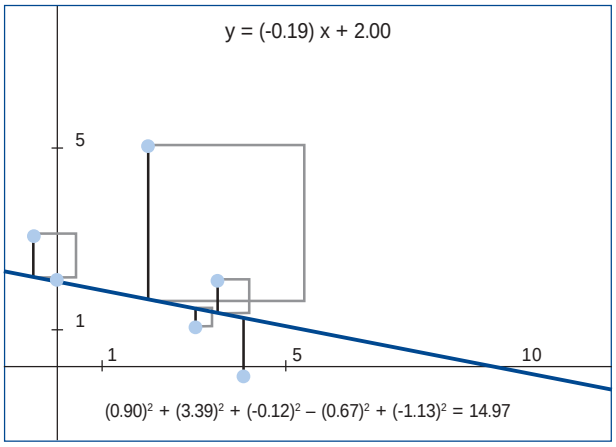
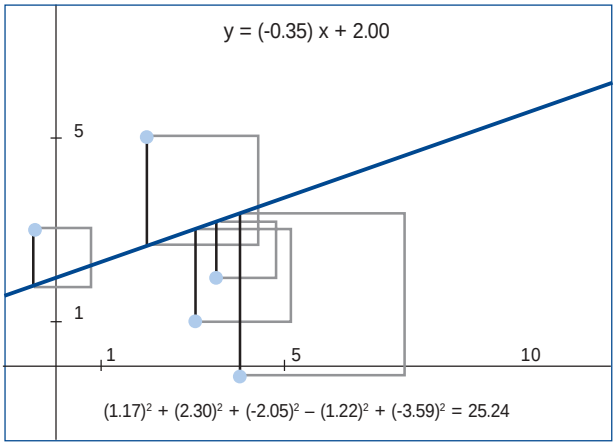


Figure A3.3: Least Squares Example 3

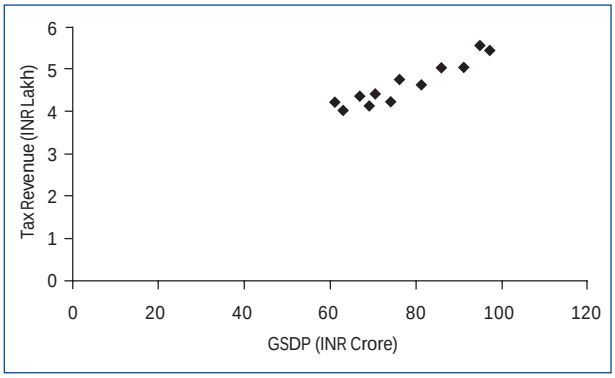


Regression analysis is the process of constructing a mathematical model or function that can be used to predict or determine one variable by another variable. A simple regression involves two variables and is also called as bivariate (two variables) linear regression. In this most elementary regression models we have a dependent variable, the variable to be predicted, usually denoted by Y and an independent variable, the predictor or explanatory variable, usually denoted by X.

Table A3.1: Tax Revenue and GSDP Data – Table of Results

Year	GSDP (INR Crore) (X)	Tax Revenue (INR Lakhs)
1990	61	4.280
1991	63	4.080
1992	67	4.420
1993	69	4.170
1994	70	4.480
1995	74	4.300
1996	76	4.820
1997	81	4.700
1998	86	5.110
1999	91	5.130
2000	95	5.640
2001	97	5.560

Figure A3.4: Tax Revenue and GSDP Data – Scatter Diagram



mathematical function as follows:

$$Y = \beta 0 + \beta 1X + \varepsilon \qquad \text{(A3.2)}$$

Where,
β0 and β1 are population parameters
β0 and β1 are estimated by sample statistics b0 and b1

The last term ε in the above equation takes care of errors in measurement and the factors that affect the dependent variable. It is referred to as error term.

This equation A3.2 could be estimated by using OLS method of estimation. The estimated equation of this Simple Regression Line will be:

$$\hat{Y} = b_0 + b_1 X$$

where :

b_0 = the sample intercept

b_1 = the sample slope

$\hat{Y}$ = the predicted value of Y

The OLS will compute b_0 and b_1 by using the sum of squares of deviations between X and Y (denoted as S_{XY}) and sum of squares of deviations between various values of X and arithmetic mean of X (or X bar) (denoted as S_{XX}). The method utilizes the following formulae:

$$SS_{XY} = \sum (X - \bar{X})(Y - \bar{Y}) = \sum XY - \frac{(\sum X)(\sum Y)}{n}$$

$$SS_{XX} = \sum (X - \bar{X})^2 = \sum X^2 - \frac{\sum X^2}{n}$$

$$b_1 = \frac{SS_{XY}}{SS_{XX}}$$

$$b_0 = \bar{Y} - b_1 \bar{X} = \frac{\sum Y}{n} - b_1 \frac{\sum X}{n}$$

The computation of sums/statistics relevant for obtaining estimates of *b*1 and *b*0 in the Regression Line is shown in Table A3.2.

Using the above values, *b*1 and *b*0 can be obtained as follows:

$$SS_{XY} = \sum XY - \frac{\sum X \sum Y}{n} = 4{,}462.22 - \frac{(930)(56.69)}{12} = 68.745$$

$$SS_{XX} = \sum X^2 - \frac{(\sum X)^2}{n} = 73{,}764 - \frac{(930)^2}{12} = 1689$$

Table A3.2: Computations: OLS Estimation

GSDP (INR Crore) X	Tax Revenue (INR Lakh) Y	X^2	XY
61	4.28	3,721	261.08
63	4.08	3,969	257.04
67	4.42	4,489	296.14
69	4.17	4,761	287.73
70	4.48	4,900	313.60
74	4.30	5,476	318.20
76	4.82	5,776	366.32
81	4.70	6,561	380.70
86	5.11	7,396	439.46
91	5.13	8,281	466.83
95	5.64	9,025	535.80
97	5.56	9,409	539.32

$\Sigma X = 930$ $\Sigma Y = 56.69$ $\Sigma X^2 = 73{,}764$ $\Sigma XY = 4{,}462.22$

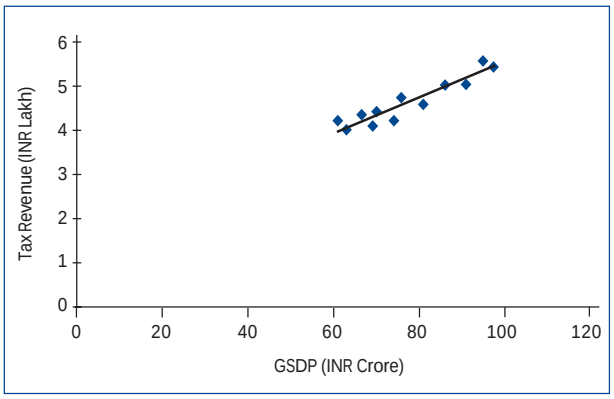
$$b_1 = \frac{SS_{XY}}{SS_{XX}} = \frac{68.745}{1689} = .0407$$

$$b_0 = \frac{\sum Y}{n} - b_1 \frac{\sum X}{n} = \frac{56.69}{12} - (.0407)\frac{930}{12} = 1.57$$

$$\hat{Y} = 1.57 + .0407X$$

This estimated regression line will have an intercept of 1.57 and a slope of 0.0407 that is the coefficient of X variable as depicted below in Figure A3.5. This suggests that revenue increases by 0.0407 lakh rupees following an increase of rupees one crore in GSDP. The intercept indicates that there will be a revenue of rupees 1.57 lakh even if GSDP is nil. This type of scenario could be expected for a commodity tax as the consumption will take place even if GSDP is nil. Such consumption could be financed from accumulated wealth and/or borrowings. However, before using this estimated relationship between tax revenue and GSDP, one

Figure A3.5: OLS Estimation – Scatter Diagram



would be interested in knowing how good is this estimated relationship, and how stable are the estimated parameters to be used for forecasting revenue for the future. This query is addressed through hypothesis testing that is the subject matter of the following sections in this Part.

Table A3.3: OLS Regression Output

Summary Output

Regression Statistics	
Multiple R	0.94820033
R Square	0.89908386
Adjusted R Square	0.88899225
Standard Error	0.17721746
Observations	12

Anova

	df	SS	MS	F	Significance F
Regression	1	2.79803	2.79803	89.092179	2.7E.06
Residual	10	0.31406	0.03141		
Total	11	3.11209			

	Coefficients	Standard Error	t-Stat	P-values
Intercept	1.56979278	0.33808	4.64322	0.0009175
GSDP (INR Crore)	0.0407016	0.00431	9.43887	2.692E-06

Hypothesis Testing of the Model

Given the complex computations involved in estimating a regression line and relevant statistics for testing its goodness of fit and stability of the estimated parameters, it is advisable to use standard computer packages for estimating such relationships. With the computer package EXCEL, the OLS estimation result will be as given in Table A3.3.

In Table A3.3, R square (= 0.899) indicates the extent of variation in the dependent variable that has been explained by the estimated equation (i.e. 89.9 percent), and is referred to as **Coefficient of Determination**. It could take values from 0 to 1. The former value would imply that the estimated equation does not explain any variation in the dependent variable and hence is of no use. The latter value would indicate that all the variation in the dependent variable is explained by the estimated equation. In practice, an estimated equation is considered to be good if R square greater than or equal to 0.90. It is calculated by the computer using sum of squares as follows:

The value 0.899 of Coefficient of Determination is interpreted to mean that 89.9 percent of variation in tax revenue is explained by the variable GSDP itself. It means that remaining

part of the variation, i.e., nearly 11 percent remains unexplained by the model. This 89.9 percent variation is referred to as "Explained Variation" and 11 percent variation is referred to as 'Unexplained Variation' by the model/ equation estimated. A fundamental principle of least squares method is that variation in a

$$SS_{YY} = \sum \left(Y - \overline{Y}\right)^2 = \sum Y^2 - \frac{\left(\sum Y\right)^2}{n}$$

$$SS_{YY} = \text{Explained Variation} + \text{Unexplained Variation}$$

$$SS_{YY} = SSR + SSE$$

$$1 = \frac{SSR}{SS_{YY}} + \frac{SSE}{SS_{YY}}$$

$$R^2 = \frac{SSR}{SS_{YY}}$$

$$= 1 - \frac{SSE}{SS_{YY}}$$

$$= 1 - \frac{SSE}{\sum Y^2 - \frac{\left(\sum Y\right)^2}{n}} \qquad 0 \le R^2 \le 1$$

$$SSE = 0.31434$$

$$SS_{YY} = \sum Y^2 - \frac{\left(\sum Y\right)^2}{n} = 270.9251 - \frac{(56.69)^2}{12} = 3.11209$$

$$R^2 = 1 - \frac{SSE}{SS_{YY}}$$

$$R^2 = 1 - \frac{.31434}{3.11209}$$

$$R^2 = .899$$

dependent variable can be partitioned, or divided into parts, according to the sources of variation.

R square is also known as **Power of the Model,** and its other salient features are:

- The reliability of the estimated model also depends on the number of observations and the number of variables in the model. The technical term used to capture these facts is referred to as 'degree of freedom', that could be explained as follows. If we denote the number of independent variables used in the model by "k" and the number of observations by "n", then the degrees of freedom "df" is given by "n-k". In our above illustration, we have one independent variable (i.e., k=1) and twelve observations (i.e., n= 12), and accordingly, the degree of freedom in above estimated model is eleven (df = n-k =11). In general, the larger the degree of freedom the higher is the reliability of the estimated model.
- Strictly speaking, explanatory power **R^2** of two estimated models with different degrees of freedom is not comparable. For comparing explanatory power of such models, 'Adjusted Coefficient of Variation **($\bar{R}^2$)** is used. This is calculated by the following formula which uses the estimates of variance of error term **"e"** and **Variance of Dependent Variable "Y"**. These estimated values are distinguished by using "^" sign in the formulae below:

The significance of value of statistics such as F-statistic is generally seen at three levels, referred to as level of significance, which indicate the probability that our results might have an error by some percentage. Generally used three levels of significance are 1 percent, 5 percent and 10 percent. One percent level of significance is considered as higher level of significance as it perceives a lower probability of error.

$$R^2 = 1 - \frac{\widehat{Var}(\varepsilon)}{\widehat{Var}(Y)}$$

$$\widehat{Var}(\varepsilon) = s^2 = \frac{\Sigma \hat{\varepsilon}_i^2}{N-k} \qquad Var(\hat{Y}) = \frac{\Sigma (Y_i - \overline{Y})^2}{N-1}$$

$$R^2 = 1 - \frac{s^2}{\widehat{Var}(Y)} \quad \frac{N-k}{N-1} \qquad R^2 = 1 - (1 - R^2) \frac{N-k}{N-1}$$

1. If k = 1, then $R^2 = \bar{R}^2$
2. If k is greater than 1, then $R^2 \geq \bar{R}^2$
3. $\bar{R}^2$ can be negative

In our above illustration, R^{-2} is 0.889 (see Table A3.3).

- It is important also to take into account the fact that overall explanatory power of the model stands to statistical criteria known as statistical significance. Unless a result of regression is statistically significant we cannot draw meaningful policy implications. The statistical significance of the model as well as individual estimated coefficients is important. The statistical significance of the overall explanatory power of the model is revealed through the value of a statistic called as F statistic and it is computed as follows:

$$F_{1,N-2} = \frac{\text{Explained Variance}}{\text{Unexplained Variance}} = \frac{RSS/1}{ESS/(N-2)} = \frac{\hat{\beta}^2 \sum X^2 i}{s^2}$$

$$F_{k-1,N-k} = \frac{RSS}{ESS} \frac{N-k}{k-1} = \frac{R^2}{1-R^2} \frac{N-k}{k-1}$$

The **significance of value of statistics such as F-statistic** is generally seen at three levels, referred to as level of significance, which indicate the probability that our results might have an error by some percentage. Generally used three levels of significance are 1 percent, 5 percent and 10 percent. One percent level of significance is considered as higher level of significance as it perceives a lower probability of error. Similarly, 10 percent level of significance is considered as lower level of significance as it perceives a higher probability of error. Therefore, higher the level of significance, more precise or reliable would be the estimates.

In our above illustration of the relationship between Tax Revenue and GSDP, significance of the model can be tested as follows. The null hypothesis Ho and the alternative hypothesis H1 are as given below:.

Ho : $\mathbf{R^2} = 0$
H1 : $\mathbf{R^2} \neq 0$

In our example of tax revenue and GSDP referred to above, estimated value of F-statistic is 89.09. The theoretical value of F-Statistic at 5 percent level of significance for k (=1) and n-k-1 (=10) degrees of freedom is 4.96, as shown below in the Box. Clearly, estimated value of F-Statistic is higher than its theoretical value at 5 percent level of significance, implying that null hypothesis Ho is not accepted. This means that a significant variation in the tax revenue is explained by the estimated model, and it is safe to use it for policy purposes.

$df_{reg} = k = 1$
$df_{err} = n - k - 1 = 12 - 1 - 1 = 10$
$\alpha = .05$
$F_{.05,1,10} = 4.96$
If $F > 4.96$, reject H_0
If $F \leq 4.96$, do not reject H_0

Hypothesis Testing of Individual Coefficients

While F statistic discussed above provides overall significance of the model (or its explanatory power $\mathbf{R^2}$, the **significance of individual variable (or its estimated coefficient)** is seen through "t" statistic. It is

computed by the following formulae, which uses the standard error of estimates and the sum of squares deviations depicted in the box below.

$$t = \frac{b_1 - \beta_1}{S_b}$$

where: $S_b = \frac{S_e}{\sqrt{SS_{xx}}}$

$$S_e = \sqrt{\frac{SSE}{n-2}}$$

$$SS_{xx} = \sum X^2 - \frac{(\sum X)^2}{n}$$

β_1 = the hypothesized slope

df = $n - 2$

Using a significance level of (1 percent, 5 percent or 10 percent), we test the hypothesis which states that **value of estimated coefficient is zero or nonzero statistically.** For this purpose, computed/estimated value of 't-Statistic' is compared with a theoretical value of 't-Statistic' that is generally provided in statistical tables in most of the books on elementary statistics.

Testing significance of independent variable in our above illustration can be explained as follows. The null hypothesis H_0 and the alternate hypothesis H_1 are as given below:

$$H_0: \beta_1 = 0$$

$$H_1: \beta_1 \neq 0$$

The estimated value of the coefficient of X (GSDP), i.e., β_1 is 0.0407 and the absolute value of its t statistic that is |t | is 9.38. The theoretical value of t-statistic at 5 percent level of significance for 10 degrees of freedom is 2.228 as shown below. Clearly, the estimated value of t-statistic is higher than its theoretical value implying that the null hypothesis, that is, $\beta_1 = 0$ is rejected. This means that the dependent variable (GSDP) has a statistically significant impact of the tax revenue, and the coefficient of the dependent variable is reliable for policy purposes.

$df = n - 2 = 10 - 2 = 10$

$\alpha = .05$

$t_{.025,10} = 2.228$

If $|t| > 2.228$, reject H_0

If $-2.228 \leq t \leq 2.228$, do not reject H_0

Comparing Functional Forms

Typically, **R^2** or adjusted **R^2** is used for comparing different models. The former is used where degrees of freedom across the models remain unchanged while the latter is used where degrees of freedom vary across the models. This rule is applicable as long as dependent variable "Y" is not transformed. However, if Y is transformed, then R^2, adjusted or not, is not strictly comparable across the models. For example, suppose a choice is to be made between a linear and a double-log linear functional form given below:

$$Y = \beta_0 - \beta_1 X + \varepsilon \qquad \text{(A3.3)}$$

$$1n(Y) = \beta_0 - \beta_1 \ln(X) + \varepsilon \qquad \text{(A3.4)}$$

Both the above equations can be estimated by applying OLS method as both these equations are linear in Y and ln (Y) respectively but **R^2** of these equations would not be comparable as the variation in Y is completely different from that in ln(Y). For comparing such transformed equations, quasi-R^2 is used. Mathematically, it can be expressed as:

$$\text{quasi-}R^2 = 1 - \frac{\sum_i (Y_i - \exp(1n(\hat{Y}_i)))^2}{\sum_i (Y - \overline{Y})^2}$$

The easiest way to calculate the quasi-R^2 in this case is to use the double-log regression results to forecast log of Y, then calculate the anti-log (exponential) of this forecast, and regress Y on the result. The R^2 from this regression is the quasi-R^2. (Warning: the adjusted-R^2 from this regression is incorrect. Why? But that does not matter because we have used the same number of observations and independent variables for both regressions).

Irrespective of the functional form chosen, one has to be very careful about using regression results in forecasting Y outside the range covered by the sample.

Exercises on Regression Analysis for Forecasting/ Estimation

Q.1 The following table gives the values of X and Y

X	1	2	3	4	5
Y	4	2	3	4	2

1. Calculate the least squared equation.
2. How many degrees of freedom are present?
3. For x=3.5, what is the value of x?
4. For y= 10, what is the value of x?

Run a regression using a computer program and then verify the results by applying the formulae.

Q.2 Using the following data set, estimate the growth rates of State Domestic Product of West Bengal using the functions named as trend, growth, linest and logest in excel worksheet. Analyze how these growth rates are different?

Year	State Domestic Product of West Bengal at 1990-91 Prices	X (Time Interval)
	Y	T
1993-94	1,499	1
1994-95	1,576	2
1995-96	1,546	3
1996-97	1,525	4
1997-98	1,565	5
1998-99	1,605	6
1999-00	1,672	7
2000-01	1,652	8
2001-02	1,722	9
2002-03	1,688	10
2003-04	1,715	11
2004-05	1,775	12
2005-06	1,872	13

Q.3 Gross Fiscal Deficits of individual states are given below. Analyze the trends in gross fiscal deficit by using OLS estimation.

Q.4 The following Table gives the quantities in bushels of wheat produced per acre, Y, resulting from the use of various amounts (in pounds) of fertilizer used per acre of land X, over a period of ten years. Plot the scatter diagram, and using OLS

State	Gross Fiscal Deficit (INR Crore)					
	1998-99	1999-00	2000-01	2001-02	2002-03 RE	2003-04 BE
Andhra Pradesh	5705.6	4976.4	7305.9	6723.1	7341.4	7338.1
Arunachal Pradesh	55.4	59.3	210.1	274.7	159.9	56.7
Assam	338.2	1605.8	1540.0	1448.1	2351.2	3123.1
Bihar	2378.9	6107.7	4884.4	4010.3	4911.4	4107.3
Chhattisgarh	0.0	0.0	-47.5	1060.7	1526.9	1922.9
Goa	269.1	341.0	412.9	412.9	418.2	421.9
Gujarat	5619.0	6791.9	7987.6	6510.7	10686.3	9457.2
Haryana	2240.4	2132.5	2265.2	2739.6	2202.7	2135.4
Himachal Pradesh	1661.5	189.6	1844.8	1511.4	2346.2	2502.0
Jammu & Kashmir	1054.4	1338.6	2166.4	748.1	1245.0	660.2
Jharkhand	0.0	0.0	0.0	1642.7	2187.5	1290.6
Karnataka	3112.1	4276.5	4219.3	5869.9	5759.8	6032.8
Kerala	3012.2	4536.7	3877.8	3269.4	2845.0	3306.9
Madhya Pradesh	4126.7	3911.4	2712.1	3649.4	4569.5	4000.3
Maharashtra	7462.4	11706.2	8975.8	10897.7	13454.4	8421.5
Manipur	106.2	655.8	234.4	340.3	450.7	295.7
Meghalaya	147.3	209.1	249.4	221	380.9	291.2
Mizoram	132.3	179.2	375.3	422.4	314.6	281.1
Nagaland	243.2	249.1	358.8	366.0	392.3	312.2
Orissa	2915.5	3746.1	3325.3	3964.2	3181.4	4219.2
Punjab	3779.3	3194.8	3903.7	4958.9	4772.1	5108.4
Rajasthan	5150.9	5361.2	4312.8	5748.4	6504.6	7415.0
Sikkim	146.9	92.5	50.5	66.9	51.9	45.4
Tamil Nadu	4777.1	5382.3	5076.0	4739.5	8105.7	6514.5
Tripura	118.4	290.3	445.2	538.2	753.0	635.6
Uttarakhand	0.0	0.0	136.4	424.2	1843.9	1958.7
Uttar Pradesh	11632.5	11098.7	10179.6	9898.2	13315.2	19803.2
West Bengal	7109.1	11666.4	10920.2	11804.0	11990.6	12384.0
NCT Delhi	959.2	1381.5	1609.7	1733.1	2573.9	2134.6
All States	**74253.8**	**91480.6**	**89532.1**	**95994.0**	**116636.2**	**116175.7**

Source: Minister of Finance, Government of India (2004).

find the elasticity of wheat production with respect to fertilizer use.

Wheat Production by Year

Year	X	Y
1980	8	40
1981	10	44
1982	12	46
1983	14	48
1984	16	52
1985	18	58
1986	22	60
1987	24	68
1988	26	74
1989	32	80

Q.5 Karnataka Computronics is a small computer firm in Bangalore that produces lap tops. Through a market survey, it has found the numbers of computers it can sell at different prices. It has also conducted an internal study and found what it can supply at those prices. The information is as follows:

Laptop Supply and Demand

Price in USD	Quantity Demanded	Quantity Supplied
1200	4,475	1,250
1300	4,300	1,440
1400	4,120	1,680
1500	3,935	1,850
1600	3,720	2,100
1700	3,550	2,325
1800	3,400	2,550
1900	3,210	2,820
2000	2,990	3,100
2100	2,725	3,460
2200	2,460	3,800
2300	2,150	4,200
2400	1,900	4,650
2500	1,680	5,000

Using OLS fit the demand curve for laptops and analyze the significance of coefficients. Also, estimate a supply curve and calculate the equilibrium quantity and price.

Q.6 Using 100 observations from the labor market in the Ulhas Nagar, an attempt was made in 1993 to explore a possible link between yearly earnings (in INR lakhs) of individuals in the age group 25-54 and their levels of education (x1) and years of experience (x2). The regression output was as follows:

Regression Output – Year of Education and Income

Constant	- 6.176
R Squared	0.315
X1 Coefficient	0.978
Std Err of X1 Coefficient	0.4006
X2 Coefficient	0.124
Std Err of X2 Coefficient	0.0561

Analyze the results to derive the implication for education policy.

Q. 7 A study was made about factors that might affect birth rate in India. It was thought that birth rate (number of yearly births per thousand of population) will depend upon the level of literacy among women, extent of urbanization, family planning effort reflected by budget allocation, and the infant morality rate. The data

for 17 Indian states were taken from 1981 census. The regression results are:

Regression Results: Factors Effects Infant Morality

Independent Variables	Coefficient	t-statistic
Literacy (l)	-0.2	2.6
Urbanization (u)	-0.015	0.18
Family Planning Effort (e)	-0.06	1.25
Infant Morality (m)	0.044	1.94
Constant Term = 45.16, R^2 = 0.71, n = 17 .		

From these results: write the regression equation and analyze the importance of various factors as well as policy implications.

Annexure 4:

Regression Analysis: Implications of Relaxing Assumptions of OLS Method

As discussed in earlier Parts, the objective in regression analysis is to obtain the estimates of the unknown parameters "a" and "b" in the following type of equation for a given set of observations on y and x:

$$y_i = a\,x_i + b + u_i \qquad \text{(A4.1)}$$

The OLS estimation of the above model is based on the following assumptions:

- The relationship is linear as shown in equation A4.1;
- The error terms, i.e., u_is are normally distributed with zero mean, i.e., $E(u_i) = 0$ and variance σ^2;
- Variance of the error terms are the same, i.e., common variance, i.e., Var. $(u_i) = \sigma^2$;
- Errors are independent of one another, i.e., independence of u_is for all i not equal to j; and
- Errors are independent of the values of x.

The objective of this Part is to discuss the consequences of these assumptions and how we could have better estimates by relaxing the assumptions of the OLS method. OLS method gives Best Linear Unbiased Estimates (BLUE) provided its assumptions hold good. However, it is not so when its assumptions do not hold good. In this Chapter, an attempt is made to describe a mechanism to detect the problem and suggest remedial measures.

We will relax, one by one, the following three major assumptions of OLS that are prerequisites to make the OLS estimates BLUE:

(1) Constant variance which is also known as Homoscedasticity, relaxing this assumption would imply dealing with presence of HETEROSCEDASTICITY;

(2) The error terms are uncorrelated, relaxing this assumption would mean dealing with dependence of the error terms in the model, i.e., with AUTOCORRELATION; and

(3) Absence of linear relation between independent variables, relaxing this assumption would mean dealing with existence of linear relationship between the independent variables in a multiple regression model, that is MULTICOLLINEARITY

The first of the assumptions that an OLS estimate makes is the assumption of constant variance of the error/residual term. One can see from the Figure A4.1 that the variation in the consumption of various excisable commodities during April 1993 and December 2002 are different. While there are instances where the seasonal or monthly variation in a year may remain constant over time but it may also undergo a change. Table A4.1 provides the detail of the variation in monthly consumption in various categories of alcoholic beverages over a year, for each of the years from 1993-94 to 2003-04. One can notice the fluctuation in the variance in monthly consumption of excisable products in Karnataka over the years. The objective here is to draw attention to the fact that often the assumption of the constant variance made under OLS estimation may not hold good.

Heteroscedasticity

The violation of the assumption of Homoscedasticity (that is of presence of Heteroscedasticity or nonconstant variance) may not have direct impact on the values of the

Figure A4.1: Alcohol Volume Graphs from Karnataka Excise Data

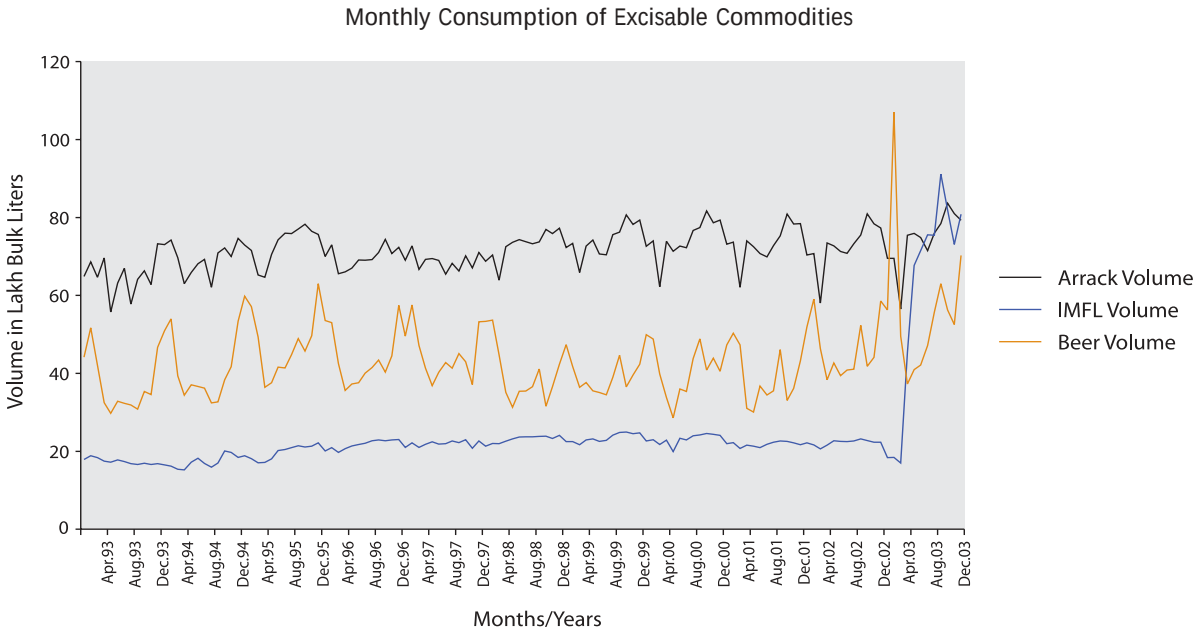


Table A4.1: Monthly Variation in Alcohol Consumption in Karnataka

Month/Year	Arrack	IMFL	Beer
Apr. 93 to March 94	23.22	0.51	51.92
Apr. 94 to March 95	16.54	2.51	61.13
Apr. 95 to March 96	19.95	3.21	72.45
Apr. 96 to March 97	7.38	1.40	48.85
Apr. 97 to March 98	4.40	0.50	39.50
Apr. 98 to March 99	13.86	0.84	57.36
Apr. 99 to March 00	17.58	1.25	16.62
Apr. 00 to March 01	25.37	1.72	43.96
Apr. 01 to March 02	23.31	0.36	50.62
Apr. 02 to March 03	32.75	0.46	53.51
Apr. 03 to March 04	50.32	750.04	341.22

coefficients, but it affects the validity of the statistical tests (F-test and t- test), the confidence interval, and the level of significance.

The detection of Heteroscedasticity could be done by various methods. However, the commonly used test is the Goldfeld and Quandt Test. Where the observations are split into two groups — one corresponding to larger values of x and the other corresponding to smaller values of x, provided the sample is not too large. Separate regressions for each set of observations are fitted and F-test applied to test the equality of error variances. The F-Statistic is obtained as the ratio of variance of residuals from the OLS regression with the larger value observations to the variance of residuals from the OLS regression with the smaller observations. If the value of the computed F-Statistic is lower than the theoretical value of F-Distribution at 1 percent or 5 percent level of significance with the specified degrees of freedom, then the hypothesis of homoscedasticity, i.e., constancy of variances is accepted, and reject otherwise.

We consider the data on revenue from motor vehicles tax and number of vehicles registered during the period between 1991-92 and 2004-05

in Karnataka (Table A4.2). To test for the presence or absence of heteroscedasticity, we divide the observations into two groups, as mentioned earlier. After dividing the set of observations into two groups, the divided data sets are as shown below in Tables A4.3 and A4.4. We now run OLS regression separately for the two groups. We get the values of σ^2 of residuals from the second group (with the higher values of x) as 20766.03 and that from the first group (with lower values of x) as 4938.49. Thus the F-ratio for test is
F = 20766.03/4938.49 = 4.20. The theoretical value of F-Statistic from F-Distribution Tables, at 1 percent level of significance with 6 and 6 degrees of freedom is 8.47. Since estimated F-Statistic (4.20) < 8.47, we accept the null hypothesis that the variance is constant, i.e., the residuals are homoscedastic.

In case the problem of heteroscedasticity is identified, this can be overcome normally by some kind of a mathematical transformation of the variables involved, such as log-linear transformation, cube root of the values of the variables, or square root of the values of the variables. This is illustrated in Figure A4.2 by plotting the log volume of monthly consumption of excisable commodities- beer, arrack and IMFL. A comparison of Figure A4.2 with Figure A4.1 reveals that the extent of variation in the plot has reduced with the logarithmic transformation of actual level of consumption of these commodities. In general, one has to do some kind of hit and trial exercise with alternative transformations (cube root, square root, logarithm, negative reciprocal etc.) to identify the transformation that reduces the variation significantly that would minimize the problem of heteroscedasticity in the Model.

Table A4.2: Revenue from Motor Vehicles and Vehicles Registered in Karnataka

Year	Revenue (Y)	Vehicles Registered (X)
1991-92	228	0.103835
1992-93	221	0.140164
1993-94	259	0.086871
1994-95	291	0.250428
1995-96	456	0.235749
1996-97	330	0.28447
1997-98	449	0.197865
1998-99	403	0.25607
1999-00	477	0.273816
2000-01	522	0.339105
2001-02	749	0.308631
2002-03	721	0.550557
2003-04	851	0.415356
2004-05	951	0.516874

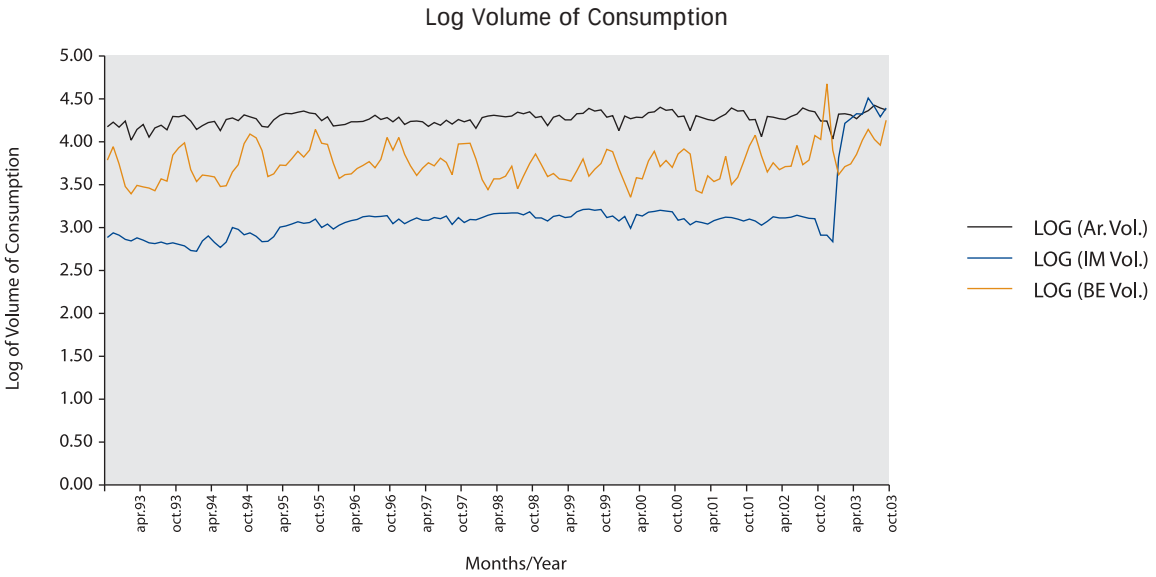
Table A4.3 Revenue from Motor Vehicles with Lesser Number of Vehicles Registered

Year	Revenue (Y)	Vehicles Registered (X)
1991-92	228	0.103835
1992-93	221	0.140164
1993-94	259	0.086871
1994-95	291	0.250428
1996-97	330	0.28447
1998-99	403	0.25607
1997-98	449	0.197865

Table A4.4: Revenue from Motor Vehicles with Higher Number of Vehicles Registered

Year	Revenue (Y)	Vehicles Registered (X)
1995-96	456	0.235749
1999-00	477	0.273816
2000-01	522	0.339105
2001-02	749	0.308631
2002-03	721	0.550557
2003-04	851	0.415356
2004-05	951	0.516874

Figure A4.2: Log Value of Volume of Consumption



Autocorrelation

An OLS estimate presumes that Autocorrelation can be identified either by plotting the residuals or by analyzing the trend in it. The residuals are independent of each other. In other words, there is no relationship among the residuals generated form each of the observations. Existence of a pattern between the residuals is the problem referred to as autocorrelation, which is also known as serial correlation. The serial correlation could be positive or negative. This problem of autocorrelation is a serious problem and it occurs frequently in OLS estimation.

Plot pattern will reveal how the residuals are related. Either each of the residual is negatively correlated with the previous one or it could be positively correlated with the previous residual. It is also possible to have correlation between residuals more than one time apart. For example, if the data are seasonal but the seasonality has not been incorporated in the model, there may be correlation with a seasonal lag.

We here consider the data from our previous example where we have put the revenue from motor vehicles tax against the number of vehicles registered over a period of 14 years, i.e., between 1991-92 and 2004-05 (Table A4.2). We will now run the OLS regression of Y on X using the equation y = a + b x, where x is the number of motor vehicles registered (MVR) and y is the revenue from motor vehicles tax (MVT). The details of the regression output along with the estimated (predicted) values of MVT and its residuals (actual — estimated) are given in Table A4.5. The Figure A4.3 shows the plot of the residuals of MVT against MVR. One can see the negative correlation between the previous residual and the following residual. The successive upward and downward movements of the residuals show that they are negatively correlated. Thus there is presence of autocorrelation.

Table A4.5: Summary of Regression Output and Residuals

Summary Output

Regression Statistics	
Multiple R	0.864438688
R^2	0.747254246
Adjusted R^2	0.726192099
SE	124.32214
Observations	14

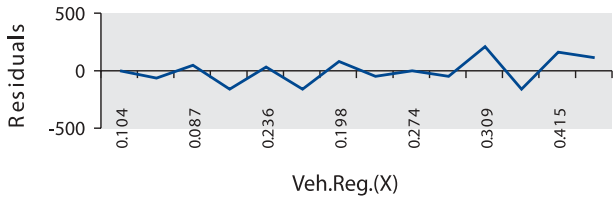
ANOVA

	df	SS	MS	F	Sig. F
Regression	1	548356.155	548356.2	35.47854	6.65E-05
Residual	12	185471.934	15455.99		
Total	13	733828.089			
	Coefficients	**SE**	**t Stat**	**P-value**	**Lower 95%**
Intercept	74.43736599	77.7902285	0.956899	0.3575	-95.053
Veh. Reg.(X)	1481.234053	248.679968	5.956387	6.65E-05	939.407

Residual Output

Observation	Predicted MV Rev. (Y)	Residuals
1	228.2413039	-0.2413039
2	282.0530558	-61.053056
3	203.1136494	55.8863506
4	445.3798474	-154.37985
5	423.6368127	32.3631873
6	495.804017	-165.80402
7	367.5217418	81.4782582
8	453.7369699	-50.73697
9	480.0229494	-3.0229494
10	576.7312395	-54.731239
11	531.5921129	217.407887
12	889.9411424	-168.94114
13	689.6768172	161.323183
14	840.0483408	110.451659

Figure A4.3: Veh.Reg.(X) Residual Plot

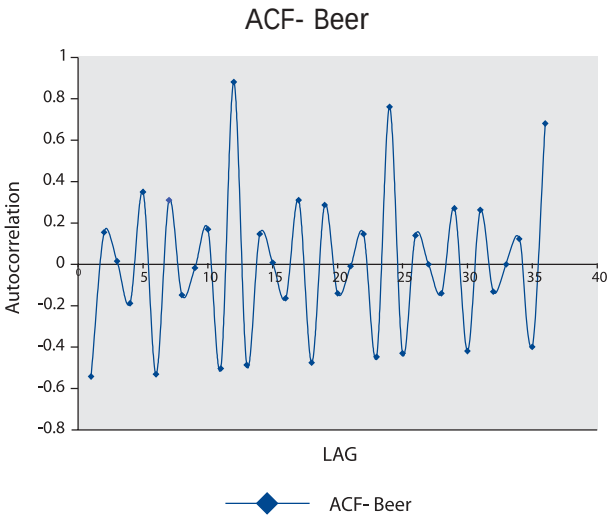


The alternative approach to checking for autocorrelation is to compute the autocorrelation function (ACF) and plot it as a correlogram. While correlation is the relationship between two variables, autocorrelation is the correlation between a variable and a series generated from various lags of the variable. A correlogram is a graphical representation of the autocorrelation function which is nothing but the autocorrelations with lags of period 1, 2, 3, ……. etc. A correlogram helps us visualize the ACF quickly and easily.

Let us try to generate an autocorrelation function and plot the correlogram with data on monthly Consumption of Beer in Karnataka. We will provide the detail data after the exercises to the section. Here in this section we provide the results derived from this data. One can see that

both for monthly beer consumption and monthly IMFL consumption, the autocorrelation at lags 12, 24 and 36 are positive and higher than the autocorrelation at other lags, showing the pattern of seasonality in the consumption of beer and IMFL in Karnataka. Figure A4.4 shows the ACF of beer consumption.

Figure A4.4: ACF Generated from Monthly Beer Consumption Data



For testing the existence of autocorrelation in a model Durbin-Watson (DW) Test is the most commonly used test. However, DW Test Statistic has certain limitation in the sense that it measures the correlation only with a lag of one period (referred to as lag 1). This however, suffices our purpose in the sense that existence of autocorrelation with lag 1 largely ensures autocorrelation in other lag periods as well and vice-versa. The value of DW-Statistic lies between 0 and 4:

$$DW = \sum (u_t - u_{t-1})^2 / \sum u_t^2 \qquad (A4.2)$$

The alternative approach to checking for autocorrelation is to compute the autocorrelation function (ACF) and plot it as a correlogram. While correlation is the relationship between two variables, autocorrelation is the correlation between a variable and a series generated from various lags of the variable. A correlogram is a graphical representation of the autocorrelation function which is nothing but the autocorrelations with lags of period 1, 2, 3, ……. etc. A correlogram helps us visualize the ACF quickly and easily.

Where, u_t is the error term at time "t" and u_{t-1} is the error term with lag 1.

Any standard econometric analysis package provides the value of the DW-Statistic like the EViews, STATA etc. However, the OLS estimates generated from MS-Excel fail to provide the DW-Statistic directly. However, one can obviously derive the value of the DW-Statistic from the values of the residuals obtained after running an OLS regression as shown in Table A4.6.

From the above, one can derive the value of the DW-Statistic as the ratio of the sum of square of the first differences of errors and sum of the square of errors, as follows:[32]

$DW = \sum(u_t - u_{t-1})^2 / \sum u_t^2 = 554295.45/185471.93 = 2.988$

This shows that there is a negative correlation between the error terms as shown in the graph earlier as well. After detection one can use the Generalized Least Squares technique to remove autocorrelation with lag 1.

[32] The software package EViews does give DW-Statistic along with OLS estimates. The usage of EViews is illustrated in Annexure 6. It also allows use of Generalized Least Squares for removing autocorrelation.

Table A4.6: Computation of DW-statistic

Observation	Predicted MV Revenue (Y)	Residuals	Square of Residuals	$u_t - u_{t-1}$	Square $(u_t - u_{t-1})$
1	228.2413039	-0.24	0.06		
2	282.0530558	-61.05	3727.48	-60.81	3698.07
3	203.1136494	55.89	3123.28	116.94	13674.82
4	445.3798474	-154.38	23833.14	-210.27	44211.87
5	423.6368127	32.36	1047.38	186.74	34872.96
6	495.8040170	-165.80	27490.97	-198.17	39270.24
7	367.5217418	81.48	6638.71	247.28	61148.52
8	453.7369699	-50.74	2574.24	-132.22	17480.87
9	480.0229494	-3.02	9.14	47.71	2276.63
10	576.7312395	-54.73	2995.51	-51.71	2673.75
11	531.5921129	217.41	47266.19	272.14	74059.70
12	889.9411424	-168.94	28541.11	-386.35	149265.57
13	689.6768172	161.32	26025.17	330.26	109074.52
14	840.0483408	110.45	12199.57	-50.87	2587.91
Summation			185471.93		554295.45

Multicollinearity

If two variables are associated, they can be called collinear. In regression analysis, multicollinearity is the name given to any one of the following conditions:

- Two explanatory variables are perfectly correlated;
- Two explanatory variables are highly correlated (i.e., the correlation coefficient between them is close to +1 or -1);
- A linear combination of some of the explanatory variables is highly correlated with another explanatory variable; and
- A linear combination of one subset of explanatory variables is highly correlated with a linear combination of another subset of explanatory variables.

It is not possible to conduct OLS estimation if two or more of the explanatory variables are perfectly correlated. Moreover, even if there is multicollinearity which is not perfect, the stability of the regression coefficients is affected due to the existence of multicollinearity. Unlike the problem of Heteroscedasticity and Autocorrelation, multicollinearity is not a problem of the model as a whole. This becomes a major problem when the coefficient of the individual variable under consideration is of concern and importance. It could be easily detected by computing the Correlation Matrix of the explanatory variables in a model. For understanding the problem of the existence of multicollinearity in a model and its detection, let us consider an example where revenue from beer is considered to be a function of urbanization, purchasing power and market size. The explanatory variables could be represented by:

- Percentage of urban population to total population (UPTP) — a representative of the extent of urbanization in the state;
- Per capita net state domestic product (PCNSDP) - a representative of the purchasing power; and
- Total population (TP) — a representative of the size of the market.

The relevant data set is presented in Table A4.7. Now, our objective here is to detect whether the representative indicators considered for the three of the above explanatory variables are in anyway correlated to each other. To do this we generate the correlation matrix of the explanatory variables as shown in Table A4.8.

From Table A4.7, it would be noted that the explanatory variables are highly correlated among themselves. In this scenario, OLS estimation of coefficients these explanatory variables will not give unbiased estimates.

The problem of multicollinearity can be avoided by dropping some of the correlated explanatory variables and/or substituting these by alternative proxy variables which are likely to be uncorrelated with the other explanatory variables included in the model. In our example, population variable figures in some way or the other in all the explanatory variables, contributing to multicollinearity. In this case, it would be advisable to drop the highly correlated variable, i.e., UPTP.

Exercise

Annexure A4A.1 to this Part provides the yearly revenue collected on various excisable commodities like arrack, IMFL and beer in the state of Karnataka during the period between 1980-81 and 2004-05. Also provided are the figures for four explanatory variables like percent of urban population to total population (UPTP); per capita net state domestic product at current prices (PCNSDP); total population (TP) and total urban population (TUP). Check the

Table A4.7: Consumption of Beer and Explanatory Variables

Year	Beer	UPTP	PCNSDP	TP
1980-81	14.14	27.44	1520	3.67
1981-82	16.01	27.62	1707	3.74
1982-83	17.55	27.81	1855	3.81
1983-84	25.41	28	2192	3.89
1984-85	29.15	28.2	2416	3.96
1985-86	35.16	28.39	2495	4.04
1986-87	36.22	28.59	2810	4.12
1987-88	41.43	28.78	3195	4.20
1988-89	47.87	28.78	3620	4.33
1989-90	67.11	28.98	4044	4.4
1990-91	88.02	30.96	4605	4.49
1991-92	80.67	31.25	5877	4.56
1992-93	111.56	31.55	6331	4.63
1993-94	122.88	31.85	7838	4.71
1994-95	118.03	32.16	8960	4.78
1995-96	150.34	32.46	10217	4.86
1996-97	145.43	32.77	11670	4.94
1997-98	178.06	33.09	12832	5.02
1998-99	232.9	33.40	15396	5.10
1999-00	302.58	33.72	16345	5.18
2000-01	386.73	33.97	17806	5.27
2001-02	655.8	34.26	17518	5.35
2002-03	641.64	34.55	18521	5.43
2003-04	1126.6	34.85	20552	5.51
2004-05	1278.81	35.15	22583	5.59

Table A4.8: Correlation Matrix

	UPTP	PCNSDP	TP
UPTP	1.000	0.957	0.987
PCNSDP	0.957	1.000	0.962
TP	0.987	0.962	1.000

presence of heteroscedasticity, autocorrelation and multicollinearity in the model and suggest methods of analyzing the impact of these explanatory variables on revenue from various excisable commodities.

Annexure A4A.1: Revenue from State Excise by Item: Karnataka

(INR Crore)

Year	UPTP	PCNSDP	TP	TUP	Arrack	Beer	IMFL
1980-81	27.44	1520	3.67	1.00	59.99	14.14	2.62
1981-82	27.62	1707	3.74	1.03	85.19	16.01	2.44
1982-83	27.81	1855	3.81	1.05	91.80	17.55	3.30
1983-84	28.00	2192	3.89	1.08	99.76	25.41	5.25
1984-85	28.20	2416	3.96	1.11	115.52	29.15	6.00
1985-86	28.39	2495	4.04	1.14	108.68	35.16	6.71
1986-87	28.59	2810	4.12	1.17	115.45	36.22	8.69
1987-88	28.78	3195	4.20	1.20	135.45	41.43	8.76
1988-89	28.78	3620	4.33	1.23	137.56	47.87	10.20
1989-90	28.98	4044	4.40	1.26	175.20	67.11	10.53
1990-91	30.96	4605	4.49	1.39	304.21	88.02	8.89
1991-92	31.25	5877	4.56	1.43	405.55	80.67	13.07
1992-93	31.55	6331	4.63	1.46	376.18	111.56	14.59
1993-94	31.85	7838	4.71	1.50	473.11	122.88	17.19
1994-95	32.16	8960	4.78	1.54	547.30	118.03	20.13
1995-96	32.46	10217	4.86	1.58	585.72	150.34	27.13
1996-97	32.77	11670	4.94	1.62	608.90	145.43	25.04
1997-98	33.09	12832	5.02	1.66	605.09	178.06	24.93
1998-99	33.40	15396	5.10	1.70	678.80	232.90	29.45
1999-00	33.72	16345	5.18	1.75	799.24	302.58	25.08
2000-01	33.97	17806	5.27	1.79	987.83	386.73	44.42
2001-02	34.26	17518	5.35	1.83	1025.87	655.80	138.87
2002-03	34.55	18521	5.43	1.88	1108.34	641.64	159.07
2003-04	34.85	20552	5.51	1.92	1151.55	1126.60	176.32
2004-05	35.15	22583	5.59	1.95	1194.76	1278.81	193.57

Notes:
UPTP: Percentage of urban population to total population.
PCNSDP: Per capita net state domestic product at current prices.
TP: Total population.
TUP: Total urban population.
IMFL: Indian made foreign liquor.
Arrack: Deshi *(Indian) liquor.*