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ALLAMA IQBAL OPEN UNIVERSITY, ISLAMABAD

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Assignment No. 1 (Units 1–5)

Total Marks: 100 Pass Marks: 40

SOLVED ASSIGNMENT GUIDE

(For Study & Reference)

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Note: This guide is prepared for study and reference purposes only. Students are advised to read the relevant units of the course book carefully and to write their assignments in their own words. Copying this guide word for word is discouraged; use it to understand the concepts, the structure of a good answer and the way arguments are developed, and then prepare your own original assignment.

Question 1: The Present Value Criterion for Optimal Resource Allocation (20 Marks)

Question as printed: Explain the present value criterion for optimal resource allocation? (20)

Introduction

Governments constantly face a problem that private firms also face, but on a much larger scale: resources are scarce, projects are many, and the benefits and costs of a public project are spread over a long period of time. A dam, a motorway, a power plant or a school building costs a great deal today, while its benefits arrive gradually over twenty, thirty or even fifty years. A rupee of cost incurred today and a rupee of benefit received twenty years from now are plainly not the same thing, so they cannot simply be added together and compared. The present value criterion is the standard technique of cost–benefit analysis that solves this problem. It converts all future benefits and costs into their equivalent value today, by the process called discounting, and then judges a project by whether the present value of its benefits exceeds the present value of its costs. This answer explains the logic of time preference and discounting, states the criterion in its net present value and benefit–cost ratio forms, works through a complete numerical example, and then examines the difficult question of choosing the discount rate and the limitations of the criterion.

Why the Future Must Be Discounted: Time Preference and the Opportunity Cost of Capital

Discounting rests on two foundations. The first is positive time preference: individuals and societies prefer a rupee today to a rupee tomorrow, because present consumption can satisfy urgent wants, because the future is uncertain, and because a rupee held today can be invested and grow. The second foundation is the productivity of capital, or opportunity cost: resources committed to one project are withdrawn from other uses in which they would have earned a

return. If the market rate of interest is 10 per cent, Rs 100 today becomes Rs 110 after one year and Rs 121 after two years. Working backwards, Rs 110 receivable after one year is worth exactly Rs 100 today, and Rs 100 receivable after ten years at 10 per cent is worth only about Rs 38.55 today. The amount 1/(1 + r)^t, where r is the discount rate and t the number of years, is called the discount factor; multiplying a future sum by this factor gives its present value. Figure 1 shows how sharply the present value of a fixed future sum falls as the date of receipt moves further away.

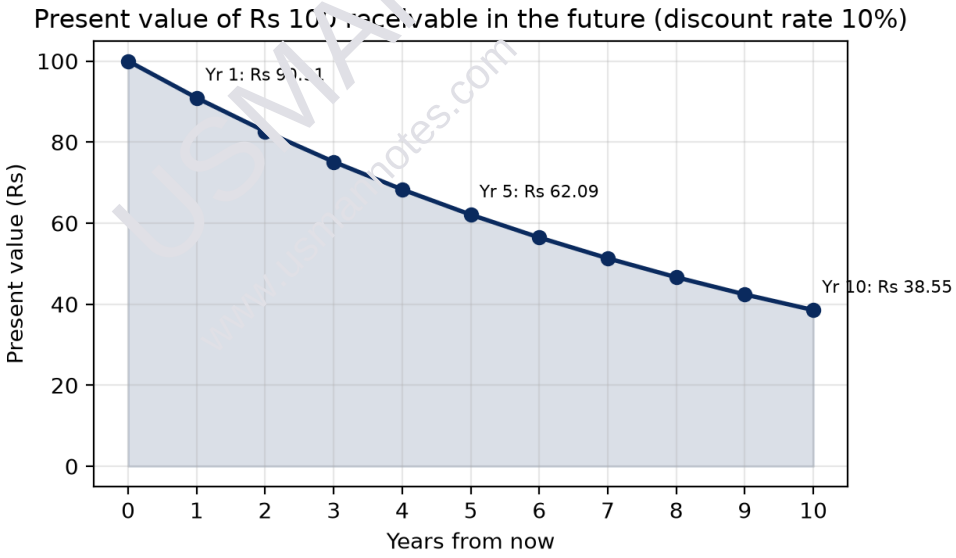


Figure 1: Present value of Rs 100 receivable at different future dates, discounted at 10 per cent per year.

Statement of the Criterion

Let a project yield benefits B_t and involve costs C_t in each year t of its life, from year 0 to year n, and let r be the chosen discount rate. The net present value (NPV) of the project is NPV = Σ [(B_t − C_t) / (1 + r)^t], summed over all years of the project life. The decision rule of the present value criterion is simple: accept the project if its net present value is positive, that is, if

the present value of benefits exceeds the present value of costs; reject it if the NPV is negative; and, when funds are limited and projects compete, rank acceptable projects by their net present value so that the available resources go first to the uses that add most to social wealth in present-value terms. An equivalent form of the same test is the benefit–cost ratio: the present value of benefits divided by the present value of costs must exceed one. A closely related measure, the internal rate of return, is the discount rate at which NPV becomes exactly zero; a project passes the test if its internal rate of return exceeds the rate at which the government can borrow or the social rate of discount. All three measures spring from the same present-value logic, although, as noted below, they can occasionally rank mutually exclusive projects differently, in which case the net present value rule is the theoretically correct one.

A Worked Example

Suppose the government is considering a small irrigation project. It costs Rs 100,000 immediately (year 0) and is expected to raise farm incomes by Rs 40,000 in year 1, Rs 45,000 in year 2 and Rs 50,000 in year 3, after which the scheme is handed over to the water users. Undiscounted, the benefits total Rs 135,000 against a cost of Rs 100,000, which looks attractive; but that comparison ignores timing. Discounting at 10 per cent, as shown in Table 1, the present value of the benefit stream is Rs 111,119.46, so the net present value is +Rs 11,119.46 and the benefit–cost ratio is 111,119.46 / 100,000 = 1.11. The project therefore passes the present value test: even after allowing fully for the time value of money, society gains more than it gives up. If the same flows were discounted at a much higher rate, the verdict could reverse, which is why the choice of discount rate — taken up below — is so consequential.

Table 1: Present value calculation for the irrigation project (discount rate 10 per cent)

Year	Benefit (Rs)	Discount factor 1/(1.10)^t	Present value (Rs)
0 (cost)	−100,000 (cost)	1.0000	−100,000.00
1	40,000	0.9091	36,363.64
2	45,000	0.8264	37,190.08
3	50,000	0.7513	37,565.74
Total	135,000	—	Net present value = +11,119.46

The Choice of the Discount Rate

The criterion itself does not dictate which rate to use, and economists have debated this question for decades. Three candidates dominate the discussion. The first is the market rate of interest on government borrowing, which measures the direct financial cost of funds. The second is the social opportunity cost of capital: the return that the displaced private investment would have earned, which is usually higher than the government borrowing rate because private returns are taxed and risky. The third is the social rate of time preference: the rate at which society itself is willing to trade future consumption for present consumption, which many argue is lower than market rates because individuals are short-sighted and because the government must also weigh the interests of future generations, who cannot vote or bid in markets. The practical difference is large: a low rate favours long-lived projects such as dams, forests and climate protection, whose benefits lie far ahead, while a high rate favours quick-yielding projects and can make almost any long-gestation project look unworthy. Many governments therefore publish an official test discount rate and require sensitivity analysis, repeating the calculation at higher and lower rates to see whether the decision is robust.

Role in Optimal Resource Allocation

Used properly, the present value criterion pushes public resources towards their most valuable uses in three ways. First, it imposes a common yardstick: projects in irrigation, health, roads and education, whose outputs are otherwise incomparable, can all be expressed in present-value rupees and ranked. Second, it disciplines project design, because engineers must show that extra spending on a grander design adds more in discounted benefits than in discounted costs — at the optimum scale of a project, the marginal present value of benefits just equals the marginal present value of costs. Third, it protects the future from being either plundered or over-privileged: costs and benefits are compared fairly across generations once a defensible social discount rate is chosen, and wasteful projects that merely look impressive in undiscounted totals are exposed. In budgetary practice the criterion is applied through cost–benefit analysis in planning commissions and finance ministries, including in Pakistan, where development projects are appraised on PC-I forms that require economic and financial rates of return to be reported.

Limitations and Criticisms

The criterion is powerful but not complete, and a good answer must note its limits. (1) It requires all benefits and costs to be measured in money, yet many public benefits — a life saved, a cleaner river, national defence — have no market price and must be valued by shadow prices that involve judgement. (2) It is silent about distribution: a project with a positive NPV may enrich the well-off and burden the poor, and the standard rule counts a rupee to a rich man the same as a rupee to a poor man unless distributional weights are deliberately introduced. (3) The result is sensitive to the discount rate, as the example showed, so the

technique can be manipulated by choosing a convenient rate. (4) It handles risk and uncertainty only imperfectly; expected values may hide the danger of catastrophic failure. (5) Irreversible effects, such as the destruction of a unique ecological site, sit awkwardly in a framework built on reversible monetary trade-offs. For these reasons the present value criterion should be treated as an aid to judgement, not a substitute for it.

Conclusion

To conclude, the present value criterion is the cornerstone of rational public investment choice. By discounting future benefits and costs at an appropriate rate and accepting projects whose net present value is positive, the government allocates scarce resources to the uses that promise the greatest addition to social welfare over time. Its worked logic is straightforward, as the irrigation example demonstrated, but its responsible use requires care in valuing non-market effects, choosing the social discount rate, and attending to distribution and risk. Combined with those qualifications, it remains the most defensible single rule for optimal resource allocation in the public sector.

Question 2: Nature and Characteristics of Public Goods (20 Marks)

Question as printed: Discuss the nature and characteristics of public goods. (20)

Introduction

One of the central reasons why governments exist in a market economy is that certain goods and services — called public goods — cannot be supplied satisfactorily, or at all, by private markets. National defence, street lighting, flood control, clean air and the rule of law are

familiar examples: once they are provided, everyone benefits, whether or not they have paid. The modern theory of public goods begins with Paul Samuelson, who in 1954 gave the concept its precise form, and it was developed further by Richard Musgrave, who distinguished the allocation problems such goods create for the budget. This answer explains the nature of a pure public good, examines its two defining characteristics — non-rivalry in consumption and non-excludability — together with the free rider problem they generate, distinguishes pure public goods from private and mixed goods, and discusses how the Samuelson condition determines their optimal supply and why government provision financed by taxation becomes necessary.

The Nature of a Public Good

A pure public good is a good whose consumption by one person does not reduce the amount available to anyone else, and from whose benefits no one in the relevant community can feasibly be excluded. Samuelson expressed this by saying that each individual's consumption of such a good leads to no subtraction from any other individual's consumption of it. National defence is the textbook case: the protection enjoyed by one citizen of a country does not diminish the protection enjoyed by another, and once the country is defended, even a citizen who contributed nothing cannot be left undefended. A lighthouse, a flood embankment, a weather forecast and basic scientific knowledge share the same nature. Notice that "public" in this context describes the consumption properties of the good, not its ownership: a publicly owned factory may produce purely private goods such as shoes, while a privately built lighthouse still has public-good properties. What matters is rivalry and excludability, not who happens to own the producing asset.

Characteristic 1: Non-Rivalry in Consumption

In the consumption of a private good, rivalry is complete: a loaf of bread eaten by one person cannot be eaten by another, so the total stock is divided among consumers and the quantities consumed by everyone add up to the total supplied. A public good behaves in the opposite way. The same unit of the good is simultaneously available to all: one more person watching a fireworks display, listening to a public broadcast or walking under street lights adds nothing to the cost of provision. In technical terms, the marginal cost of admitting an additional consumer to an already-provided public good is zero. This has a striking implication for efficiency. For a private good, efficiency requires each consumer's marginal rate of substitution to equal the marginal rate of transformation. For a public good, since everyone consumes the same quantity, efficiency requires the sum of all individuals' marginal rates of substitution to equal the marginal rate of transformation — the famous Samuelson condition, ΣMRS = MRT. Prices cannot perform this summation, because each person would pay a different personalised price (a Lindahl price) reflecting his own marginal valuation, and no single market price can clear such a market.

Characteristic 2: Non-Excludability

The second characteristic is that exclusion is impossible or prohibitively costly. A seller of private goods can simply refuse to hand over the good to a non-payer; the exclusion principle is what makes markets work. But a resident who refuses to pay for flood protection cannot be excluded from the protection of the embankment that guards his street, and a firm that contributes nothing towards national defence is defended all the same. Where exclusion is technically possible but very expensive — fencing and policing an entire coastline, for instance

— the good remains effectively non-excludable. Non-excludability breaks the link between payment and benefit on which market exchange depends, and it leads directly to the most famous consequence of public goods, the free rider problem.

The Free Rider Problem

Because benefits cannot be withheld from non-payers, each rational individual has an incentive to understate his true demand and let others pay. He becomes a free rider, enjoying the good without contributing. If only a few people behave this way the good may still be provided, but if everyone reasons identically — as they tend to do in large groups — voluntary contributions collapse far below the level needed, and the good is under-provided or not provided at all. This is a genuine market failure, not a failure of human character: even public-spirited citizens cannot tell how much others will give, and no voluntary scheme can reveal true preferences, because each person's best strategy is to conceal them. Small groups can sometimes overcome the problem through social pressure and repeated dealing, which is why village communities manage shared wells and watch rotas; but for a nation of millions, compulsion through taxation is the only reliable financing device. Taxation converts an unenforceable voluntary contribution into a legal obligation, and the political process substitutes, however imperfectly, for the missing market demand curve.

Public Goods, Private Goods and Mixed Cases

Pure public goods and pure private goods are the two poles of a spectrum, and most real goods lie between them. Table 1 sets out the contrast and the important intermediate categories. Goods that are non-rival but excludable — a cable television signal, a toll motorway with light

traffic, a patented invention — are called club goods or toll goods: markets can supply them, but pricing above the zero marginal cost of an extra user creates inefficiency and congestion eventually makes them rival. Goods that are rival but non-excludable — fish in the open sea, grazing on common land, groundwater — are common-pool resources; here the problem is reversed, and over-use rather than under-provision is the danger. Goods supplied publicly because of strong external benefits, such as education and vaccination, are private in consumption but merit public support; Musgrave called such interventions merit goods policy. Local public goods, like a municipal park, are public only for a limited community, and their efficient scale of provision is a question for local government.

Table 1: Public goods compared with private and mixed goods

Feature	Pure private good	Pure public good	Club / common-pool goods
Rivalry in consumption	Fully rival: one person's use reduces others'	Non-rival: extra consumer costs nothing	Club: non-rival until congestion; Common pool: rival
Excludability	Easy and cheap	Impossible or too costly	Club: excludable; Common pool: non-excludable
Free rider problem	Absent	Severe	Moderate (club) / over-use (pool)
Market provision	Efficient in principle	Fails or badly under-provides	Partial; needs rules or charges
Examples	Bread, clothing, haircut	Defence, lighthouse, flood control	Cable TV, toll road; fisheries, commons

Implications for Government and Financing

The characteristics of public goods explain both why the state must step in and how it should organise provision. Because markets fail, the government normally finances pure public goods

from general taxation and provides them free at the point of use, charging a zero price that matches the zero marginal cost of consumption. Provision need not mean production: the state may finance a good but contract its production to private firms, as with much defence equipment. The quantity to provide is, in principle, set by the Samuelson condition — expand the good until the sum of citizens' marginal benefits equals marginal cost — and in practice by cost–benefit analysis and democratic budgeting. Two difficulties persist: preference revelation, since no mechanism perfectly induces citizens to state their true valuations (though economists have designed demand-revealing schemes, they are rarely practical at national scale), and the possibility of government failure, where bureaucratic or political incentives distort provision. Neither difficulty overturns the central conclusion: without collective action, goods with these characteristics will be supplied far below the social optimum.

Conclusion

In conclusion, a public good is defined by its consumption properties — non-rivalry and non-excludability — and these two characteristics explain everything else about it: the zero marginal cost of an additional user, the summation rule for its optimal quantity, the free rider problem, and the failure of voluntary market supply. Recognising where a good lies on the spectrum between the purely private and the purely public poles allows policy to be designed intelligently — markets where exclusion and rivalry hold, charges and clubs where exclusion alone is feasible, regulation for common pools, and tax-financed public provision where both defining characteristics of the pure public good are present.

Question 3: Principles for Funds Allocation to Divisible and Lumpy Projects (20 Marks)

Question as printed: Explain principles for funds allocation to divisible and lumpy projects? (20)

Introduction

Every budget is an exercise in rationing: the funds available to a government are always smaller than the list of worthwhile projects competing for them. The planning problem is to divide the given outlay among projects so that the total social benefit is as large as possible. The theory of this division, however, differs sharply according to the physical nature of the projects. Some projects are divisible — they can be expanded or contracted in small steps, like a road-maintenance programme, a textbook scheme or an extension service, where each additional rupee buys a little more of the same thing. Others are lumpy or indivisible — they must be built whole or not at all, like a bridge, a dam or a hospital, where half a bridge is worth nothing. This answer states the equi-marginal principle that governs divisible projects, explains why lumpiness breaks that simple rule, sets out the principles — ranking by benefit–cost performance, attention to thresholds, complementarity, sequencing and balanced packages — that guide allocation when projects are lumpy, and illustrates the difference with a numerical comparison.

The Equi-Marginal Principle for Divisible Projects

For divisible projects the governing principle is the equi-marginal rule, borrowed from the theory of consumer and firm behaviour and applied to the budget. Funds should be shifted from one project to another whenever a rupee moved yields more benefit in its new use than it

loses in its old use, and this shifting should continue until the marginal benefit per rupee is equal in every project that receives funds. Formally, if MB_i is the marginal benefit of the last rupee spent on project i, optimality requires MB_1 = MB_2 = ... = MB_n for all funded projects, with unfunded projects showing a marginal benefit below this common level even for their first rupee. The rule works because of diminishing marginal benefit: the first rupees spent on any project meet the most urgent needs and yield the most, while later rupees serve progressively less valuable purposes. In present-value language the same rule says: expand each divisible project until the marginal present value of benefit per rupee of marginal cost is equalised across the whole programme. A planning office applying this principle needs, for each project, a schedule of marginal returns — in practice estimated from cost–benefit studies — and then allocates the budget in small tranches, always to the use with the highest marginal return, until the funds are exhausted.

Why Lumpy Projects Break the Simple Rule

A lumpy project cannot be taken in small tranches. It has a threshold or minimum viable scale: a bridge must reach the far bank, a power station must be completed before it generates a single unit, and a hospital without its operating theatre is a warehouse. Three consequences follow. First, marginal analysis at the point of decision is impossible in the usual sense; the choice is discrete — build or do not build — so the relevant comparison is between the total (or average) benefit–cost performance of the whole project and the performance of the best alternative use of the same block of funds. Second, indivisibility creates the problem of the remainder: after funding one large project, the leftover funds may be too small for the next lumpy project, so the ranking of projects by ratio alone can leave money idle or force a poor combination; the

planner must compare whole packages or combinations of projects that fit the budget, not merely individual ratios. Third, lumpy projects are frequently complementary: a dam is worth much more with its canal network, and a port with its connecting railway, so projects must be evaluated as clusters whose joint benefits exceed the sum of their separate benefits, and sequenced so that each stage is in place when the next needs it.

Principles for Allocating Funds to Lumpy Projects

From these features, practical principles for lumpy projects can be stated. (1) Appraise each candidate as a whole by net present value and benefit–cost ratio, using discounted values, and require a positive NPV at the official discount rate before it enters the eligible list. (2) Rank eligible projects by benefit–cost ratio or NPV per rupee of capital, but then test combinations: choose the package of whole projects, fitting within the budget, that maximises total NPV — even if this means passing over the single highest-ratio project in favour of two slightly lower-ratio projects that together use the funds better. (3) Respect technical thresholds and gestation periods: never fund a lumpy project below its minimum viable scale, and phase large projects over several budgets with committed tranches so that half-finished structures do not decay. (4) Evaluate complementary projects jointly and sequence them deliberately, funding enabling works — access roads, transmission lines — in step with the main investment. (5) Allow for regional and social balance where the constitution or policy demands it, but record the efficiency cost of doing so openly. (6) Keep a contingency margin, because lumpy projects are notorious for cost overruns, and a reserve prevents one project from cannibalising all others mid-stream. Table 1 contrasts the two allocation problems side by side.

Table 1: Funds allocation — divisible versus lumpy projects

Aspect	Divisible projects	Lumpy (indivisible) projects
Nature	Can be expanded in small steps	Must be built whole or not at all
Governing rule	Equi-marginal benefit per rupee	Whole-project NPV; best fitting package
Decision unit	The marginal rupee / tranche	The complete project
Key risk	Spreading funds too thinly	Idle remainders, half-built assets
Examples	Maintenance, textbooks, extension work	Dams, bridges, hospitals, power stations

A Numerical Illustration

Suppose a district has Rs 100 million to allocate. Divisible programme A (road maintenance) yields marginal benefits per Rs 10 million tranche of 16, 14, 12, 10, 8 and 6 million rupees of present-value benefit, while divisible programme B (school materials) yields 15, 13, 11, 9, 7 and 5. Applying the equi-marginal rule, the planner funds tranches in descending order of marginal benefit: 16 (A), 15 (B), 14 (A), 13 (B), 12 (A), 11 (B), 10 (A), 9 (B), 8 (A), 7 (B) — ten tranches exhausting the Rs 100 million, with the marginal benefit of the last rupee approximately equal (between 7 and 8) in both programmes. Now replace programme B with a lumpy project: a bridge costing the full Rs 100 million with a present value of benefits of Rs 150 million, i.e. an NPV of Rs 50 million. Tranches and margins are irrelevant; the choice is the whole bridge (NPV Rs 50 million) against the best divisible package (whose combined NPV from the ten tranches above is 16+15+14+13+12+11+10+9+8+7 = Rs 115 million of benefits over Rs 100 million of cost, an NPV of only Rs 15 million, if each tranche's figure is read as its gross benefit). On these figures the lumpy bridge wins outright — a verdict no marginal calculation could have reached, reached instead by comparing complete alternatives. If instead the bridge cost Rs 60 million

with benefits of Rs 88 million (NPV Rs 28 million), the planner would compare packages: bridge plus the best Rs 40 million of divisible tranches against the all-divisible package — exactly the combination test described above.

Practical Difficulties and Safeguards

Both sets of principles assume that benefits can be estimated honestly, which in practice is the weakest link. Sponsoring departments systematically overstate benefits and understate costs of their pet lumpy projects, because a bridge or dam is politically visible while maintenance is not; this political economy bias explains the familiar pattern of impressive new structures alongside decaying existing assets. Safeguards include independent appraisal by a planning commission, standardised shadow prices and discount rates, publication of appraisal assumptions, and post-completion evaluation comparing promised with actual returns. A further practical rule is to protect divisible maintenance of existing assets before committing to new lumpy construction, since the marginal return to maintaining what already exists is often the highest in the whole budget — a direct application of the equi-marginal principle across the lumpy–divisible divide. Finally, where uncertainty is high, flexibility has value: divisible and modular projects can be adjusted as information arrives, whereas a lumpy commitment is irreversible, which argues for an extra margin of caution — a higher required NPV — before indivisible projects are approved.

Conclusion

To conclude, funds allocation follows one logic with two techniques. The underlying logic is always to maximise the social benefit obtained from a limited budget. Where projects are divisible, the technique is the equi-marginal principle: shift funds until the marginal benefit per

rupee is equal everywhere. Where projects are lumpy, margins do not exist at the point of decision, so the planner appraises whole projects by net present value, ranks them, tests the combinations that fit the budget, respects minimum viable scales and complementarities, and sequences construction over time. A budget process that applies each technique where it belongs — and guards both against inflated appraisals — comes closest to the optimal allocation of public funds.

Question 4: Alternative Concepts of Tax Incidence and Their Measurement (20 Marks)

Question as printed: Discuss the alternative concept of tax incidence. How are they measured? (20)

Introduction

The person who hands tax money to the government is very often not the person whose real income is finally reduced by the tax. A shopkeeper pays sales tax to the treasury but recovers it in the price charged to customers; an employer pays a payroll tax but may recoup it through lower wages. The study of who ultimately bears a tax — the theory of tax incidence — is therefore one of the oldest and most important branches of public finance, because the fairness and the economic effects of a tax system depend on its real, not its legal, burden. This answer distinguishes the elementary concepts of impact, shifting and incidence, then develops the main alternative concepts of incidence used in modern analysis — specific and general equilibrium incidence, absolute, differential and balanced-budget incidence, and short-run

versus long-run incidence — and finally explains the principal methods by which incidence is measured, from price-and-elasticity analysis to econometric and effective-tax-rate studies.

Impact, Shifting and Incidence: The Basic Distinctions

Three terms must be kept apart. The impact of a tax is its first resting place: the person legally liable who pays it to the government, as the importer pays customs duty or the firm remits sales tax. Shifting is the process by which that person passes the burden onwards through price changes — forward shifting onto buyers through higher prices, or backward shifting onto suppliers and workers through lower input prices and wages. The incidence of the tax is its final resting place: the person whose real income is reduced and who cannot shift the burden any further. Musgrave added a further useful notion, the economic incidence or effects, covering the changes in production, effort and investment that a tax induces beyond the mere transfer of money. Dalton's classical account treated shifting as occurring along the line of exchange, governed by the relative elasticities of demand and supply: the less elastic side of the market bears the larger share, a result that can be stated precisely — the consumer's share of a specific tax equals $E_s / (E_s - E_d)$, where E_s is the elasticity of supply and E_d the (negative) elasticity of demand. If supply is perfectly elastic or demand perfectly inelastic, the whole tax is shifted forward to consumers; if demand is perfectly elastic, none of it can be.

Alternative Concept 1: Statutory versus Economic Incidence

The first alternative is between statutory (or formal) incidence and economic (or effective) incidence. Statutory incidence simply records who is legally assigned the tax and is the concept used in tax law and revenue accounts. Economic incidence asks the substantive question:

whose real income is lower, compared with the situation without the tax, once all price and wage adjustments have worked through? The two diverge systematically. An excise on cigarettes is statutorily paid by manufacturers but economically borne mainly by smokers because demand is inelastic; a tax on employers' payroll contributions is statutorily a business cost but is widely believed to fall largely on workers through lower wage growth. All serious incidence analysis works with the economic concept, and the gap between the two is precisely what makes the subject non-trivial.

Alternative Concept 2: Specific (Partial Equilibrium) and General Equilibrium Incidence

The classical analysis, associated with Marshall and Dalton, is a specific or partial equilibrium approach: it traces the burden of one tax in one market, holding everything else constant, using the elasticity formula given above. The modern approach, founded by Harberger's 1962 analysis of the corporation income tax, is general equilibrium incidence: a tax in one sector sets off movements of capital and labour between sectors, changes the prices of factors and products throughout the economy, and may end up burdening people far removed from the taxed market. Harberger showed that a tax on corporate capital in the United States, though statutorily paid by companies, could fall on owners of capital in general — corporate and non-corporate alike — because capital migrates until after-tax returns are equalised. The partial approach remains useful for excises on single commodities; the general approach is indispensable for broad taxes on income, capital and payrolls, and it has changed policy conclusions — for instance, by showing that the burden of a tax nominally on one industry can be spread across all owners of a factor of production.

Alternative Concepts 3 and 4: Absolute, Differential and Balanced-Budget Incidence; Short Run and Long Run

Musgrave systematised the comparison underlying every incidence statement, because a burden can only be defined relative to some alternative. Absolute incidence examines a single tax change while government spending and other taxes are held constant — a hypothetical that isolates the tax but ignores the deficit it implies. Differential incidence compares two taxes raising the same revenue: it asks, for example, how the distribution of burden changes if an income tax is replaced by a consumption tax of equal yield, holding the budget otherwise unchanged; this is the most policy relevant concept for tax reform. Balanced-budget incidence studies a tax together with the expenditure it finances, recognising that the benefit side of the budget also affects welfare and distribution — a tax that looks regressive alone may be part of a strongly progressive fiscal operation when the spending it funds serves the poor. Finally, incidence differs between the short run and the long run: in the short run, fixed contracts, sticky wages and immobile capital trap the burden where the tax first falls, while in the long run prices, wages, asset values and locations adjust — a property tax may be capitalised into lower house prices, shifting its burden to whoever owned the property when the tax was announced. Any complete incidence study must state which of these concepts it is using; results that appear contradictory in the literature often differ only because different concepts have been applied.

How Incidence Is Measured

Measurement proceeds by several complementary methods. (1) Analytical price analysis: for commodity taxes, the pass-through of the tax into consumer prices is estimated from the

elasticity formula or observed directly from price data before and after a tax change; if the market price rises by the full amount of the tax, forward shifting is complete. (2) Econometric estimation: researchers regress prices, wages or factor returns on tax changes, ideally using natural experiments — for example, comparing wages in regions or industries differentially affected by a payroll tax reform — to identify who gained and who lost. (3) Computable general equilibrium (CGE) models: economy-wide models in the Harberger tradition simulate a tax change through all markets simultaneously and report the resulting changes in the real incomes of household groups, which is the standard tool for major reforms such as introducing a value added tax. (4) Effective tax rate and microsimulation studies: using household income and expenditure surveys, analysts compute the taxes actually borne by each income decile — assigning indirect taxes by consumption patterns and direct taxes by income sources, under stated shifting assumptions — and express the burden as a percentage of income; this yields the familiar verdicts that a tax is progressive, proportional or regressive. (5) Capitalisation studies measure how expected future taxes are reflected in asset prices, for instance in land and housing values. In every method the assumptions about shifting do much of the work, so honest measurement reports results under alternative assumptions rather than pretending to a single exact figure.

Conclusion

To conclude, tax incidence is not one concept but a family of them, and clarity about which is in use is the first requirement of sound analysis. The elementary distinction between impact, shifting and final incidence opens the subject; the contrasts between statutory and economic incidence, between partial and general equilibrium analysis, and among absolute, differential

and balanced-budget comparisons — each in short-run and long-run versions — give the analyst the appropriate tool for each question. Measurement combines elasticity-based price analysis, econometric studies of actual reforms, general equilibrium modelling and household-level effective tax rate calculations. Together these concepts and methods reveal the real distribution of the tax burden, which is what tax policy, concerned with both efficiency and justice, ultimately needs to know.

Question 5: Tax, Tax Rate and Types of Tax Rates (20 Marks)

Question as printed: Define tax and tax rate. Distinguish different types of tax rates with examples? (20)

Introduction

Taxation is the principal instrument by which a modern state raises the revenue to finance public goods, redistribution and stabilisation, and the language of taxation must therefore be precise. Two terms stand at the foundation of the whole subject: the tax itself, and the tax rate, which determines how the burden of a tax is spread across taxpayers of different means. Whether a given rate structure treats rich and poor fairly depends entirely on the type of rate chosen, which is why the classification of tax rates — proportional, progressive, regressive and digressive — is a standard test of a student's understanding of fiscal principles. This answer defines a tax and its essential characteristics, defines the tax rate together with the related ideas of the tax base, the average rate and the marginal rate, and then distinguishes the types

of tax rates with worked numerical examples, before relating the classification to the principles of equity and to actual practice in Pakistan and elsewhere.

Definition and Characteristics of a Tax

A tax is a compulsory financial charge imposed by a government on individuals, households or organisations, the proceeds of which are used to meet public expenditure for the common benefit. Bastable defined a tax as a compulsory contribution of the wealth of a person or body of persons for the service of the public powers, and Taussig described taxes as compulsory contributions levied in return for which no definite and direct service is rendered to the payer. The essential characteristics follow from these definitions. A tax is compulsory: it is levied under legal authority and refusal to pay is punishable, unlike a price or a donation. There is no direct quid pro quo: the taxpayer cannot claim a specific service in proportion to his payment, which distinguishes a tax from a fee, a licence charge or a price paid to a public enterprise. The proceeds go to a common public fund and are spent for collective purposes — defence, justice, infrastructure — from which the payer benefits only as a member of society. A tax is levied on a base specified by law, such as income, wealth, expenditure or a commodity, and it may be paid in money, as is universal today. Finally, taxation serves purposes beyond revenue: it redistributes income, discourages harmful consumption such as tobacco, and supports macroeconomic stabilisation, though revenue remains its primary function.

Definition of Tax Rate, Tax Base, Average and Marginal Rates

The tax rate is the percentage (or, for specific duties, the amount per unit) at which the tax base is charged. Tax liability is found by applying the rate to the base: Tax = Tax Base × Tax Rate.

If a person earns a taxable income of Rs 500,000 and the rate is 10 per cent, the tax is Rs 50,000. Two refinements are essential. The average tax rate is the total tax paid divided by total income; it measures the overall burden and is the correct measure for judging fairness between rich and poor. The marginal tax rate is the rate applied to the last (additional) unit of the base; it governs incentives, because it determines how much of an extra rupee earned the taxpayer keeps. Under a simple proportional tax the average and marginal rates are identical; under progressive schedules the marginal rate on the top slice of income exceeds the average rate on the whole income. Closely related is the distinction between ad valorem rates, expressed as a percentage of value (a 17 per cent sales tax), and specific rates, expressed as a fixed sum per physical unit (a duty of so many rupees per litre of petrol or per packet of cigarettes); specific rates are eroded by inflation unless indexed, while ad valorem rates rise automatically with prices.

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Types of Tax Rates

Tax rates are classified by how the average rate behaves as the base grows.

1. Proportional Tax Rate

Under a proportional tax, the rate is constant at all levels of the base, so everyone pays the same percentage and the average rate never changes. If the rate is 10 per cent, an income of Rs 50,000 pays Rs 5,000, an income of Rs 100,000 pays Rs 10,000 and an income of Rs 1,000,000 pays Rs 100,000: the richer person pays more in absolute rupees but the same proportion. A flat-rate income tax, and a uniform sales tax or VAT rate applied to consumption, approximate this pattern. Its virtues are simplicity and neutrality; its weakness, critics argue, is that an equal

percentage is not an equal sacrifice, since a rupee is worth more to a poor man than to a rich one.

2. Progressive Tax Rate

Under a progressive tax, the average rate rises as the base rises. higher income is taxed in successive slabs at increasing marginal rates. Consider slabs of 0 per cent up to Rs 100,000, 10 per cent from Rs 100,000 to Rs 300,000, 20 per cent from Rs 300,000 to Rs 600,000 and 30 per cent above Rs 600,000. A person earning Rs 300,000 pays 0 + (200,000 × 10%) = Rs 20,000, an average rate of 6.7 per cent. A person earning Rs 600,000 pays 20,000 + (300,000 × 20%) = Rs 80,000, an average rate of 13.3 per cent. A person earning Rs 1,000,000 pays 80,000 + (400,000 × 30%) = Rs 200,000, an average rate of 20 per cent. Note the common misunderstanding the example corrects: moving into a higher slab taxes only the income within that slab at the higher rate, never the whole income. Progressive income taxation, as in Pakistan's salaried income tax slabs and in most income tax systems worldwide, is the chief fiscal instrument of vertical equity and rests on the ability-to-pay principle and the diminishing marginal utility of income.

3. Regressive Tax Rate

Under a regressive tax, the average rate falls as the base rises, so the burden presses relatively harder on the poor. A fixed poll tax of Rs 1,000 per adult is the purest example: it is 2 per cent of a Rs 50,000 income but only 0.1 per cent of a Rs 1,000,000 income. More importantly, taxes that are formally proportional can be regressive with respect to income: a uniform sales tax takes the same percentage of spending, but the poor spend nearly all their income while the rich save much of theirs, so the tax absorbs a larger share of a poor family's income. A sales tax

of 10 per cent paid by a poor household spending its entire Rs 50,000 income costs it Rs 5,000, or 10 per cent of income, while a rich household spending Rs 400,000 of a Rs 1,000,000 income pays Rs 40,000, only 4 per cent of income. Regressive structures are generally criticised on equity grounds, though they are sometimes defended for administrative simplicity or where the taxed item is a luxury substitute; in practice governments offset them through exemptions on necessities and progressive spending.

4. Digressive Tax Rate

A digressive tax is a moderated form of progression: the rate rises with the base up to a point and then becomes proportional, so progression operates at lower incomes but flattens out at the top. For example, slabs might rise from 5 to 10 to 15 per cent and then remain at 15 per cent for all income above a threshold. Many real income tax systems are effectively digressive because the top marginal rate, once reached, applies unchanged to all further income, and because various ceilings — such as a cap on social security contributions — stop progression entirely. Digressive rates are a compromise between the equity of progression and the incentive and simplicity arguments for proportionality.

Table 1: Types of tax rates compared (tax paid on different incomes)

Type of rate	Structure	Income Rs 50,000	Income Rs 200,000	Income Rs 1,000,000
Proportional (10%)	Rate constant	Rs 5,000 (10%)	Rs 20,000 (10%)	Rs 100,000 (10%)
Progressive (slabs above)	Average rate rises	Rs 0 (0%)	Rs 10,000 (5%)	Rs 200,000 (20%)
Regressive (poll tax Rs 1,000)	Average rate falls	Rs 1,000 (2%)	Rs 1,000 (0.5%)	Rs 1,000 (0.1%)
Digressive	Rises, then flattens	Low rate	Higher rate	Top rate, then constant

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Relation to the Principles of Taxation

The classification matters because it operationalises the ability-to-pay principle and the doctrine of equal sacrifice. If sacrifice is measured by the marginal utility of money, then equal absolute sacrifice requires progressive rates, since the marginal utility of income falls as income grows; proportional rates imply equal proportional sacrifice, and regressive rates imply that the poor sacrifice proportionally more, which most theories of justice reject. Adam Smith's first canon — that subjects should contribute in proportion to the revenue they enjoy under the protection of the state — is satisfied by proportional and progressive structures alike, and modern welfare economics generally supports moderate progression balanced against incentive effects: very steep marginal rates can discourage work, saving and honest declaration, which is why top rates in practice are compromises. The student should also note that the progressivity of the tax system as a whole, not of any single tax, is what matters for distribution: most modern systems combine a progressive income tax with broadly proportional or mildly regressive consumption taxes and achieve the desired overall pattern through the mix, reinforced by progressive public expenditure.

Conclusion

In conclusion, a tax is a compulsory contribution to public revenue with no direct quid pro quo, and the tax rate — the percentage or unit charge applied to the tax base — determines how its burden is distributed. Rates are proportional when the percentage is constant, progressive when the average rate rises with the base, regressive when it falls, and digressive when

progression stops beyond a point. The worked examples show that these are not verbal distinctions but arithmetic ones with large consequences for equity: on an income of Rs 1,000,000 the four structures above take Rs 100,000, Rs 200,000, Rs 1,000 and a flattened intermediate amount respectively. Choosing among them is the practical core of the ability-to-pay principle, and every real tax system is a deliberate mixture of these rate types.

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