Urban Transportation, Land Use, and the Environment in Latin America: A Case Study Approach

Units: 3-0-6

General Course Description

- Aimed at the aspiring planning practitioner, policy-maker, or industry decision-maker with an interest in urban transportation and environmental issues in developing countries.
- Focus: Latin America “mega-cities”
- Geared towards interactive problem-solving
  - institutional analysis, policy analysis, and project and program evaluation and implementation.
- Detailed knowledge of transportation planning is not required
  - the course will place the general practitioner into a specific transportation public policy situation and draw from her skills to devise real solutions.

The Case Study Approach

- Mexico City and Santiago de Chile
- Student Teams – "Consultants" & "Stakeholders"
  - Develop and critique viable strategic plans
- Back-of-the-envelope calculations (Excel), policy analysis, technology analysis, institutional analysis

Requirements - Evaluation

- Completion of 4 brief (1.5 pages) papers on the materials covered during the course's Introductory Section (15%) – one per week.
- Participation in a student "consulting" team for one of the case studies – develop, over a four week period, a strategic transport/development/environment plan (65%).
- Participation in a student "stakeholder" team for the other case study – each stakeholder provides a one to two page response to the "consultant" final recommendations (15%).
- Overall Class Participation (5%).

Course Schedule

- Lectures 1-5 : Lectures/Discussions
  - Introduction, Cities in the Development Context; Urban Transport and Sustainability; Regional Strategic Transportation Planning; Transportation Strategies, Options & Examples
- Lectures 6 : Lectures, Discussions, Presentations
  - Lectures 6 – 9 : Mexico City
  - Lectures 10 – 13 : Santiago
- Lectures 14 : Conclusions

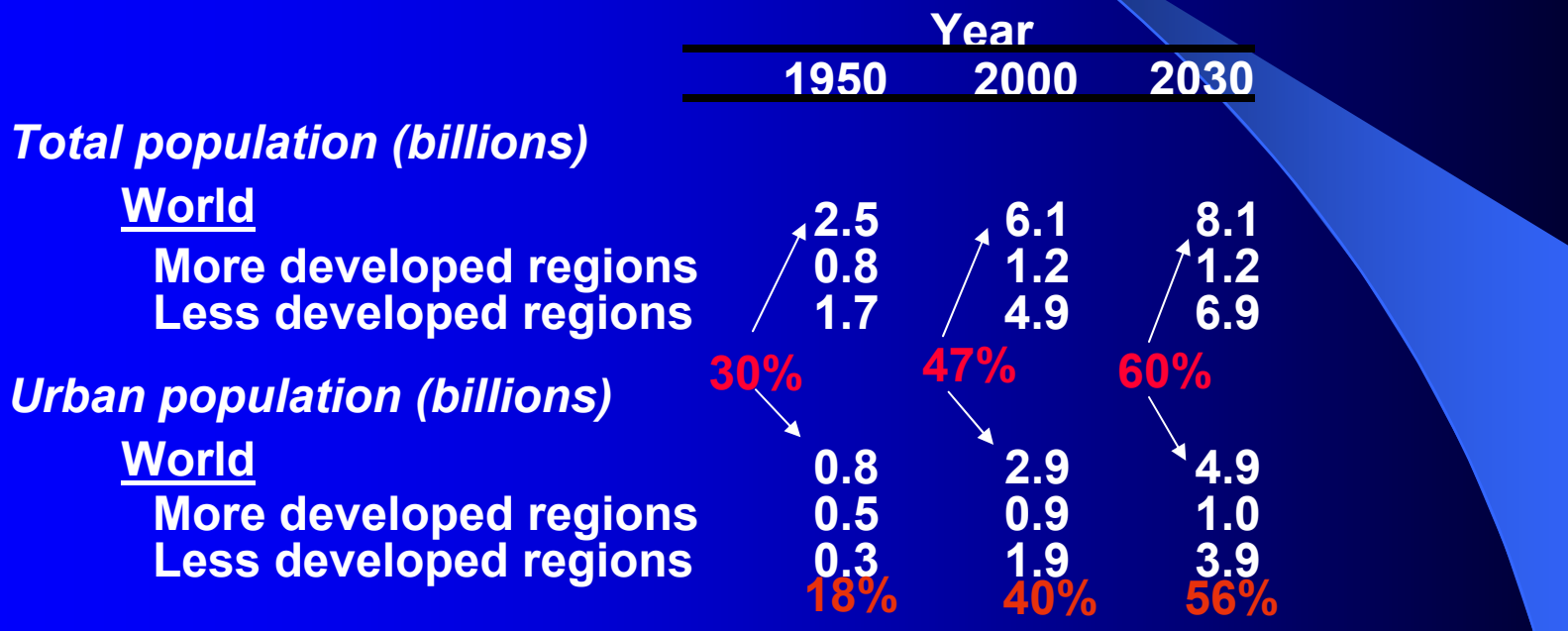
Remainder of Today's Lecture

- Introduction to Analytical and Methodological Concepts
- Introduction to the Context – Cities, Development and Transportation with a Latin America Focus

The City in Development – Two Core Phenomena

- *Urbanization* - strongly correlated with income growth – particularly as countries move from low to middle income levels
  - Linked to industrialization, economies of scale and agglomeration, educational and social desires, etc.
- *Suburbanization* – spreading out of cities and reduction in population densities
  - Driven by rich and poor settlements alike, influenced by changes in land use allowances (agricultural conversion), infrastructure investments, consumer desires, economic realities (lower land and development costs), motorization
  - The larger the city, the more sub-centers – "polycentric"

World Urbanization Trends



Source: UNPD, *World Urbanization Prospects: the 1999 Revision*

World "Suburbanization" Trends

	pop/sq km (1960)	pop/sq km (1990)	% chg. (1960-1990)
Tokyo	8,565	7,097	-17%
New York	2,878	2,086	-28%
Paris	6,860	4,614	-33%
London	6,539	4,232	-35%
Detroit	1,970	1,275	-35%
San Francisco-Oakland	1,640	1,602	-2%
Washington	2,046	1,373	-33%
Melbourne	2,028	1,491	-26%
Hamburg	6,827	3,982	-42%
Vienna	9,141	6,830	-25%
Brisbane	2,095	978	-53%
Copenhagen	4,952	3,467	-30%
Amsterdam	9,973	5,591	-44%
Zurich	5,998	4,708	-22%
Frankfurt	8,722	4,661	-47%

Will the developing world follow? Seems to already be so.

Suburbanization is not just people

- Satellite cities, industrial parks, office parks following people, infrastructure and land prices
  - Increased mobility/telecoms feed the process as micro-scale agglomeration economies weaken and other factors (additional space, freeway access) play a role
  - Manufacturing increasingly on outskirts and highly mobile – 3-5% annual mobility rates (Ingram)

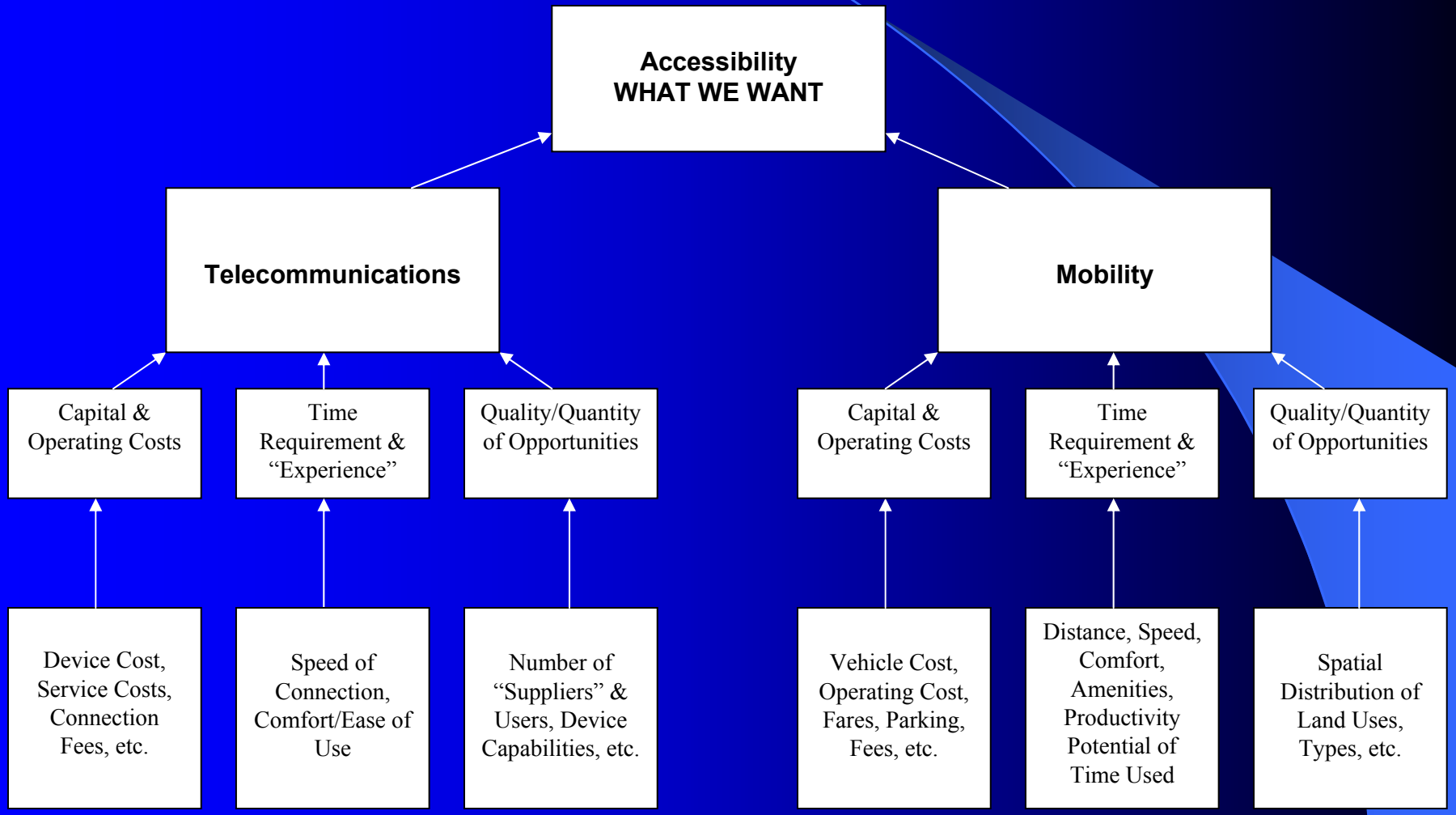
The "Developing City"

- Often high concentration of national population, economic activity, motor vehicles
- Inadequate transportation infrastructure – shortfalls, poor maintenance, poor management
- Weak/unclear institutional, fiscal and regulatory structures at metropolitan level
- In comparison to "Industrialized City"
  - Greater income disparities, larger relative number of poor, greater social needs and fewer public resources
  - Higher population densities, lower road network densities, fewer motor vehicles per capita

The City, Accessibility, Mobility

- Accessibility: "The potential for spatial interaction with various desired social and economic opportunities" – **What we want**
- Mobility: the ability to move between different places (overcome distance); key for enhancing (firms' & individuals') accessibility
- Higher *accessibility* is almost always better; higher *mobility* depends on net contribution to accessibility

The City, Accessibility, Mobility



Land Use, Transport, Accessibility

- Distribution of jobs, residences, schools, etc. defines a city's potential accessibility
  - Determines virtually all transportation activity
  - In developing world, particularly crucial, due to lower general levels of individual mobility
- "Stylized" developing country traits – Metro level
  - Historic concentration of trip attractions in city center
  - High densities
  - Socio-economic and functional segregation, forcing long trips for poor, often isolated on the urban fringe

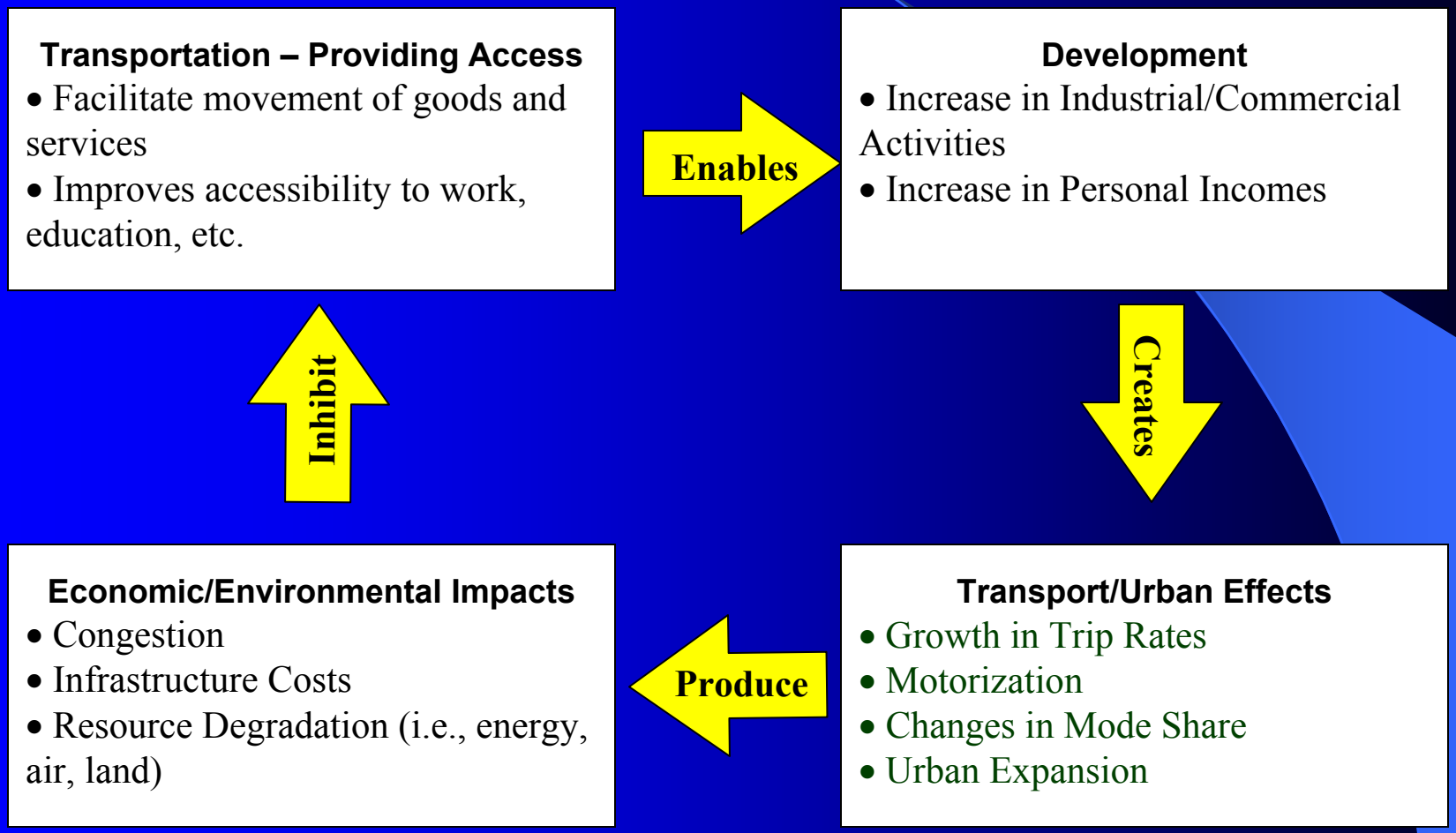
Land Use, Transport, Accessibility

- Densities, local distribution of land uses, "design" factors (street design, layout)
  - Unclear impact on trip frequency, distance, mode
- Density shown to influence travel (Newman & Kenworthy, Pickrell)
  - But, difficult to isolate other influencing factors
    - Household size, relative travel costs, socioeconomic factors
  - Lack of underlying microeconomic behavior theory
  - Few "generalizable" influences;
  - Little, if any, work specific to developing country cities

Transport, Land Use, Accessibility

- Transport system performance effects an area's relative accessibility (attractiveness)
  - Open up new areas for development
    - i.e., urban fringe highway
  - Facilitate densification
    - i.e., a center city metro
- Also influences other attractiveness characteristics
  - Noise, pollution, safety risks
- Do "highways cause sprawl"?
  - Ultimate effects depend on households/firms relative sensitivity to transport costs

Urban Transport's "Vicious or Virtuous" Cycle



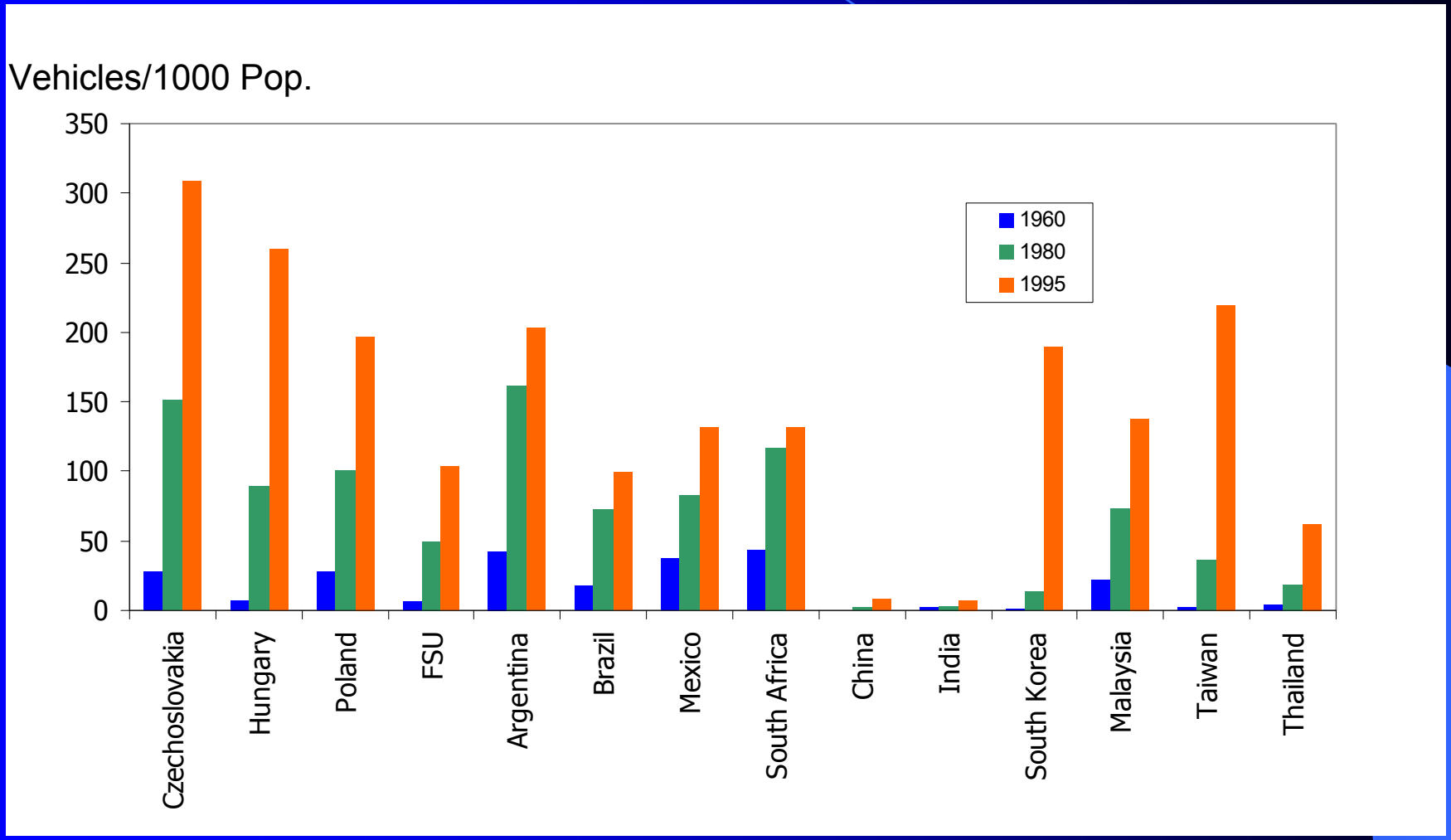
Growth in Motor Vehicle Fleets/Ownership

- Motorization – Growth in Motor Vehicle Fleets
- Motorization Rate –Motor Vehicles per capita (typically expressed vehicles/1000 population)
  - Gross indicator of vehicle ownership levels
- Both are strongly correlated to income

Motorization Rate & Income

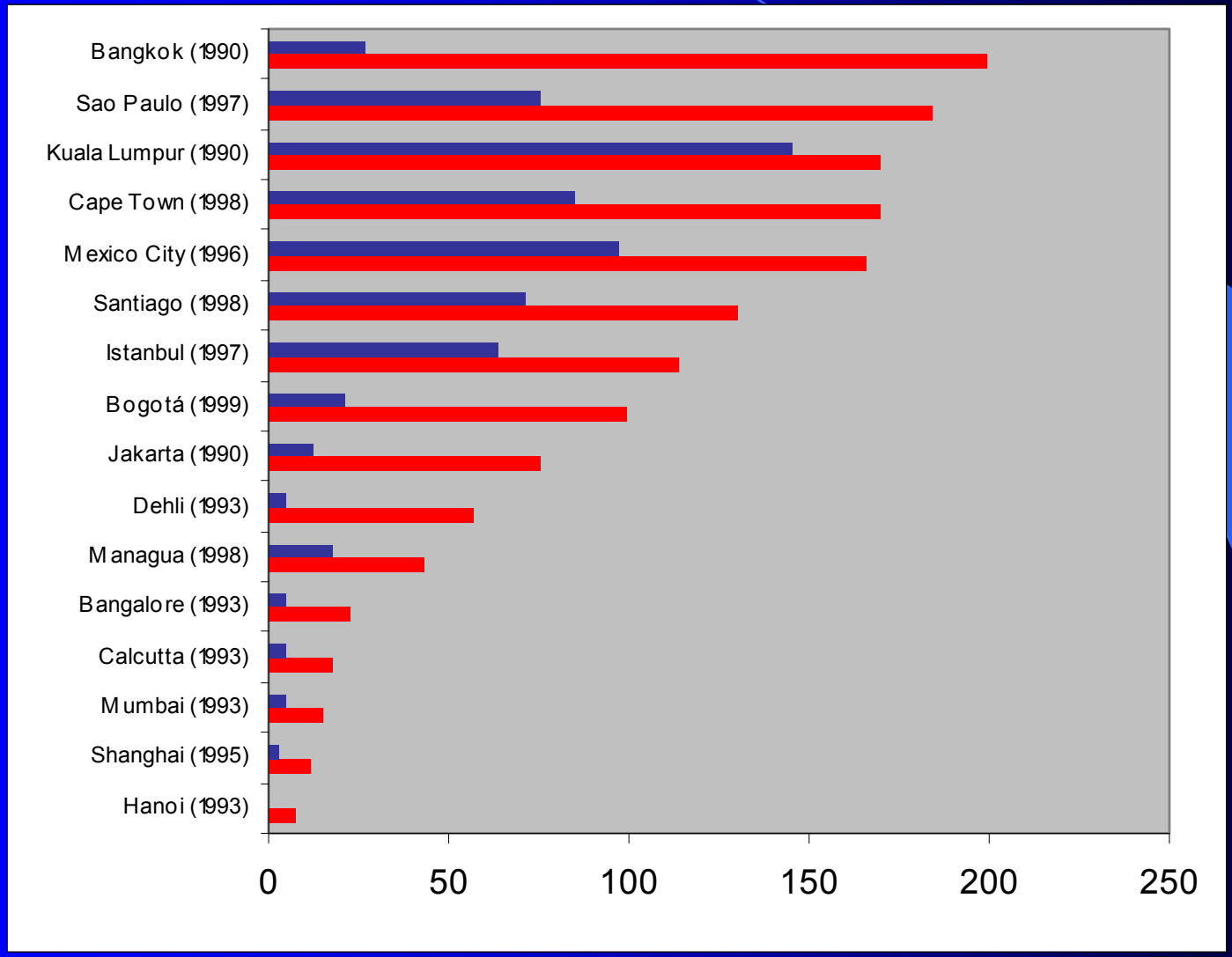
- Time-series and cross-section econometric models (i.e., using income per capita, vehicles per capita, and often other variables) across many countries or one country in time (see, especially, Ingram & Liu)
  - Income per capita shown to be highly significant (T-stat)
  - Income shown to account for typically 70-90% of private vehicle motorization rate (r-squared)
  - Income elasticities ("stylized" facts):
    - Long run (cross-section) elasticities typically greater than 1
    - National level elasticities are higher than urban-level elasticities
    - Passenger vehicle elasticities are larger than commercial vehicle elasticities

Developing Country Motorization Rate Increase



Source: Ward's/Pemberton, *World Vehicle Forecasts and Strategies: The Next 20 Years*, 1996.

Developing World Urban Motorization Rates



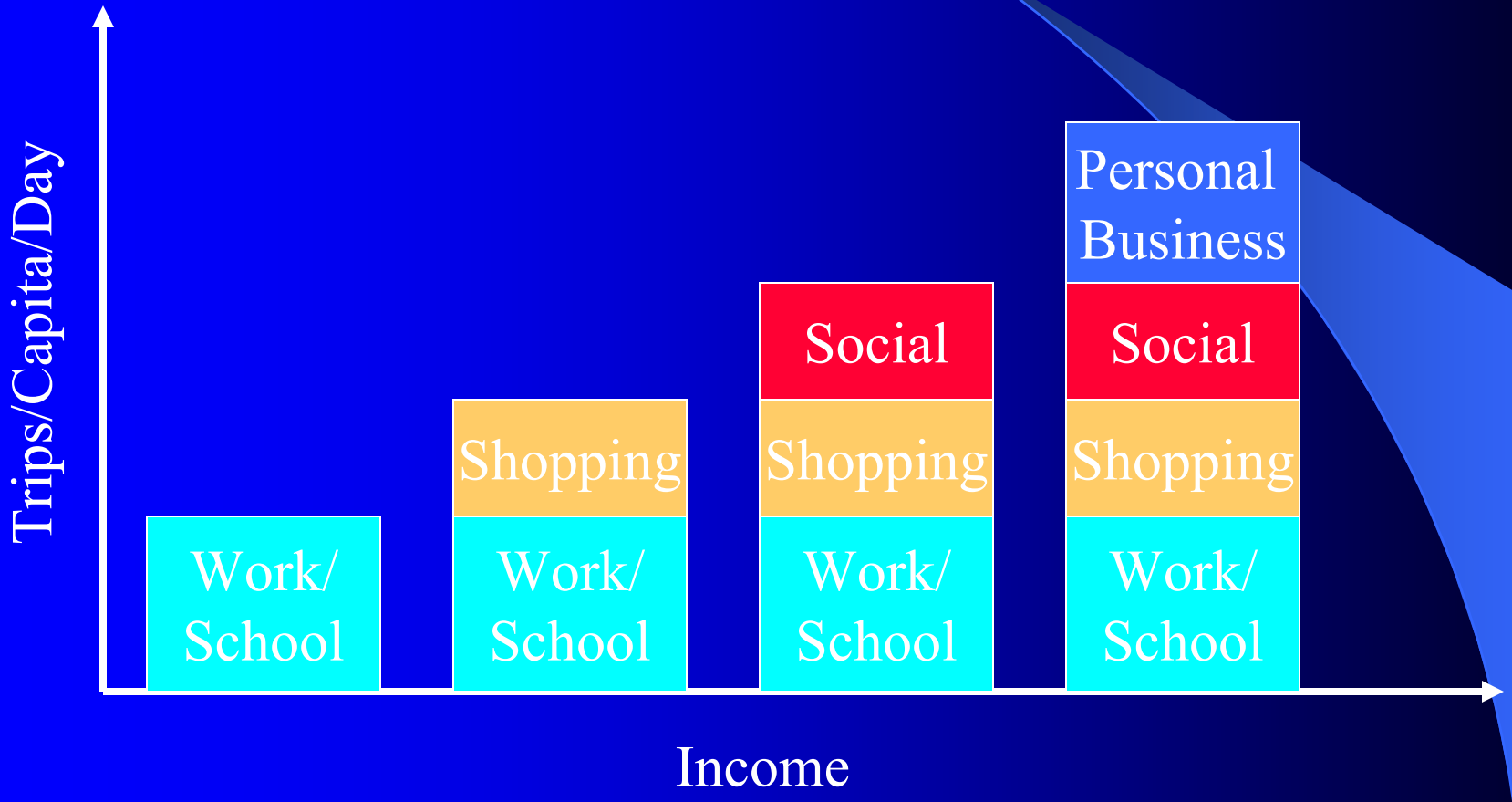
But, Income Does *not* explain everything

- Prices, taxes, policies, public transport provision, land uses, culture, etc.
  - For example, same motorization rate seen in:
    - Morocco, Chile, Mauritius, Hong Kong
    - Argentina, Korea
    - Poland, Israel
    - Mexico, Singapore

Perspectives on Motorization

- Anthropological – auto as status symbol
- Political – freedom & privacy
- Economic – rational economic decision
- Sociological (Vasconcellos, 1997)
  - Middle class reproduction, effects on consumption/lifestyle patterns and subsequent space and transport outcomes

Income & Accessibility - The Demand for Trips



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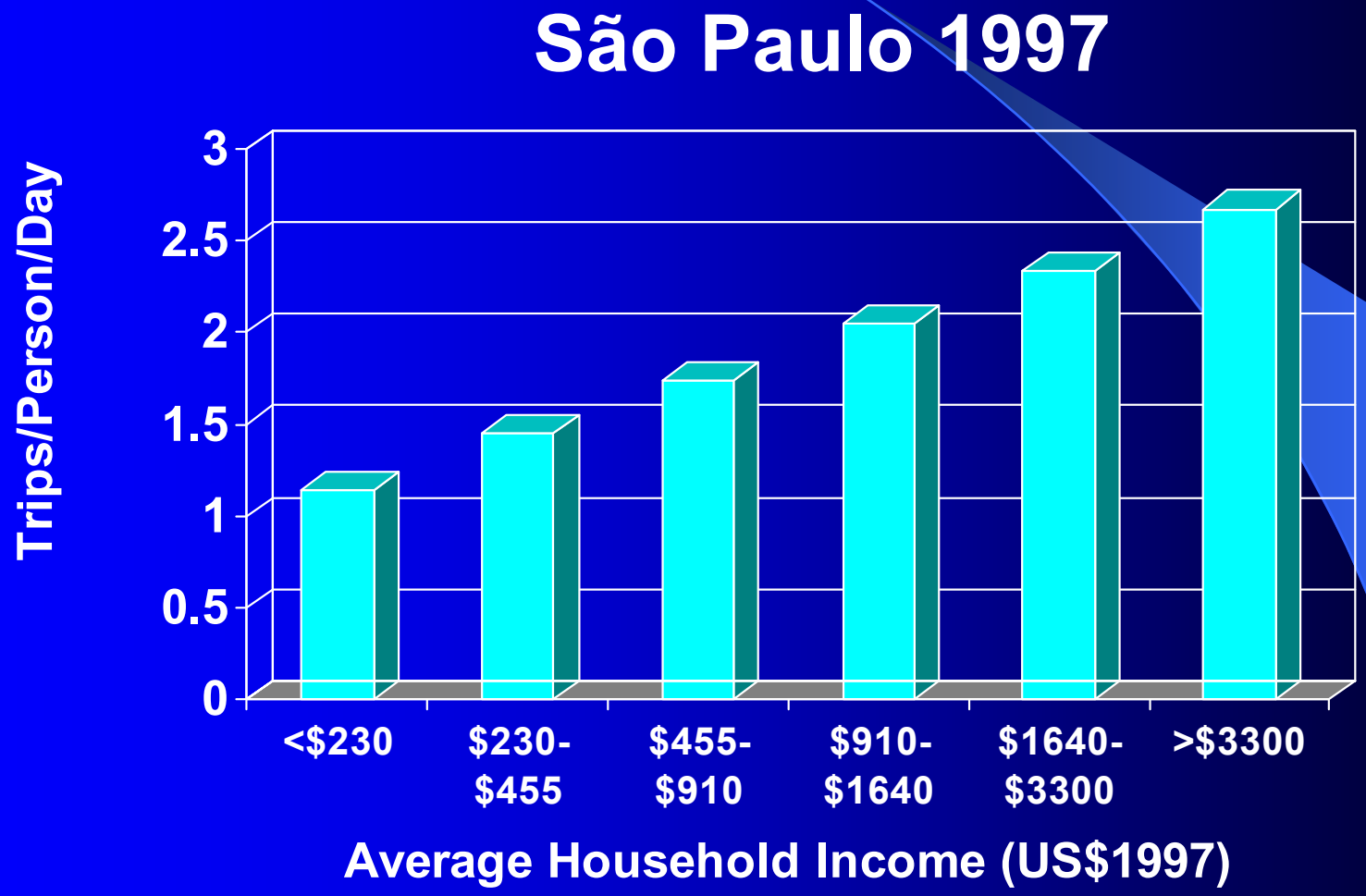
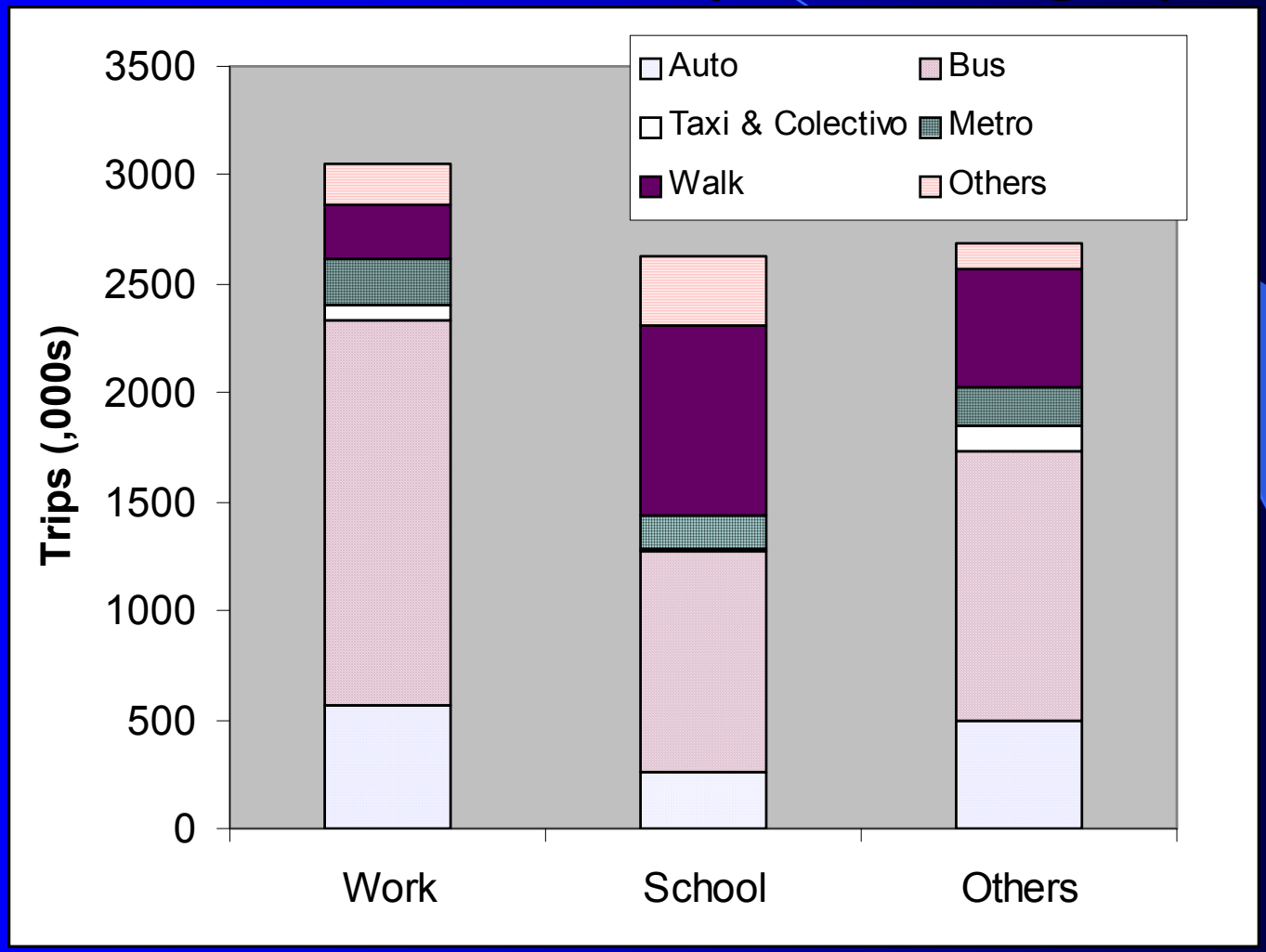


Source: Companhia do Metropolitano de São Paulo, 1999.

Accessibility – Types of Trips and Modes (Santiago)

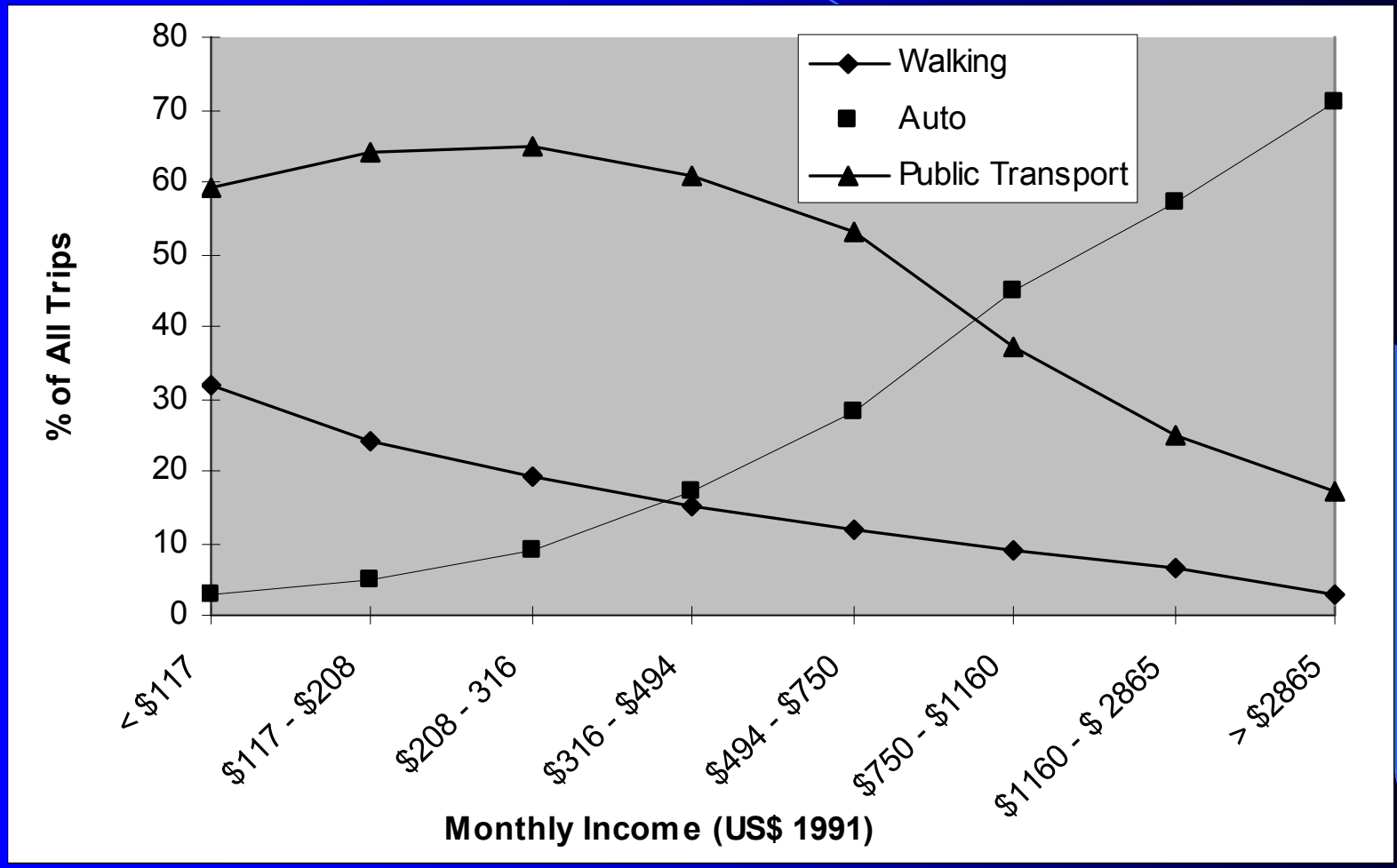


Source: SECTRA, 1991.

Income and Accessibility: The Demand for Speed, Flexibility

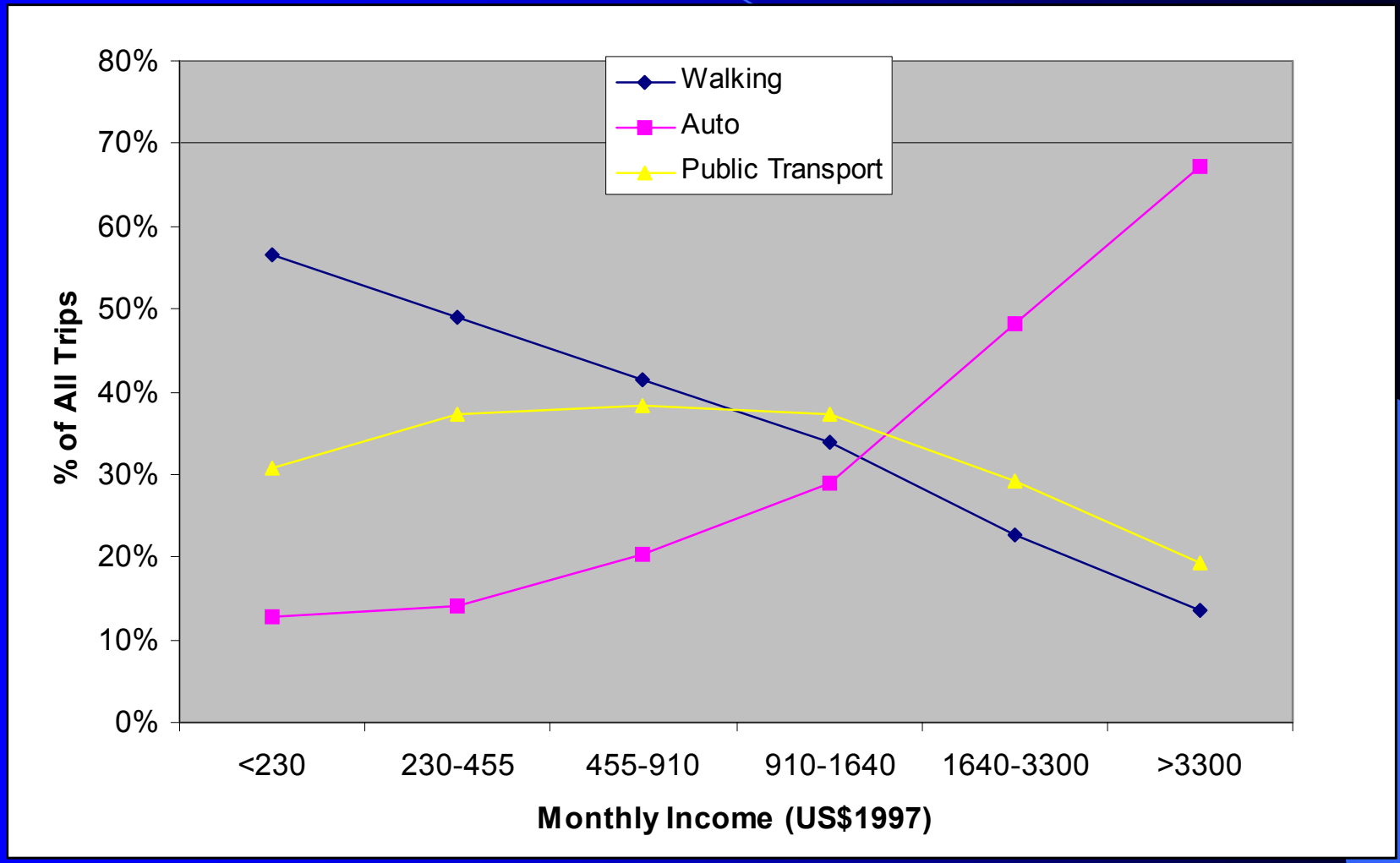
- People/households aim to maximize accessibility subject to time and income constraints
  - Trade-off b/w activities that can be performed within time and income budgets.
  - Maximize **Total Net Benefits** (All Benefits minus all costs, including transport time and money costs) obtained from activities at home and elsewhere – theory underlying residential (and business) location choice
- As incomes increase, the ability to "purchase speed" (and comfort) "frees up" the individual/household to pursue other locational attributes (i.e., more space) with potentially the same (or higher) levels of total accessibility.

Income and Mode Share - Santiago



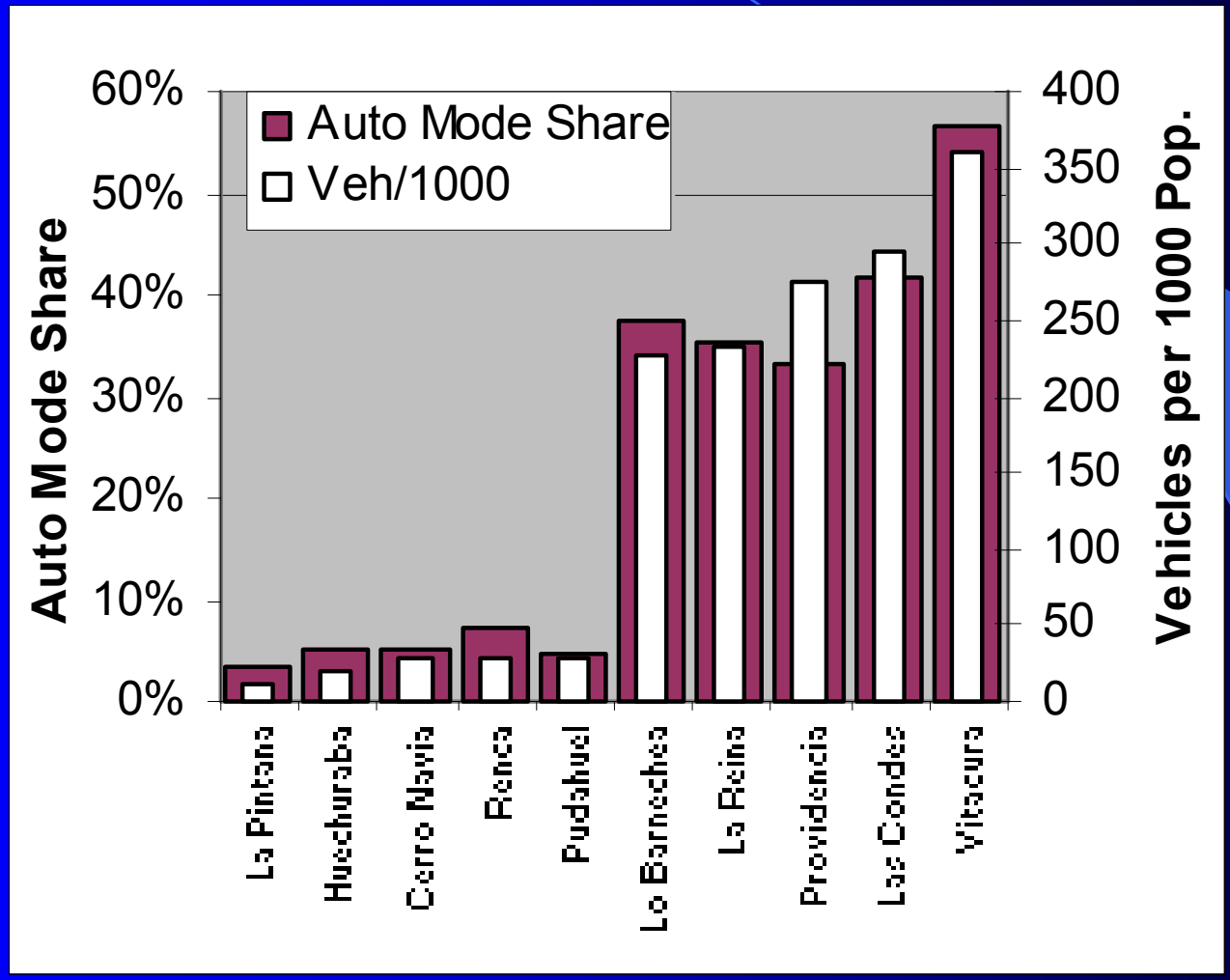
Source: SECTRA, 1991.

Income and Mode Share - São Paulo



Source: Companhia do Metropolitano de São Paulo, 1999.

Income, Motorization Rate & Mode Share – Santiago



Source: SECTRA, 1991.

Motorization Rate, Mode Share, Trips - Santiago

	1977	1991	Annual Growth
Autos/ 1000 Population	60	90	3%
Auto Mode share	9.8%	15.8%	3.4%
Trips/Capita	1.14	2.13	4.4%
Motorized Trips/Capita	0.95	1.7	4.2%

Source: SECTRA, 1991.

Non-motorized Transport (NMT)

- In Latin America's larger cities
  - Walking is still important, particularly, but not exclusively, for poor
    - In São Paulo, 10% of wealthiest residents' trips are walking
  - Walking is key feeder to public transport
    - In Santiago, 70-80% of Metro trips start or end as walk trips
  - Bicycling, when counted, is often marginal
    - Typically 1-3% of all trips
    - Vehicle access, comfort, safety, security, "culture" – all barriers

Road-Based Public Transport

- In Latin America, typical historical cycle:
  - First half of 20th C: Regulated Monopolies
  - Then: Nationalized Public Monopolies
  - By 1970s: Deteriorating conditions, economic ideology, and/or lack of regulatory power, led to privatization and/or opening up (formally or informally) to private provision
  - Today, private sector dominates provision in most places, in variety of regime types

Operating Regimes in Region

City	Public Provision	Contract	Franchise/ Concession	Licensed/Un-regulated
Bogota			Bus	Bus, Para-Transit
Buenos Aires			Bus	Bus, Paratransit
Curitiba		Bus		
Mexico City	Bus, trolleybus			Bus, Paratransit
Rio de Janeiro		Bus		Bus, Paratransit
Santiago		Bus		Bus, Paratransit
São Paulo		Bus, trolleybus		Paratransit

Source: Halcrow Fox, 2000.

Example of Roles in "Loose" Regulation

City	Authority(ies)	Companies
Bogota	Issues licenses (route, hours, capacity); basic fares; poor overall regulation	Vehicle Owners pay "entry fee" to licensed company; premium fare
Buenos Aires	Issues concession licenses; Ministry of Economy sets fares; Transport Authority routes/schedule	Vehicles are "share" in company (association); operators set vehicle type; company influences sched.
Mexico City	Issues route-based licenses for buses and minibuses; sets fares and routes	Operators determine vehicle type and schedule

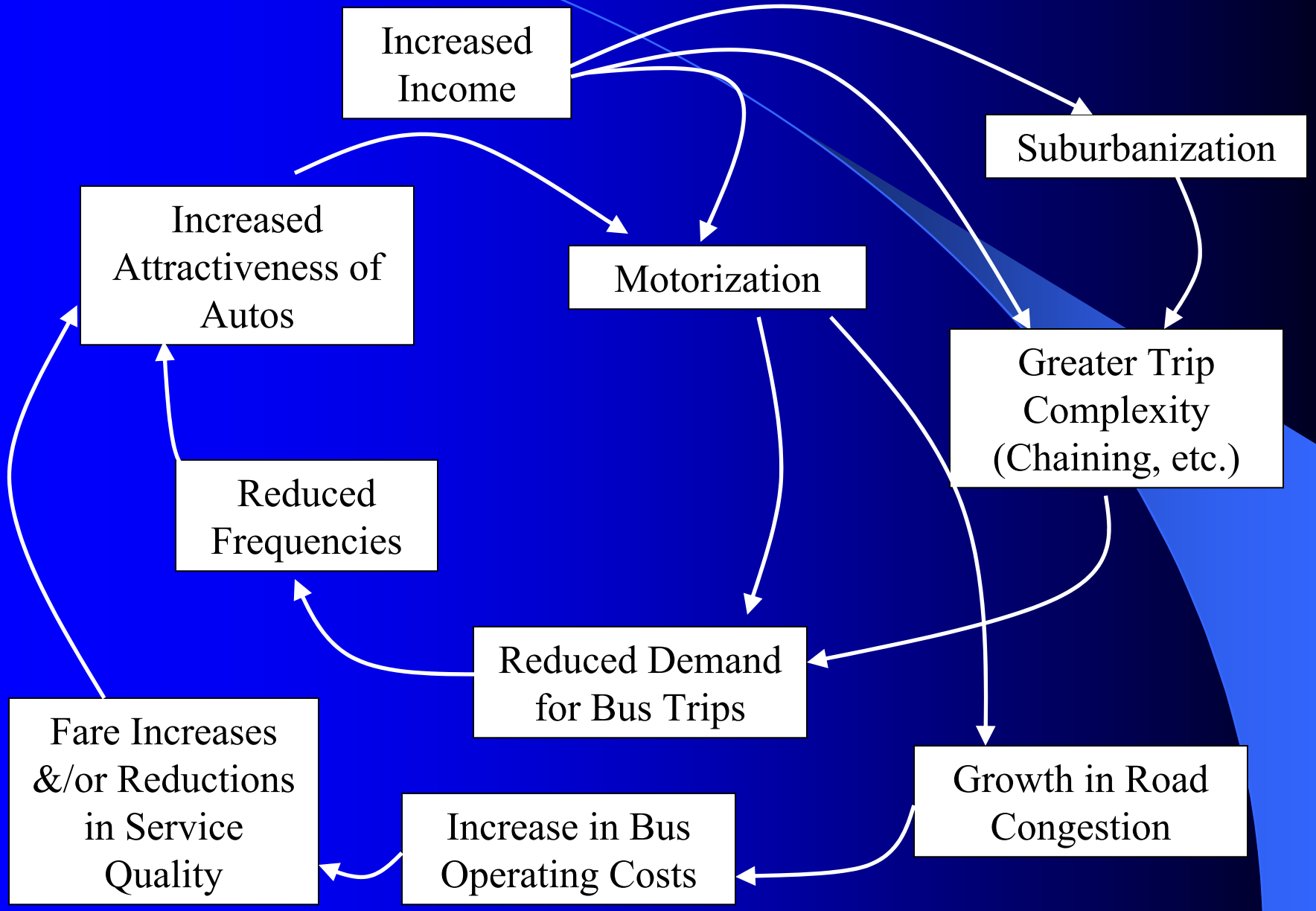
Source: Halcrow Fox, 2000.

Example of Roles in "Strong" Regulation

City	Authority(ies)	Companies
Curitiba	Gross cost contracts on area basis; reimburses operators based on per kms; fares, vehicle type, schedule, route, # buses specified.	10 "Formal" Companies.
Rio	Licenses specify level of service and fares, routes and vehicle types.	33 licensed companies.
Santiago	Contract specifies route and frequency; fare and vehicle type established in bidding.	~250 companies set fares and vehicle type via bidding.
São Paulo	Contract – based on standardized cost schedule – specifies route, frequency and vehicle type; payment on per km basis.	50 private operators; contract does not allow for much innovation.

Source: Halcrow Fox, 2000.

Automobility & the Forces Against the Bus



Bus vs. Auto – Travel Speeds

Average, Evening Peak Speeds (Km/hr) – Brazilian Cities

City	Auto	Bus
Belo Horizonte	23	16
Brasilia	45	27
Campinas	24	17
Curitiba	22	19
João Pessoa	26	18
Juiz de Fora	30	21
Pôrto Alegre	29	20
Recife	24	14
Rio de Janeiro	26	19
São Paulo	16	11

Source: Vasconcellos et al., 2000.

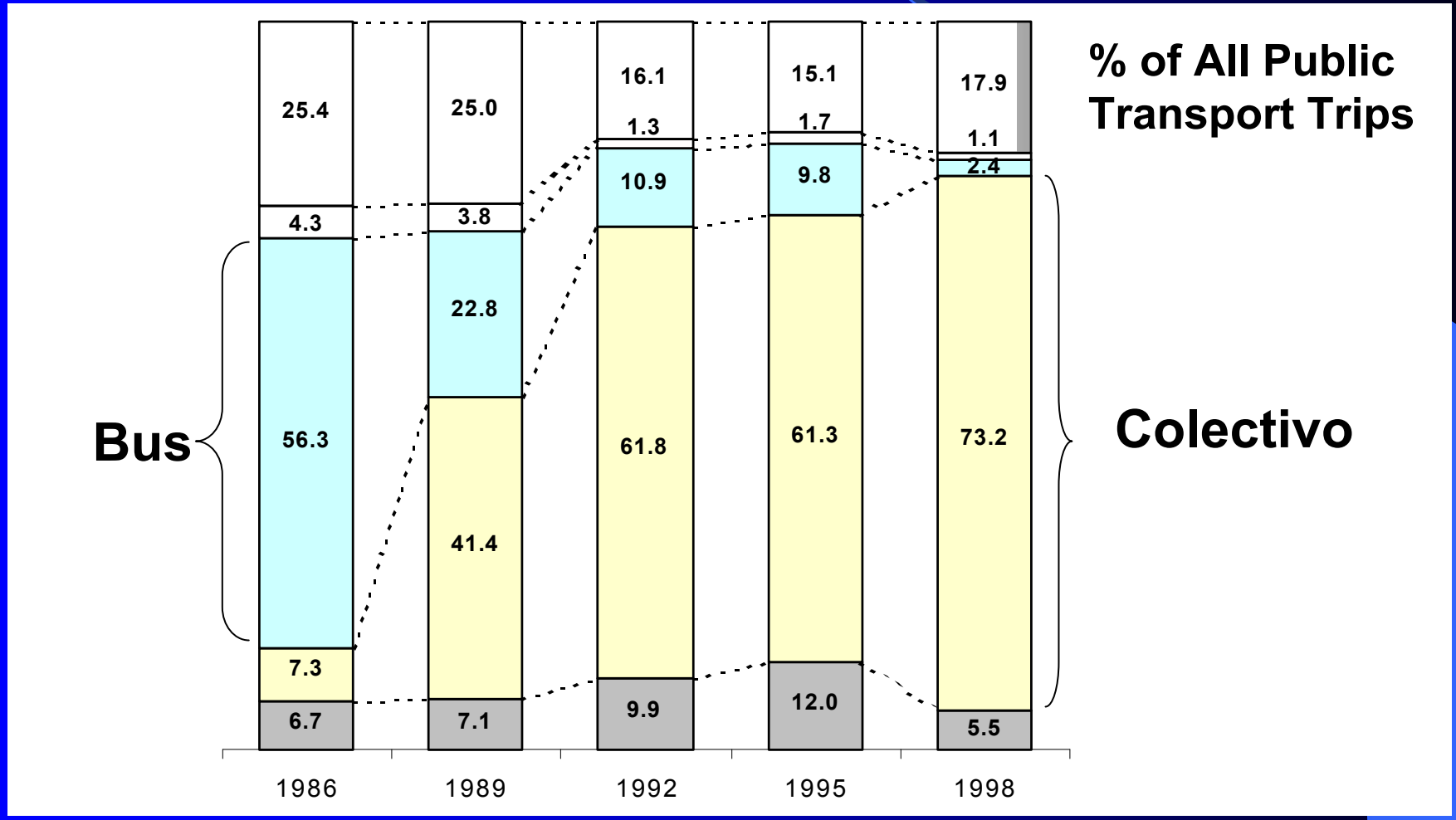
Growth of the "Informal" Sector

- Minibuses, shared sedans, vans, etc. illegal or licensed but with little regulatory effort or power
  - Mexico City, Lima, Recife (Brazil), San Jose (Costa Rica), etc.
- Combination of initiating factors:
  - Liberalization of the public transport market, scarce alternative employment opportunities, public sector employment restructuring (Peru), institutional weakness
- Positive Impacts
  - Employment, fill demand with "door to door" service
- Negative Impacts
  - System-wide effects (congestion, pollution), political clout, unsafe on-road competition

“Informal” Sector

- Rio
  - Kombis: complementary service in inaccessible areas
  - 14-seater “luxury” vehicles: competing express service
  - Fares 2 to 3 times equivalent bus fare
  - Early 1990s, 600 vehicles; today, 6,000 to 9,000
  - Buses have responded to competition, diversifying operations and adding amenities (i.e., A/C)

The Rise of the "Informal" Sector in Mexico City



Urban Rail Transit

- Metros, suburban rail, light rail
- Typically the exception in developing cities, including Latin America
  - High capital costs, lack of flexibility in adapting to changing travel patterns, long construction times
  - Still, often highly prized as visible, “modern” solutions to transport problems

Suburban Rail in Latin America

- Suburban Rail in Buenos Aires, Santiago, São Paulo, Rio, and several other Brazilian cities
- Buenos Aires
  - 7 lines, 840 kms, 8% of trips
- Rio
  - 264 kms, 2% of trips
- São Paulo
  - 6 lines, 270 kms, 2% of trips
- Santiago
  - 1 line, 85 kms, <<0.3% of trips

Metros in Latin America

	Lines	Kms	Stations	% Trips
Buenos Aires	5	44	67	5
Caracas	3	46	40	na
Mexico City	10	180	167	~13
Rio (incl LR)	2	35	30	~3
São Paulo	3	49	46	5
Santiago	3	40	51	~7

Metros

- High Capacity – 60 Passengers/Hr/Direction
- High Cost - $40-$150 mn./Km
- Capital Costs rarely if ever recovered
- Operating Revenues/Operating costs – "Farebox Ratio" (in 1990)
  - Mexico City, Rio, São Paulo < 1
  - Santiago > 1.5
  - Policy outcome, planning outcome, operations outcome?