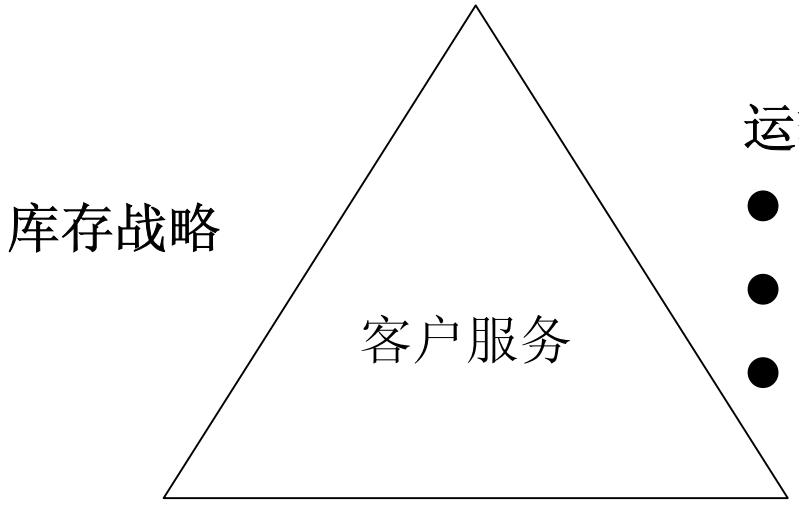
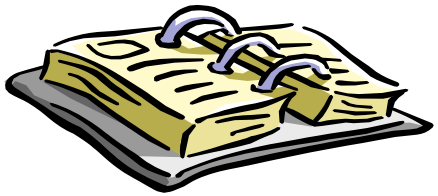
第五章 运输战略

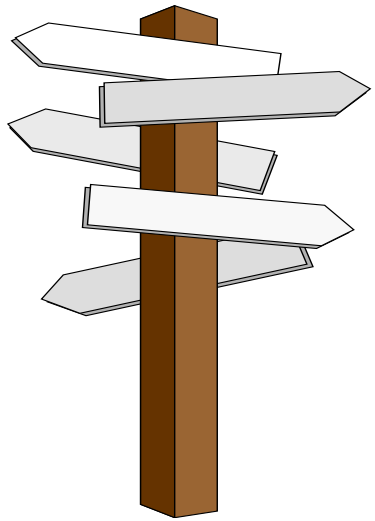


运输战略

- 运输方式
- 承运人路线/时间
- 运输批量/集运



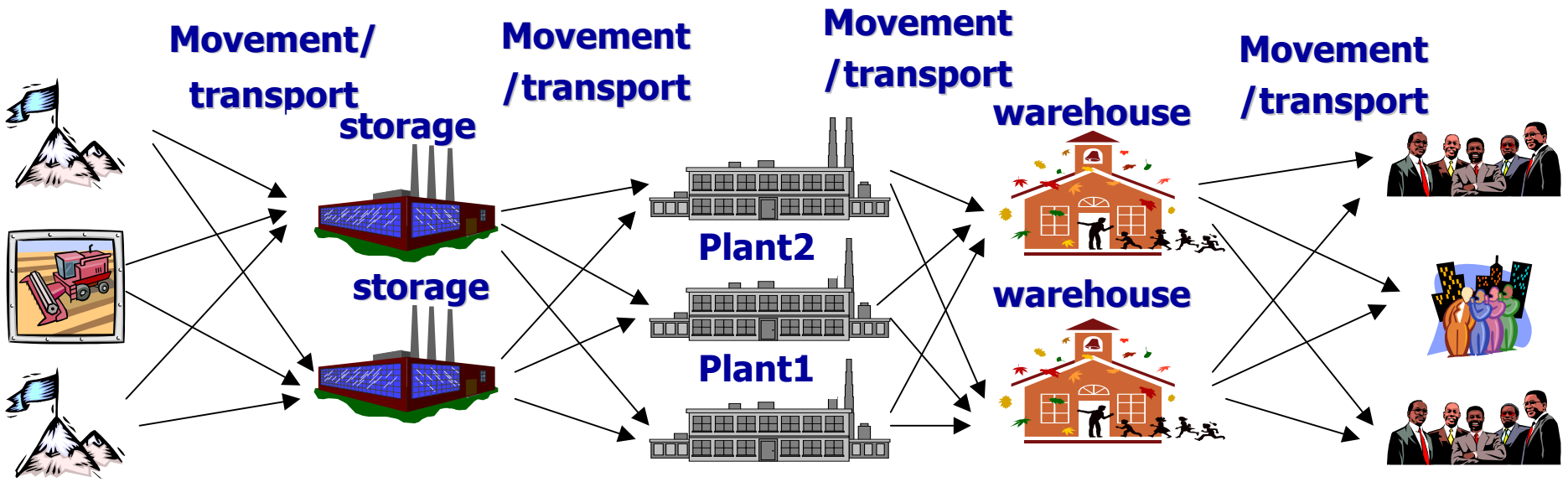
内容

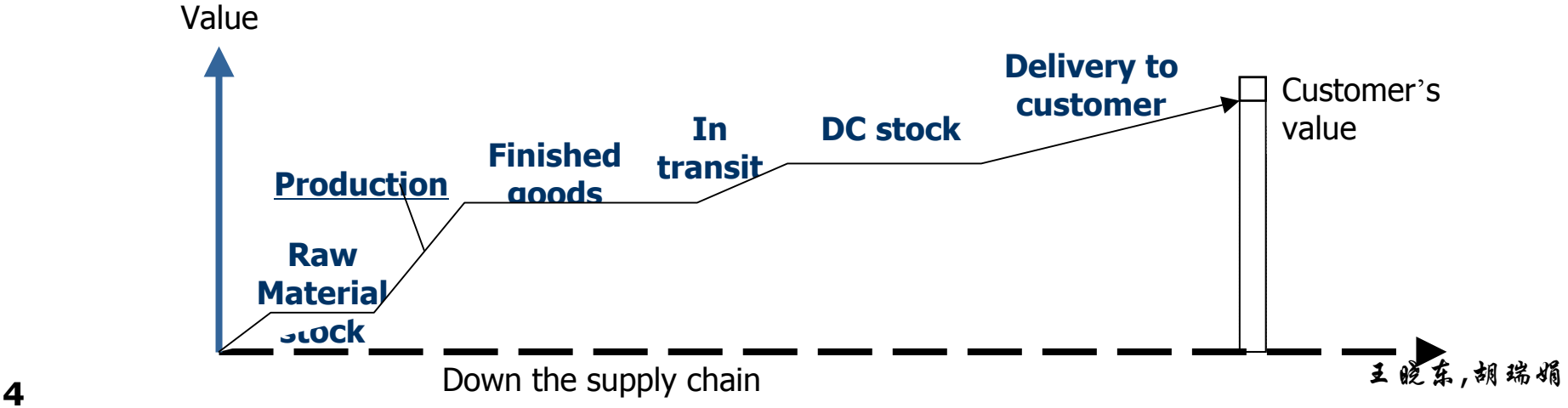


5.1 运输在物流中的作用

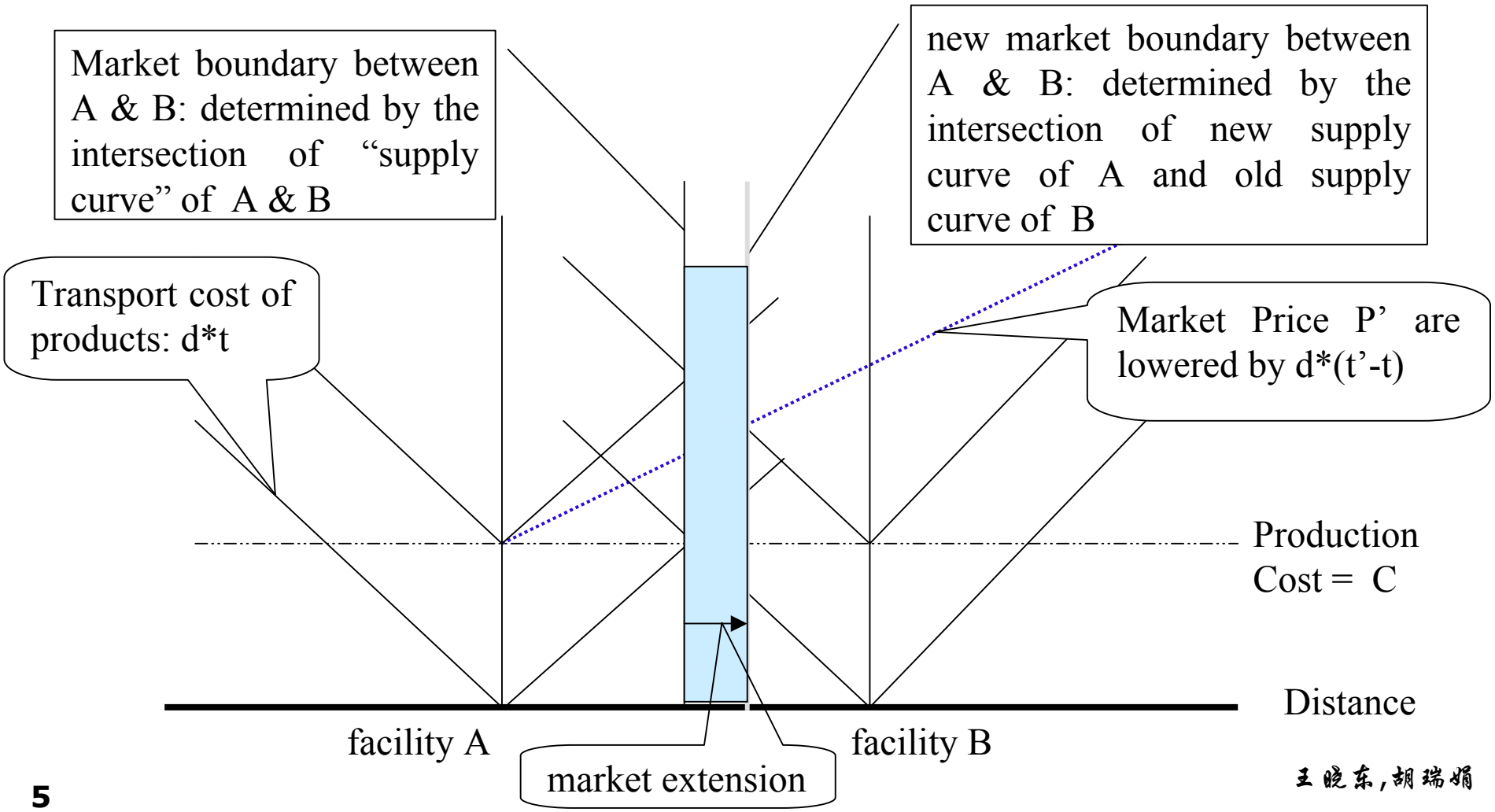
- 对多数公司来说，运输通常是物流管理中最重要的一个要素。据观察，运输成本占物流总成本的比重约为1/3到2/3。
- 运输的功能:
  - 联系生产和消费
  - 实现产品的空间效用和时间效用
- 高效低廉的运输系统能极大地增强企业市场竞争力，扩大生产的规模经济效益，降低经营成本。

联系生产和消费

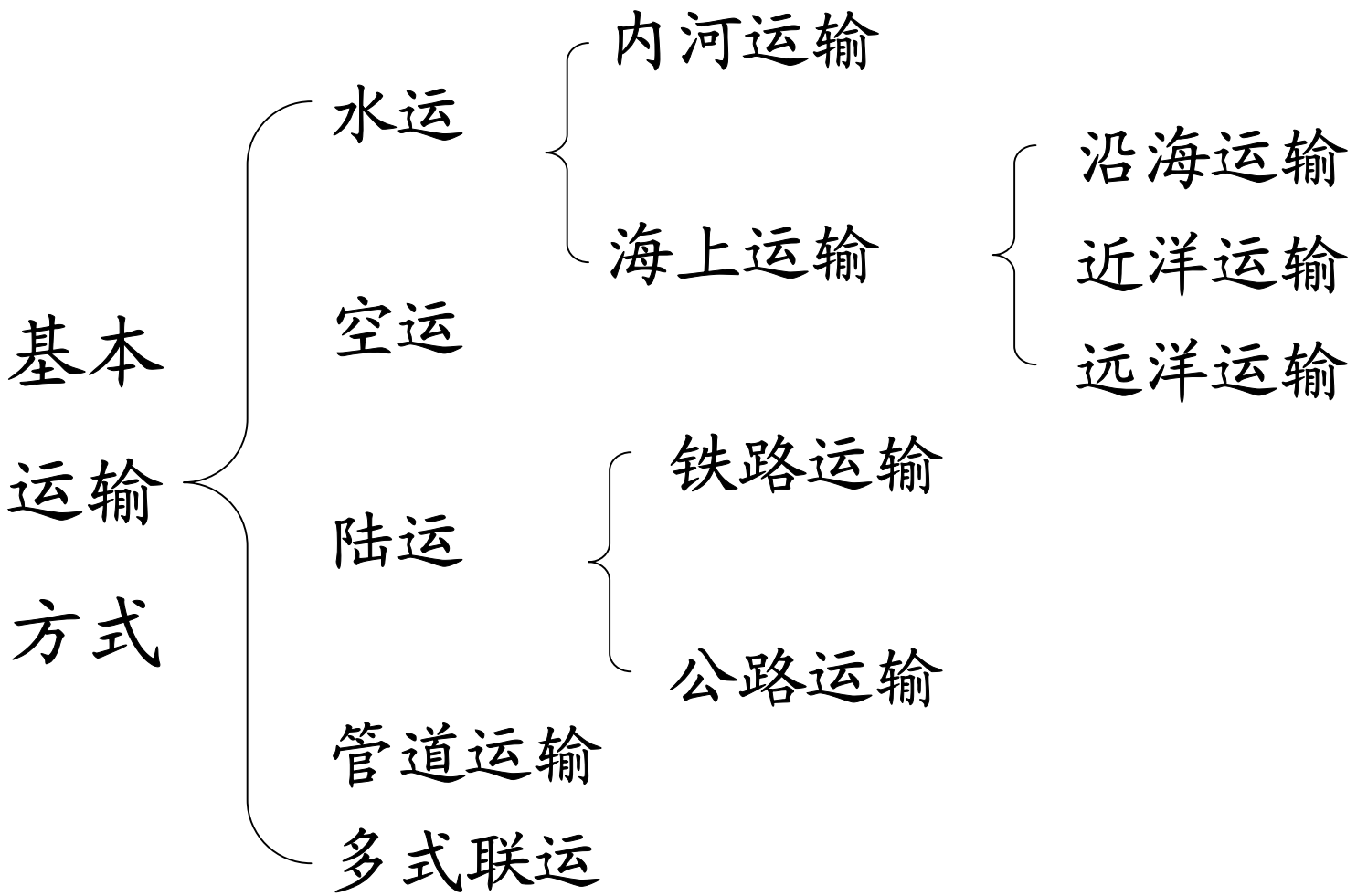

Movement/
transport
storage
storage
Movement
/transport
Plant2
Plant1
Movement
/transport
warehouse
warehouse
Movement
/transport


Value
Production
Raw
Material
stock
Finished
goods
In
transit
DC stock
Delivery to
customer
Customer's
value
Down the supply chain

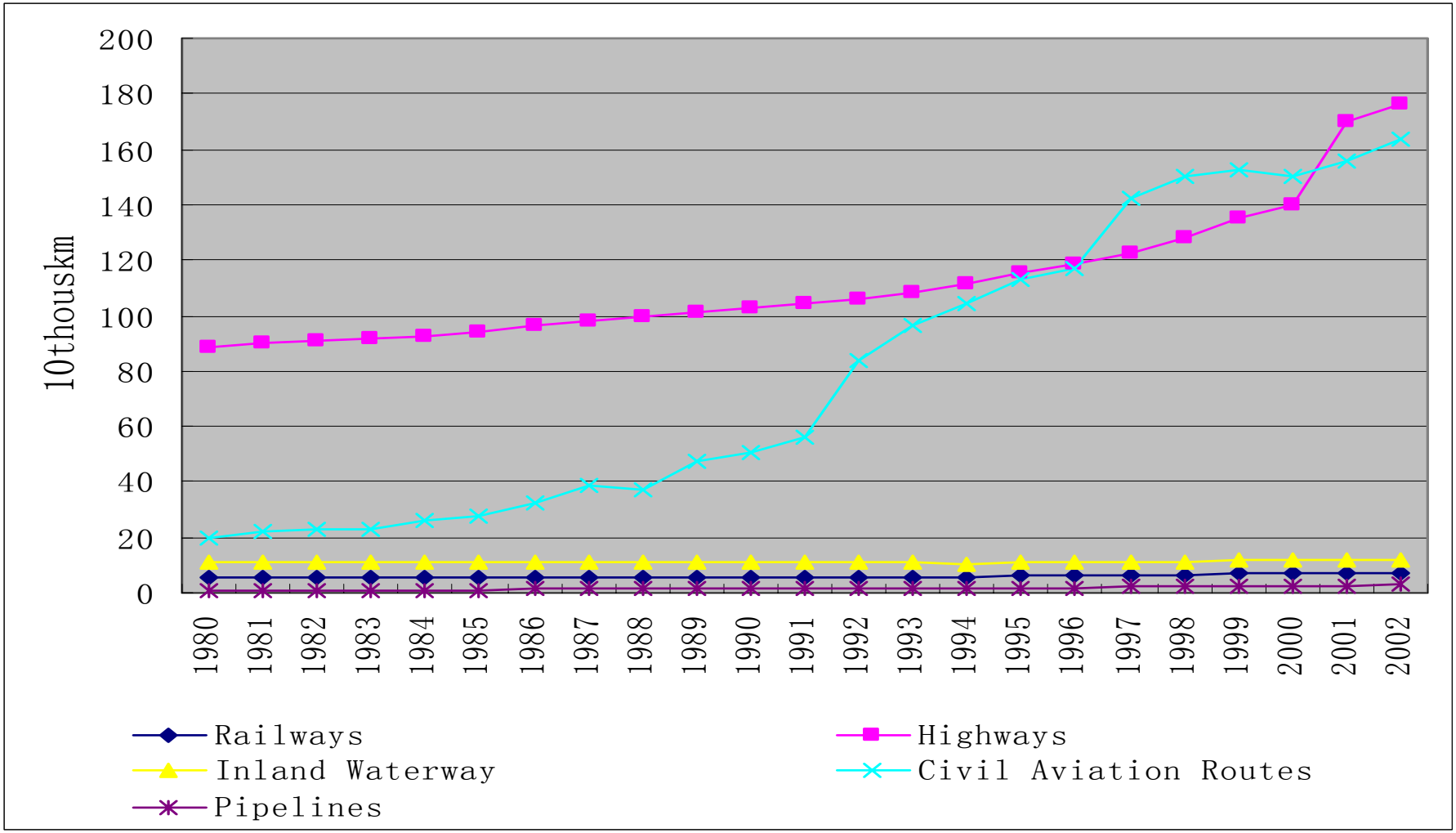
降低运输成本vs.拓展企业市场边界



5.2 运输系统概况



各运输方式运输线路在延长



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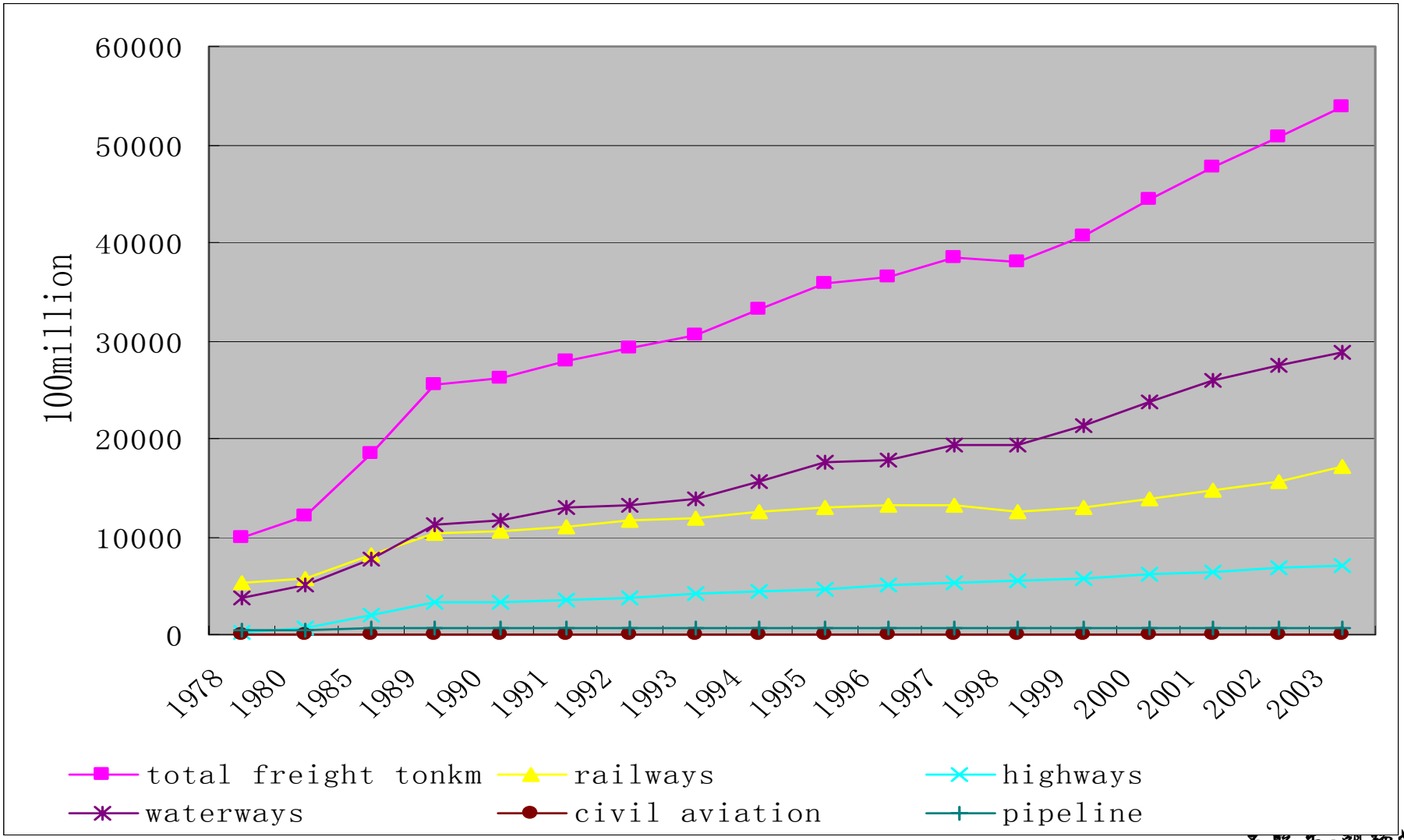
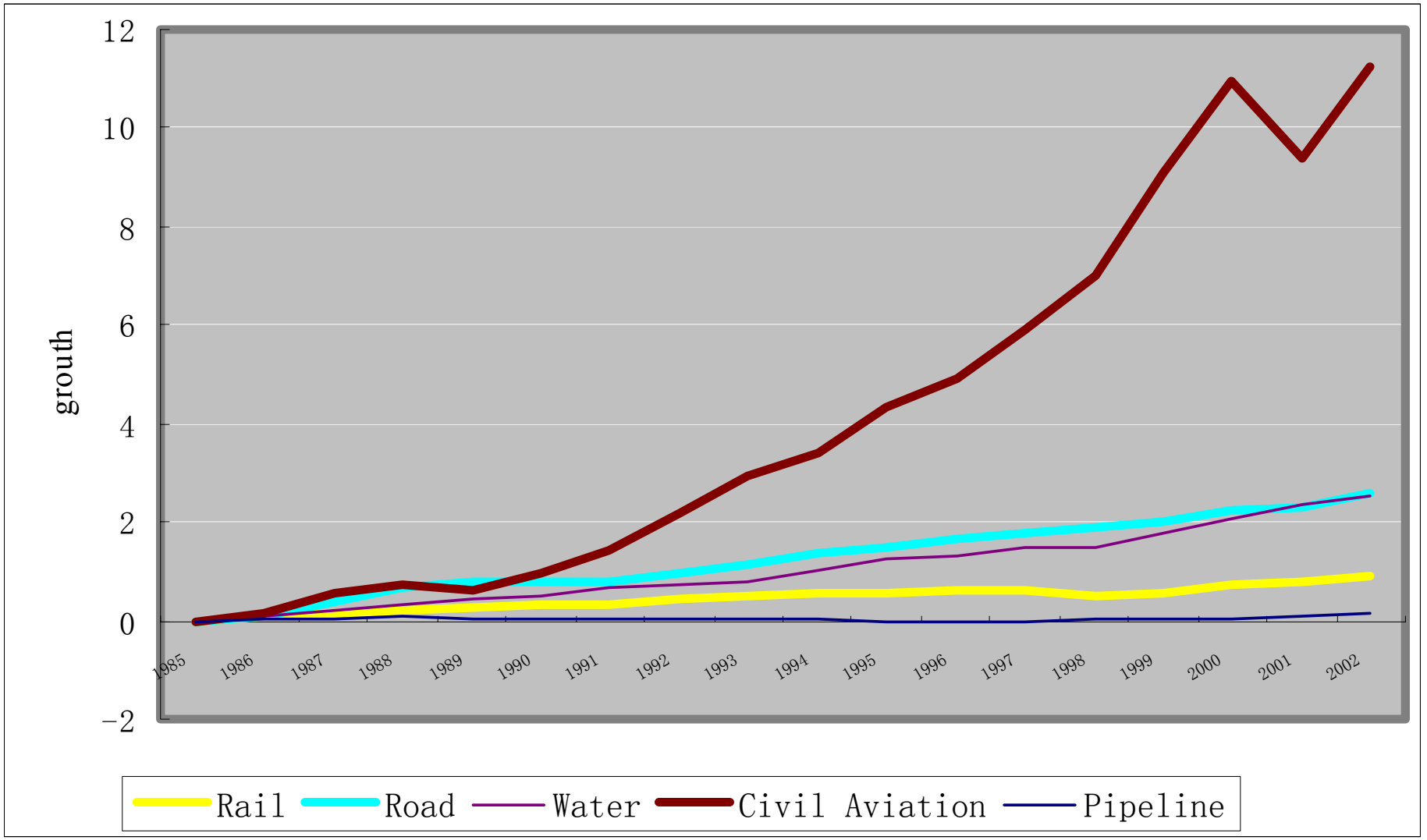
Data Source: China Statistical Yearbook, 2004.

运量快速增长

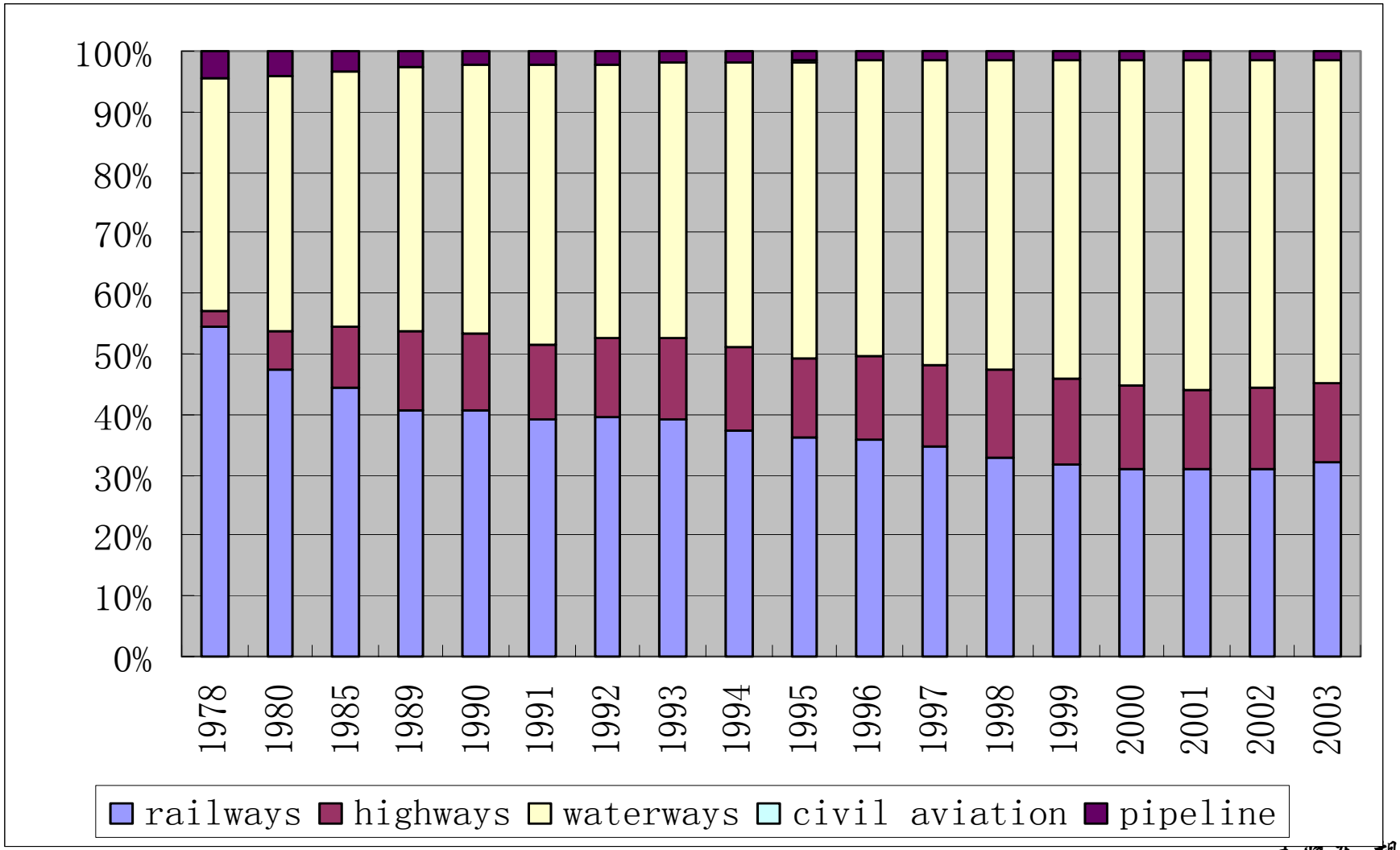


Data Source: China Statistical Yearbook, 2004.

全社会货运周转量增长

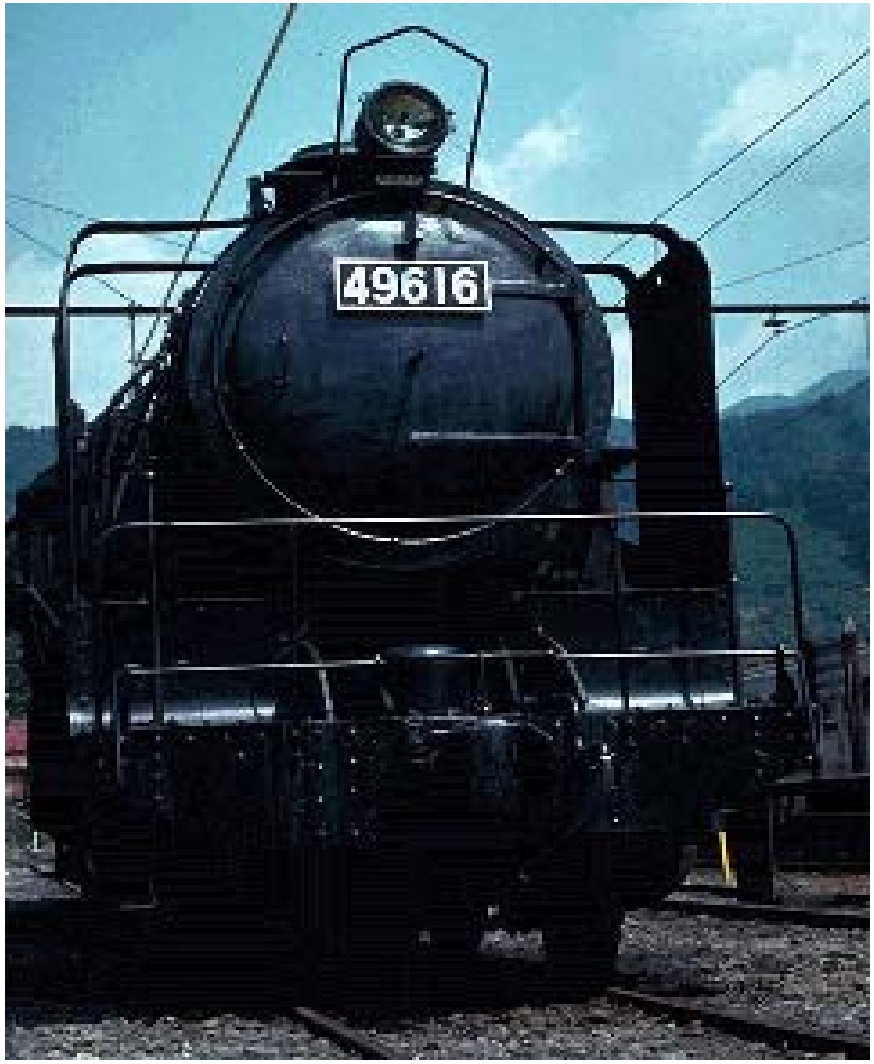

12
10
8
6
4
2
0
-2
grouth
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Rail
Road
Water
Civil Aviation
Pipeline

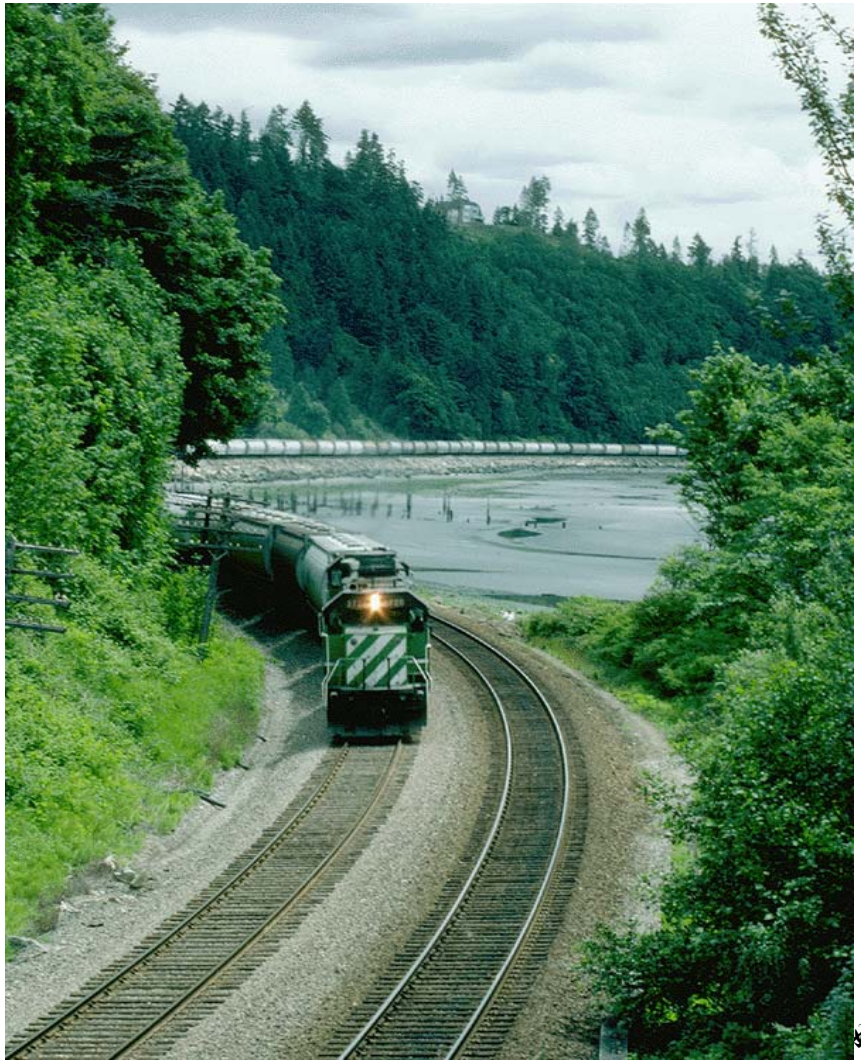
全社会货运周转量的构成



Data Source: China Statistical Yearbook, 2004.

铁路运输

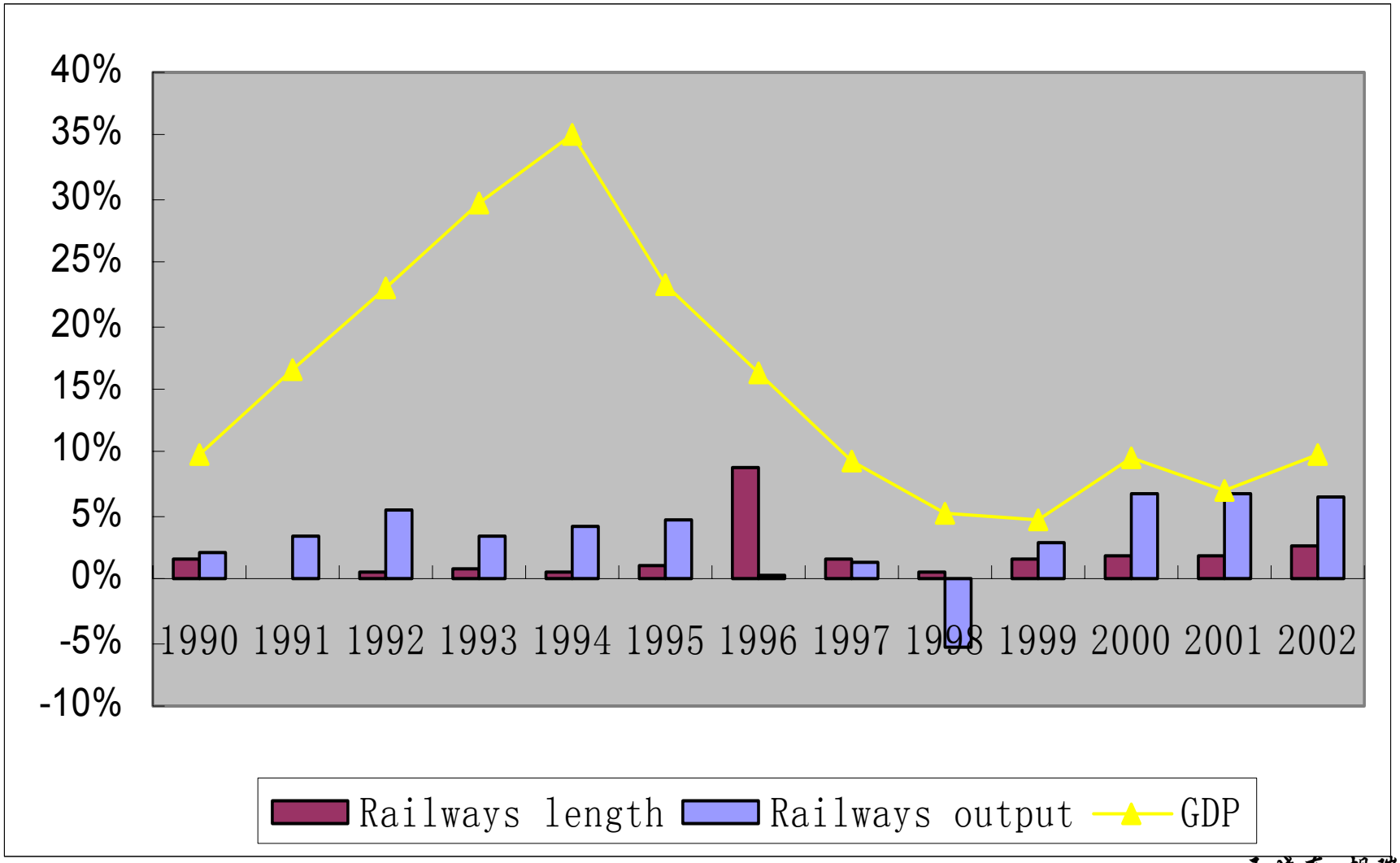




Rail

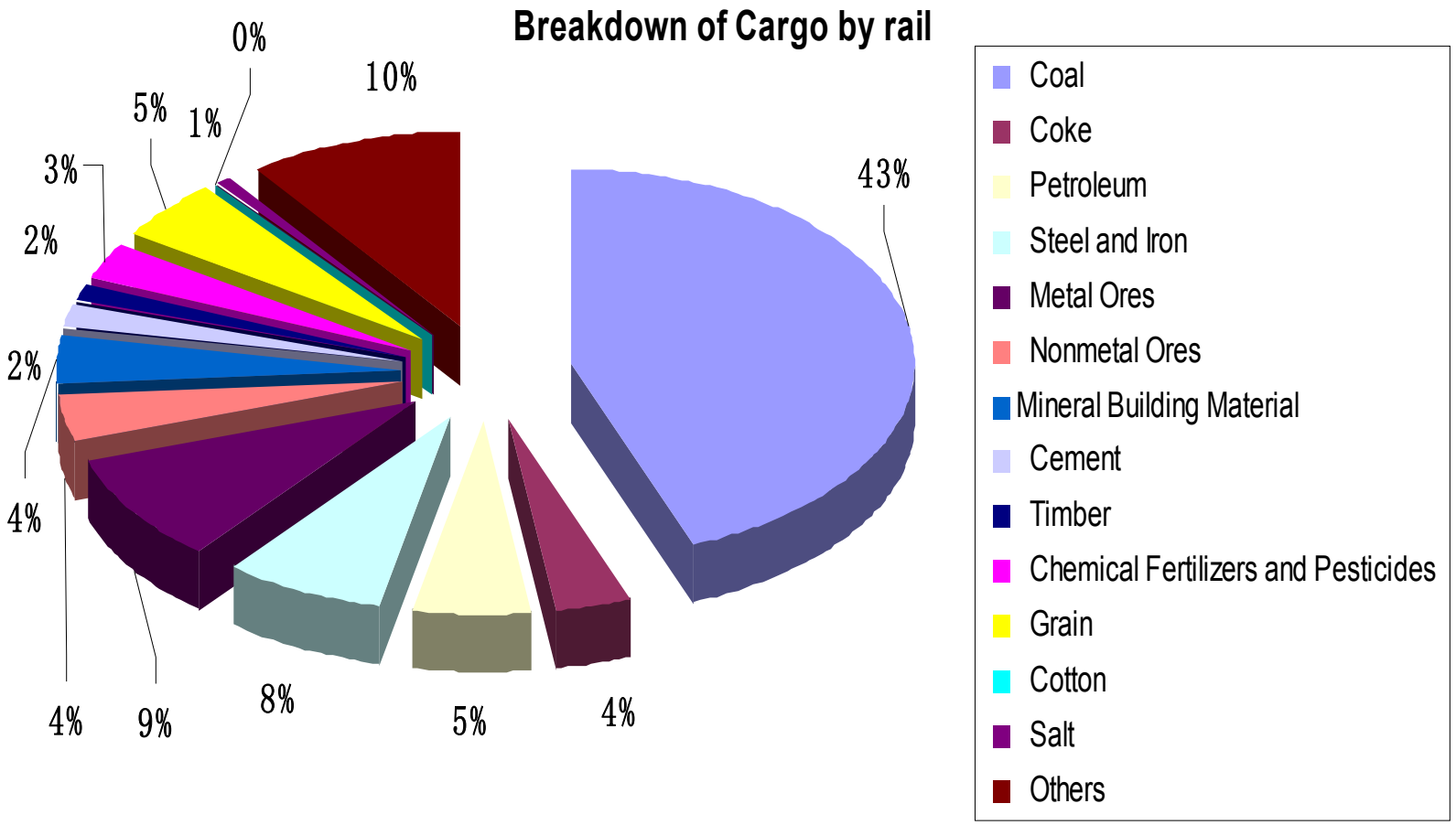
- 运行速度快：1998年磁悬浮列车在日本539公里实验时速
- 适应性强：全天候，受地理条件和天气影响小，可运送各种货物，通用性强
- 运输能力大;
- 环境污染少：电力机车
- 修建铁路要大量金属，资金
- 需要提货、送货，短途运输成本高
- 受轨道限制，灵活性差

铁路基础设施的发展



Data Source: China Statistical Yearbook, 2004.

铁路货物构成

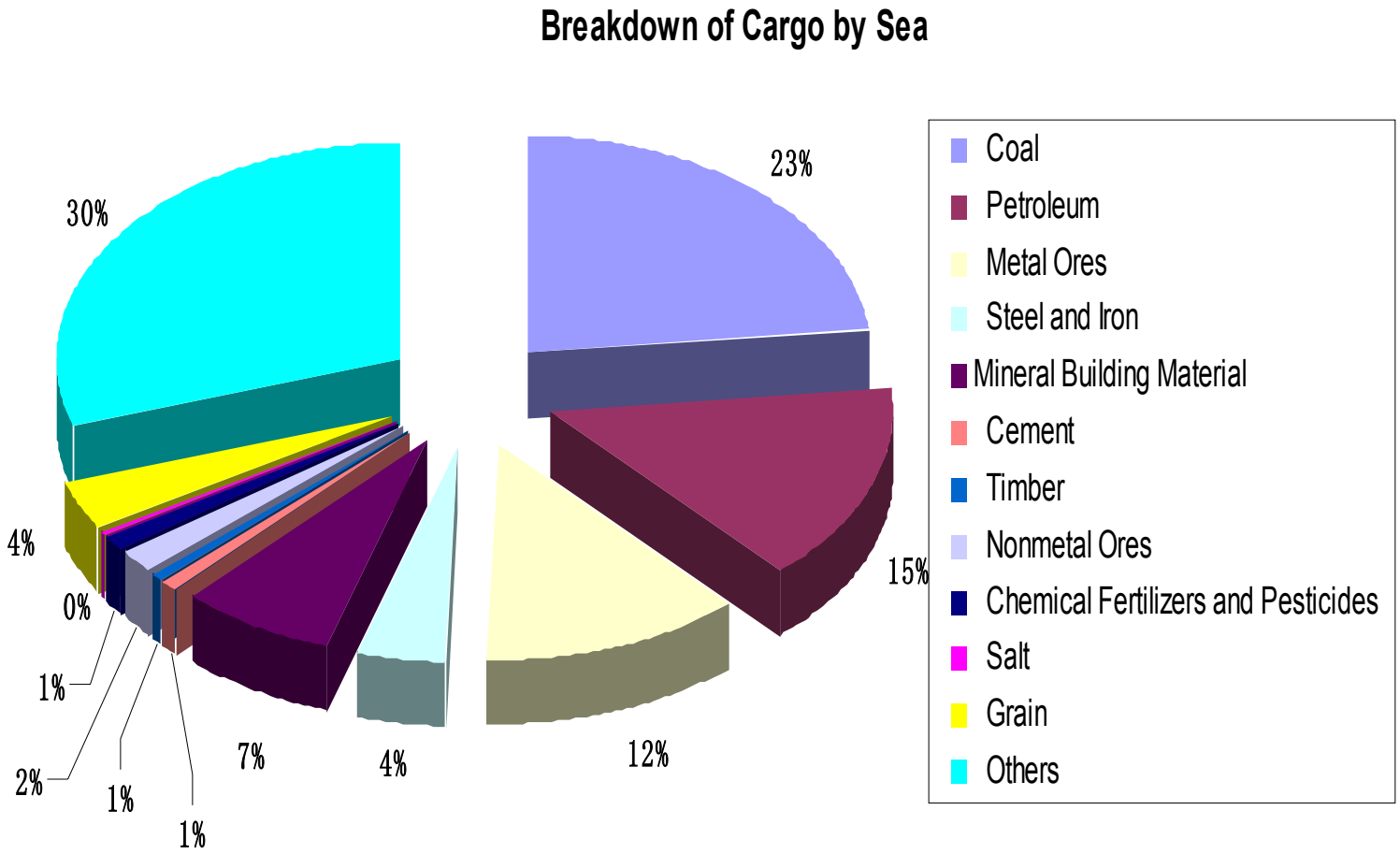

Breakdown of Cargo by rail
0%
10%
5%
1%
3%
2%
2%
4%
4%
9%
8%
5%
4%
43%
Coal
Coke
Petroleum
Steel and Iron
Metal Ores
Nonmetal Ores
Mineral Building Material
Cement
Timber
Chemical Fertilizers and Pesticides
Grain
Cotton
Salt
Others

水路运输

水运

- 运输能力大
- 无通道投资
- 通过能力强
- 适货性强，适合运大件货物
- 运输成本低（运距长，运量大）
- 对地理环境要求高，适应性差
- 路线迂回
- 速度慢
- 风险大，破损多

海运货物构成


Breakdown of Cargo by Sea
23%
15%
12%
4%
7%
1%
1%
2%
1%
0%
4%
30%
Coal
Petroleum
Metal Ores
Steel and Iron
Mineral Building Material
Cement
Timber
Nonmetal Ores
Chemical Fertilizers and Pesticides
Salt
Grain
Others

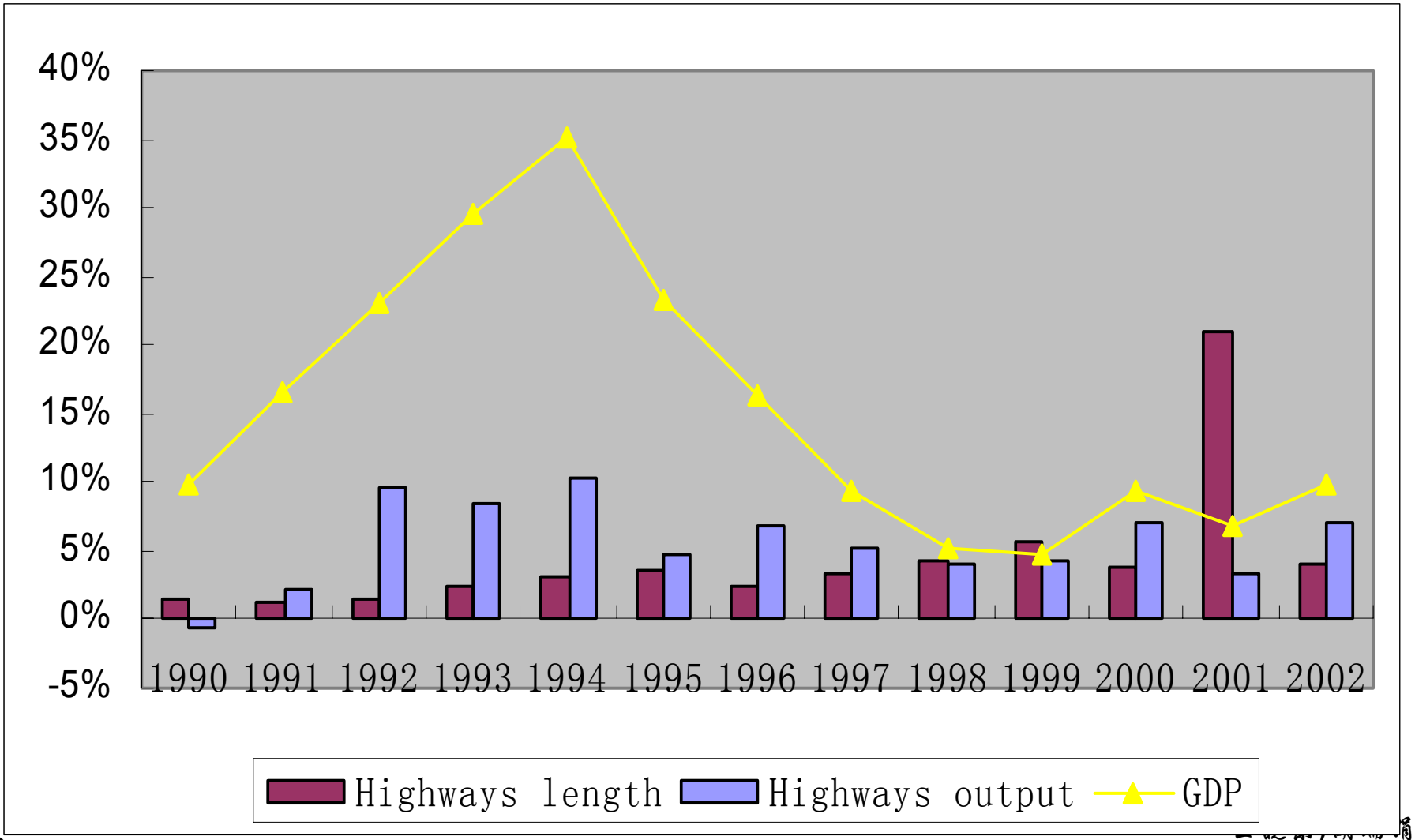
沿海主要货物港口吞吐量（万吨）

港　口	1985	1990	1995	1999	2000	2001	2002	2003
总　计	31154	48321	80166	105162	125603	142634	166628	201126
上　海	11291	13959	16567	18641	20440	22099	26384	31621
宁　波	1040	2554	6853	9660	11547	12852	15398	18543
广　州	1772	4163	7299	10157	11128	12823	15324	17187
天　津	1856	2063	5787	7298	9566	11369	12906	16182
青　岛	2611	3034	5103	7257	8636	10398	12213	14090
大　连	4381	4952	6417	8505	9084	10047	10851	12602
秦皇岛	4419	6945	8382	8261	9743	11302	11167	12562
日　照		925	1452	2003	2674	2933	3136	4507
营　口	98	237	1156	1945	2268	2520	3127	4009
连云港	929	1137	1716	2017	2708	3058	3316	3752
烟　台	689	668	1361	1646	1774	2190	2689	2936
湛　江	1231	1557	1885	1751	2038	2205	2627	2866
汕　头	201	279	716	1191	1284	1309	1380	1470
海　口	170	288	468	674	808	888	1073	1329
八　所	388	431	275	380	378	342	343	425
三　亚	78	37	42	27	48	71	49	61
其他港口		5092	14687	23749	31479	36228	44645	56984

公路运输

- 普遍性，全球公路网密度居五种运输方式之首
- 机动灵活，可门到门服务
- 通用性强，可运送几乎所有货物
- 快捷可控，在中短途运到速度快，与其他方式结合也可提供长途快运服务
- 投资少，市场开放
- 单车平均运载量小，能耗大
- 安全、舒适性差
- 公路拥挤，污染日益严重

公路基础设施的发展



Data Source: China Statistical Yearbook, 2004.

公路运输

- 在陆路运输的地位越来越重要
- 运输技术越来越先进
  - 重载车辆、托挂运输、专用车辆大量使用
  - 大中型车辆柴油化、智能化
- 已经基本形成全国公路网络，高速公路越来越多

陆路运输基础设施的国际比较

Country or Area	length of line road	density of road network (km/square km)	traffic density of rail (traffic units per km)
China	1402698	0.15	30262
Japan	1161894	3.07	13048
US	6304193	0.65	7479
France	894000	1.62	3854
UK	371913	1.62	3500
Russian Federation	532393	0.31	15854

Data Source: World Bank.

航空运输

王晓东，胡瑞娟

航空运输

- 机动性好，不受地表条件限制
- 速度快，航班密
- 依赖地面运输完成门到门服务
- 安全、舒适，对包装要求少
- 受天气影响大
- 运量小，运价高
- 运输能力有限，无法运大件货物
- 以客运为主的局面仍然继续

管道运输

- 运量大，24x365小时工作
- 能耗低，安全无污染
- 不受气候影响
- 占地少，节约能源，劳动力，货物无须包装，损耗少，没有空返问题
- 投资少，管理简单，单位运营成本低
- 适应性、通用性差、灵活性差
- 初期建设成本高

几种运输方式之间的比较

Economic characteristics	Motor	Rail	Air	Water	Pipeline
Cost (cent/ton-mile in US)	**Moderate 25.08**	**Low 2.5**	**High 58.75**	**Low 0.73**	**Low 1.40**
Market coverage	**Point-to-point**	**Terminal-to-terminal**	**Terminal-to-terminal**	**Terminal-to-terminal**	**Terminal-to-terminal**
Degree of competition	**Many**	**Few**	**Moderate**	**Few**	**Few**
Predominant traffic	**All types**	**Low/moderate value, moderate high density**	**High value, low-moderate density**	**Low value, high density**	**Low value, high density**
Average length of haul(kms) In China	**829 61**	**993 760**	**1424 2251**	**605 to 2200 1940**	**444 to552 339**

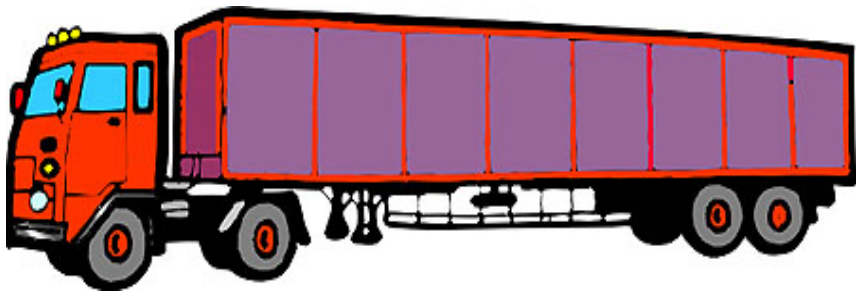
几种运输方式之间的比较（续）

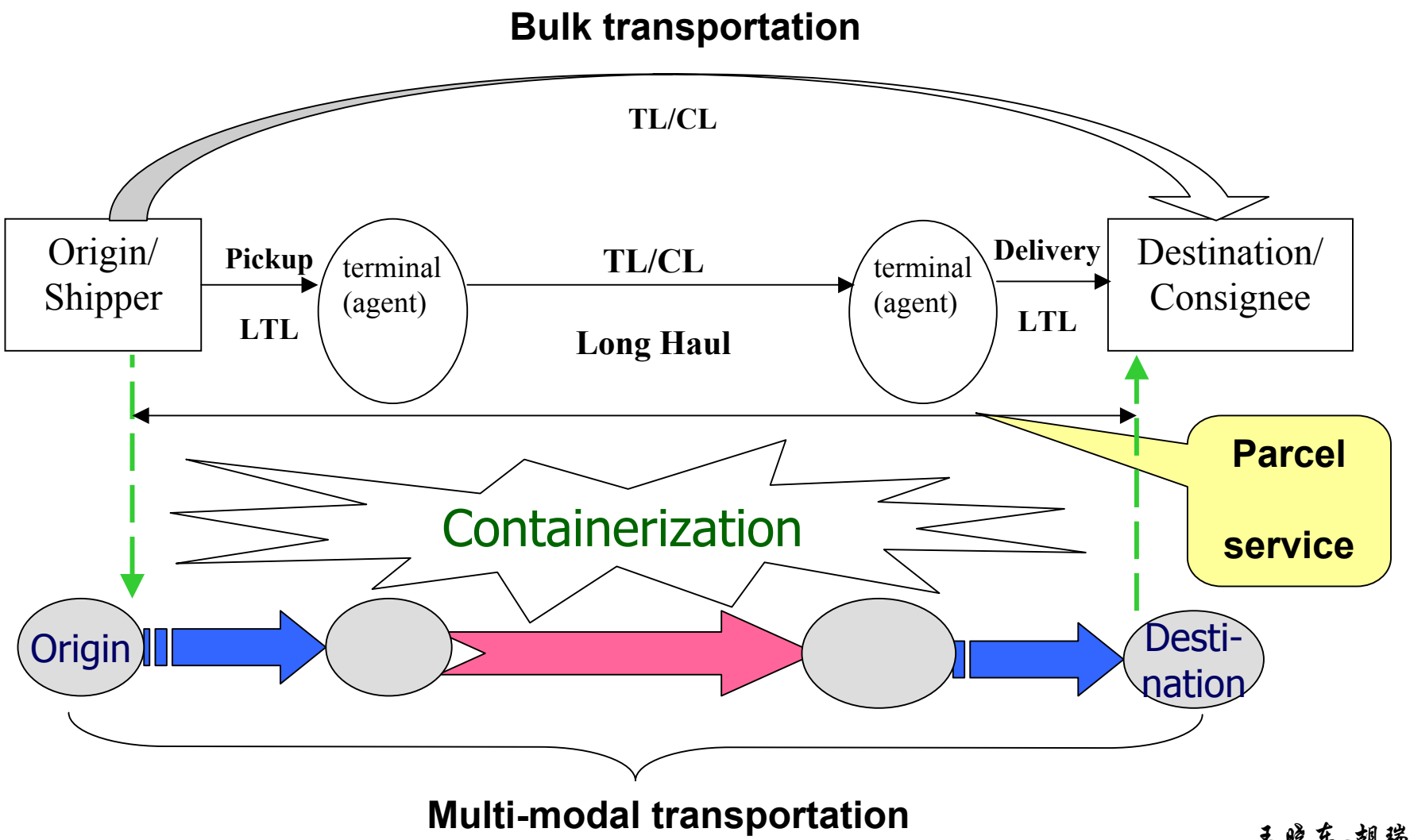
Service characteristics	Motor	Rail	Air	Water	Pipeline
Equipment capacity(tons) Average weight in China	10 to 25 3.27	50 to 12000 58.1	5 to 125	1000 to 60000	30000 to 2500000
Speed(time-in-transit)	Moderate to fast	Moderate	Fast	Slow	Slow
Availability	High	Moderate	Moderate	Low	Low
Consistency (delivery time variability)	High	Moderate	High	Low to moderate	High
Loss and damage	Low	Moderate	Low	Low to moderate	Low
Flexibility (adjustment to shipper's needs)	High	Moderate	Moderate to high	Low to moderate	Low

Source: Douglas M. Lambert,etc. *Fundamentals of Logistics Management*, McGraw Hill, 1998. Pp229.
China Statistic Yearbook, 2003

基本运输方式的结合使用

- 零担运输（LTL）和整担运输（TL/CL）
- 散货运输
- 包裹运输
- 危险品运输
- 工程运输 **Project transportation**
- 大陆桥运输
- 成组运输（集装箱运输）
- 多式联运




Bulk transportation
TL/CL
Origin/ Shipper
Pickup
LTL
terminal (agent)
TL/CL
Long Haul
terminal (agent)
Delivery
LTL
Destination/ Consignee
Parcel service
Containerization
Origin
Desti-nation
Multi-modal transportation

成组运输

- 指采用一定的方法将分散的单件货物组合在一起，成为一个规格化、标准化的大的运输单位进行运输，以适于机械化、自动化操作。
- 常见的成组化运输方式包括:
  - 托盘运输
  - 集装箱运输

多式联运

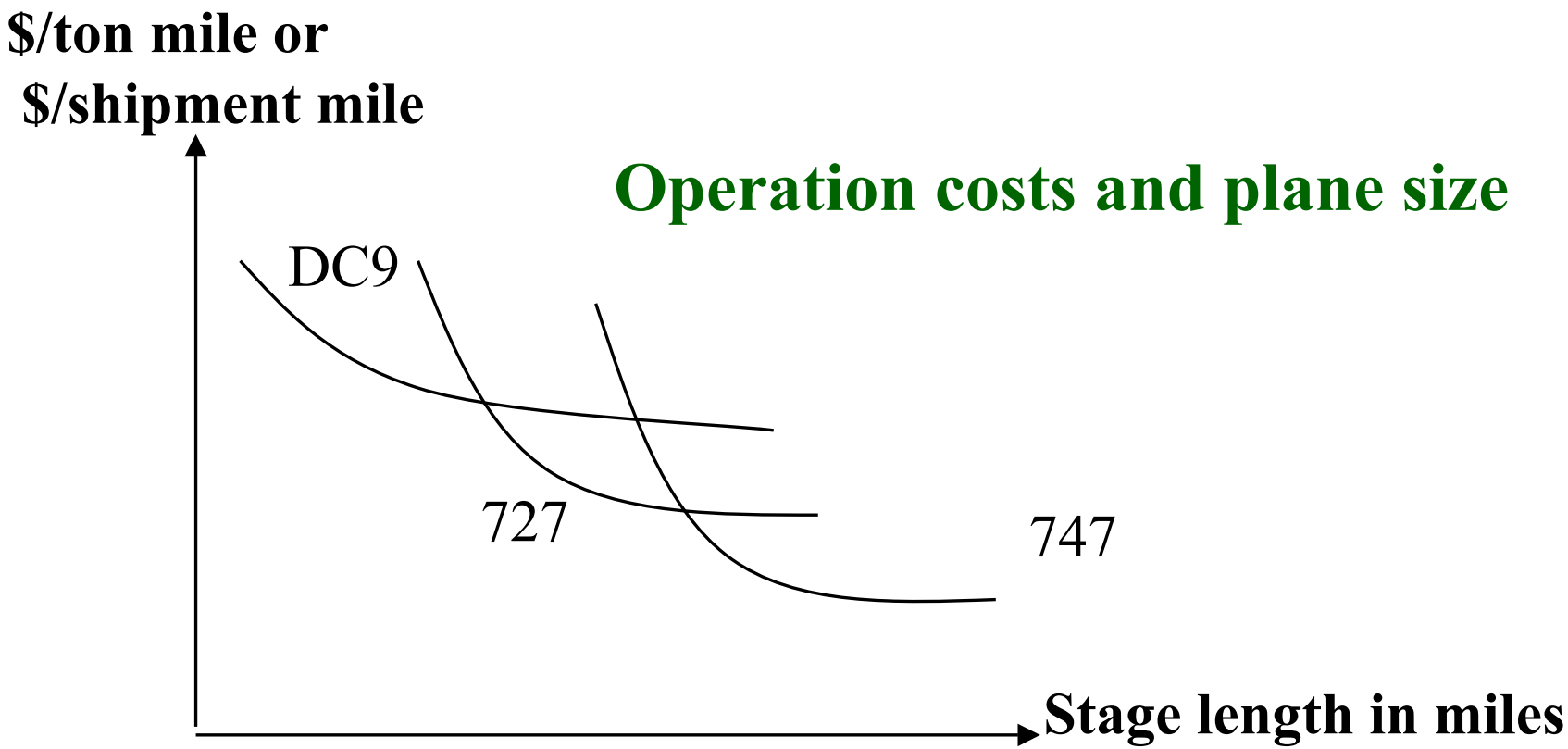
- （国际多式联运公约）国际多式联运是按照多式联运合同，以至少两种不同的运输方式，由多式联运经营人将货物从一国境内接管货物的地点送至另一国境内交付货物的地点
- 多式联运也经常采用集装箱运输方式完成

5.3 运输成本特征

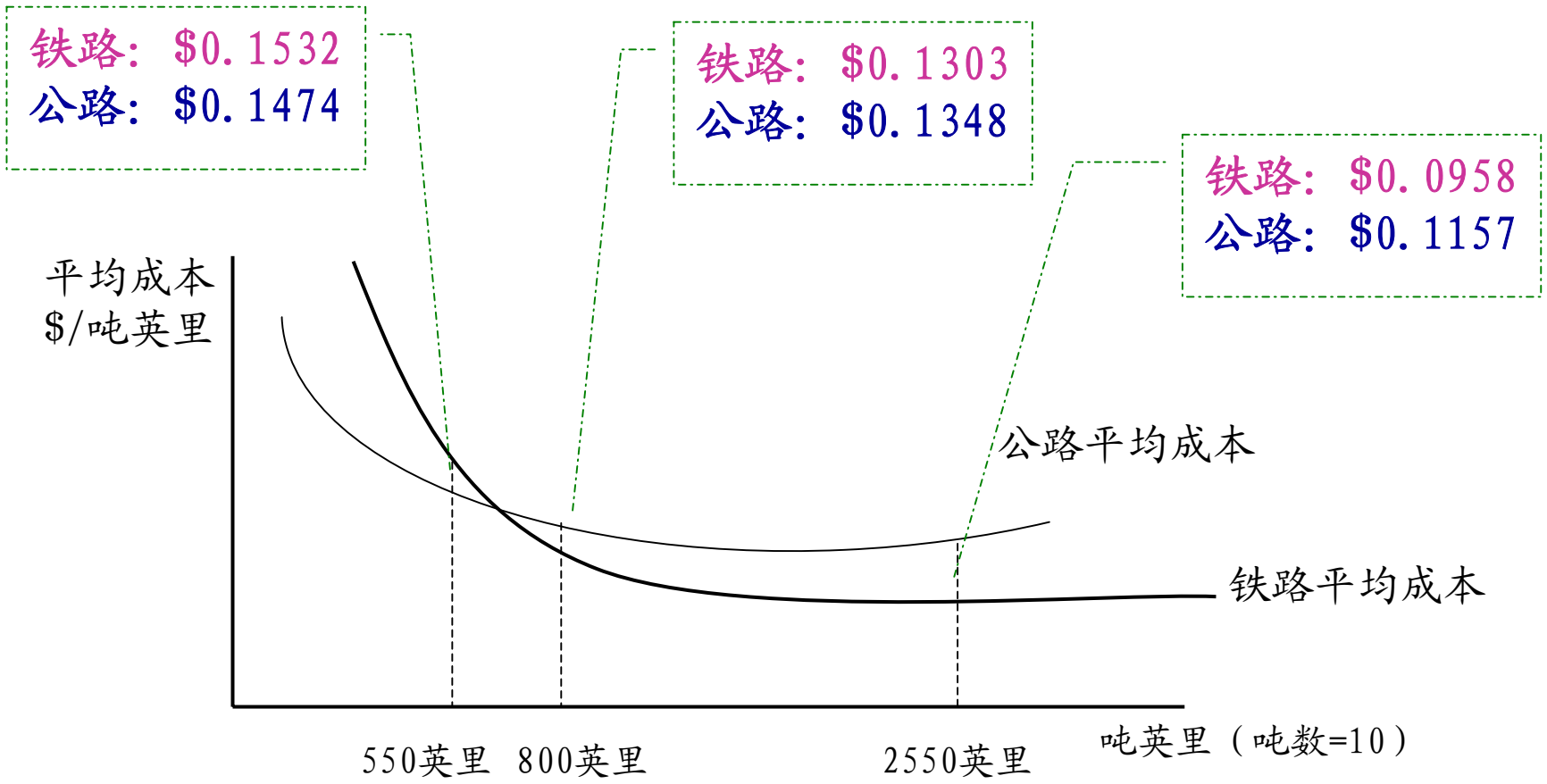
运输服务成本一般包括:

- 起点站、终点站产生的货物装卸、处理成本
- 运输途中产生的运送成本
- 中转站的转运成本
- 运输起点站、终点站产生的取货、送货成本
- 制单成本（**Billing cost**）等

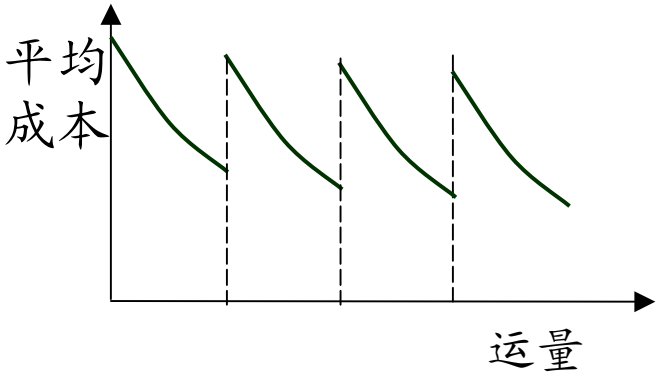
运载工具的规模与平均成本

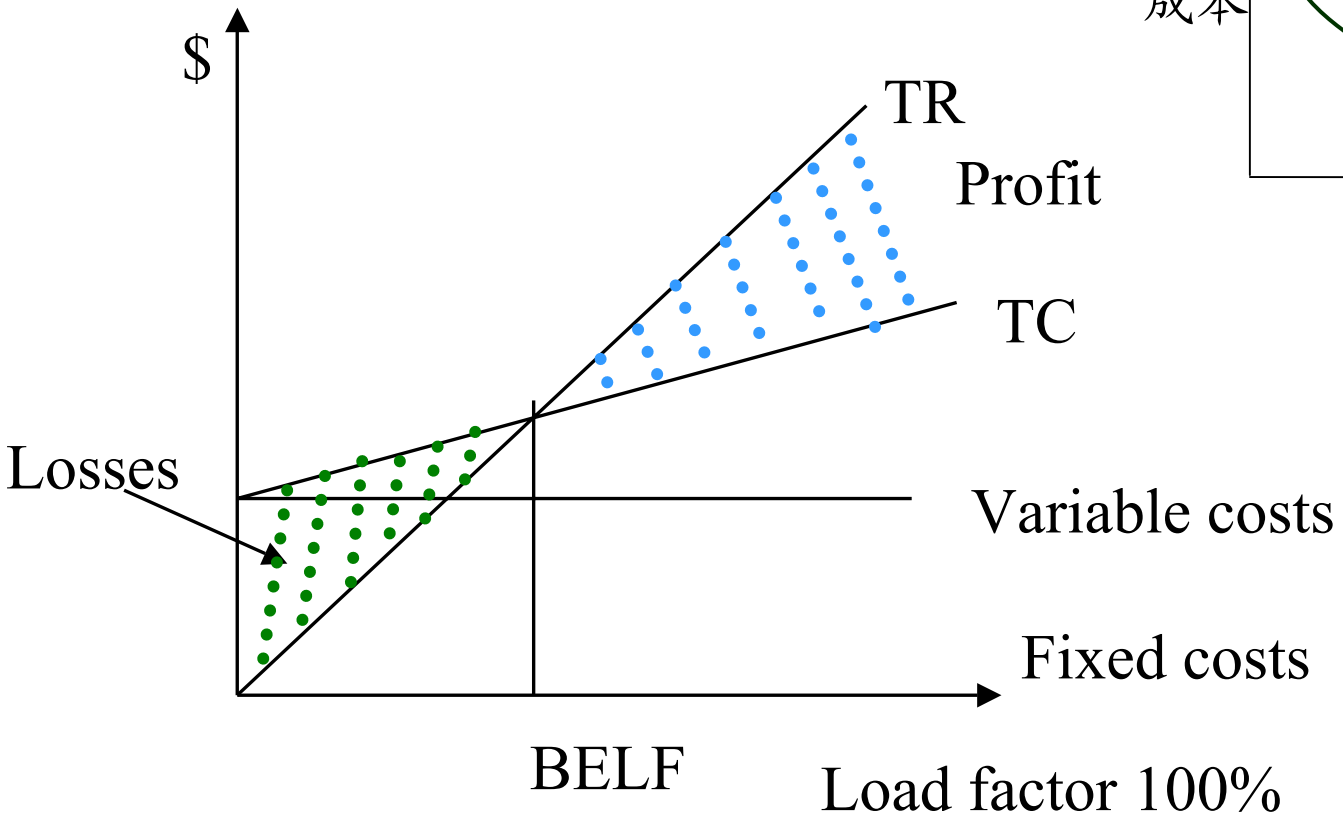


运输距离与平均成本


铁路：$0.1532
公路：$0.1474
铁路：$0.1303
公路：$0.1348
铁路：$0.0958
公路：$0.1157
平均成本
$/吨英里
公路平均成本
铁路平均成本
550英里
800英里
2550英里
吨英里（吨数=10）

载运比率与平均成本



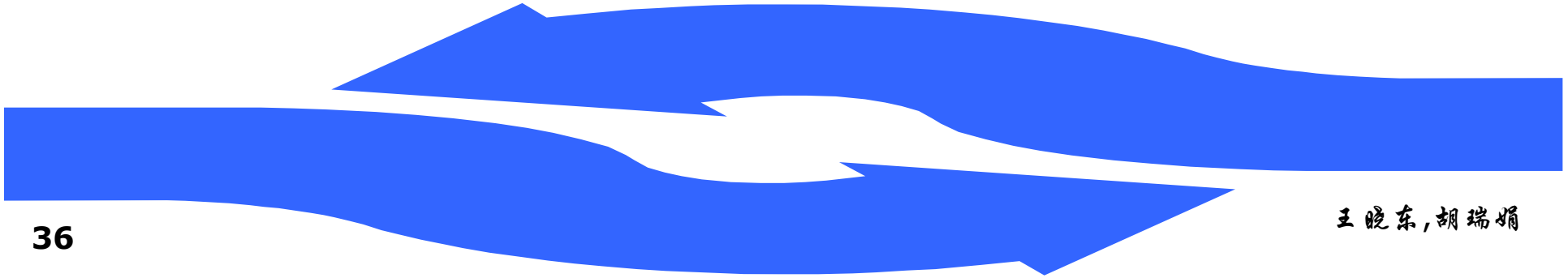


Break even load factor

联合成本或共同成本

- Forward haul & backward haul

- Byproduct



总成本和平均成本

- 某运输企业运送每单货物产生制单费用5元，每吨货物装卸费8元，甲乙两地相距100公里，每公里燃油消耗3元。

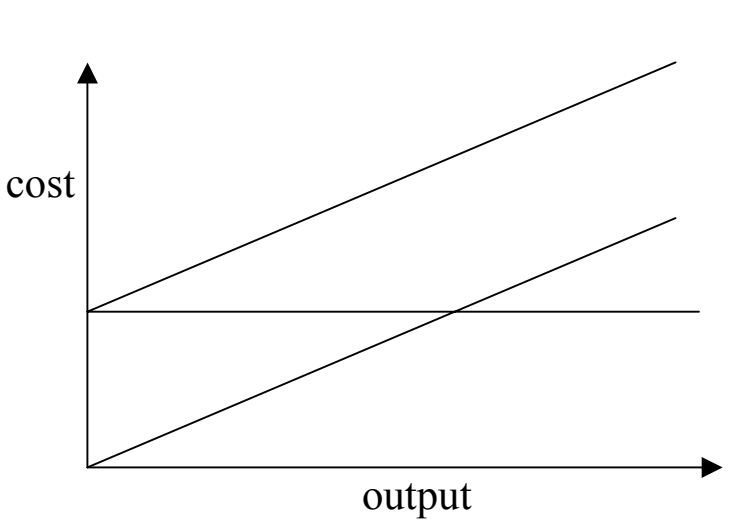
问：现有一车，某日装运7吨货物由甲地到乙地，再空车返回甲地，当天的运输总成本是多少？

  - 如果该车可同时装运两单货物（分别为7吨和3吨）由甲地到乙地，再空车返回甲地， 当天的运输总成本是多少：
  - 如果同一辆车回程时还可以运送10吨由乙地到甲地货物，则当天的运输总成本是多少？

- 另请计算在上述情况下的平均成本，请分别用元/吨·公里、元/吨来表示。

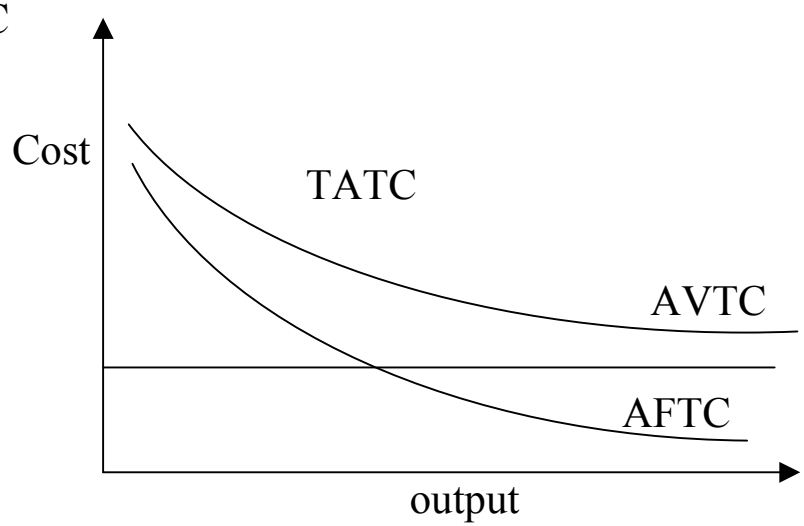
运输成本的构成

Variable Cost +Fixed Cost:



Output Units:

- ton-mile
- tons
- shipments
- shipment-mile

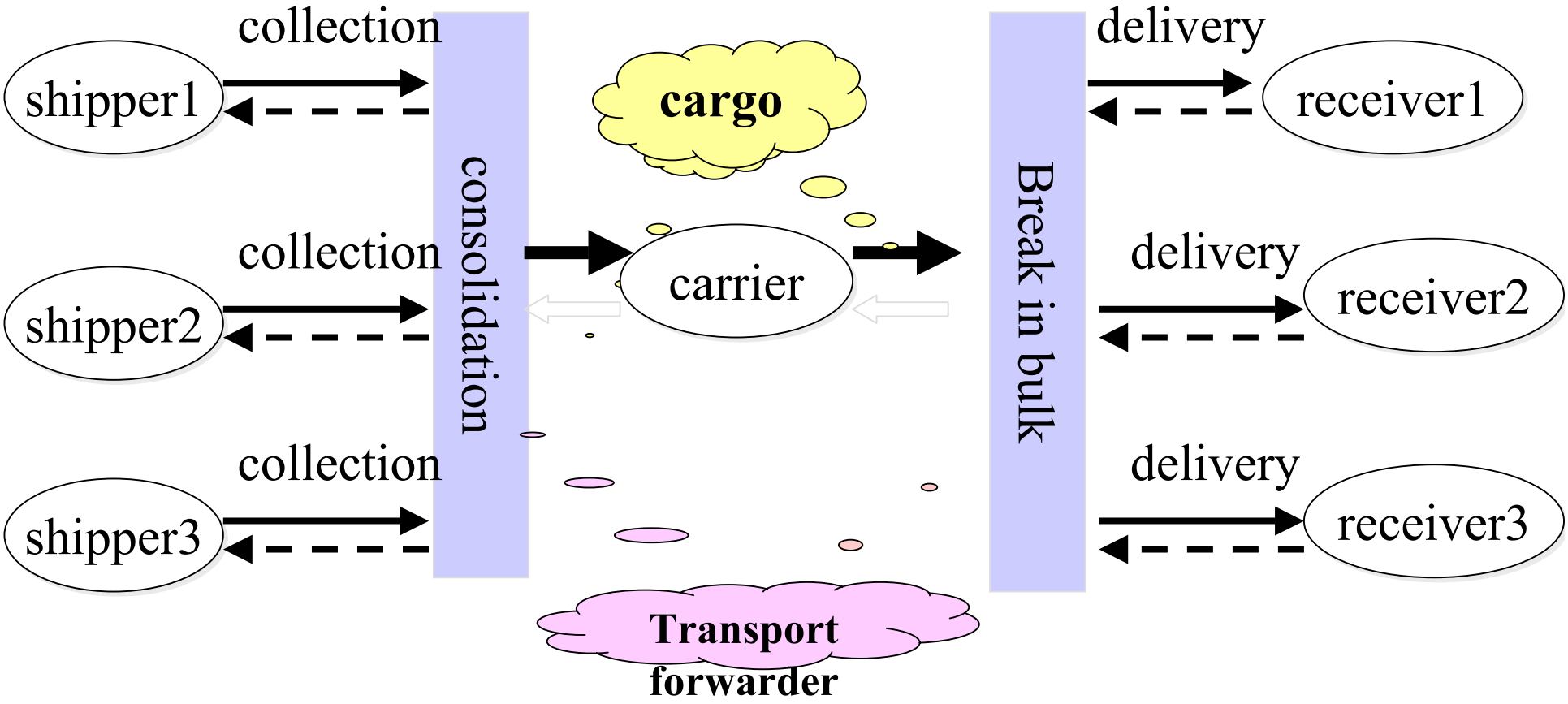


How to reduce transport costs?

降低平均成本

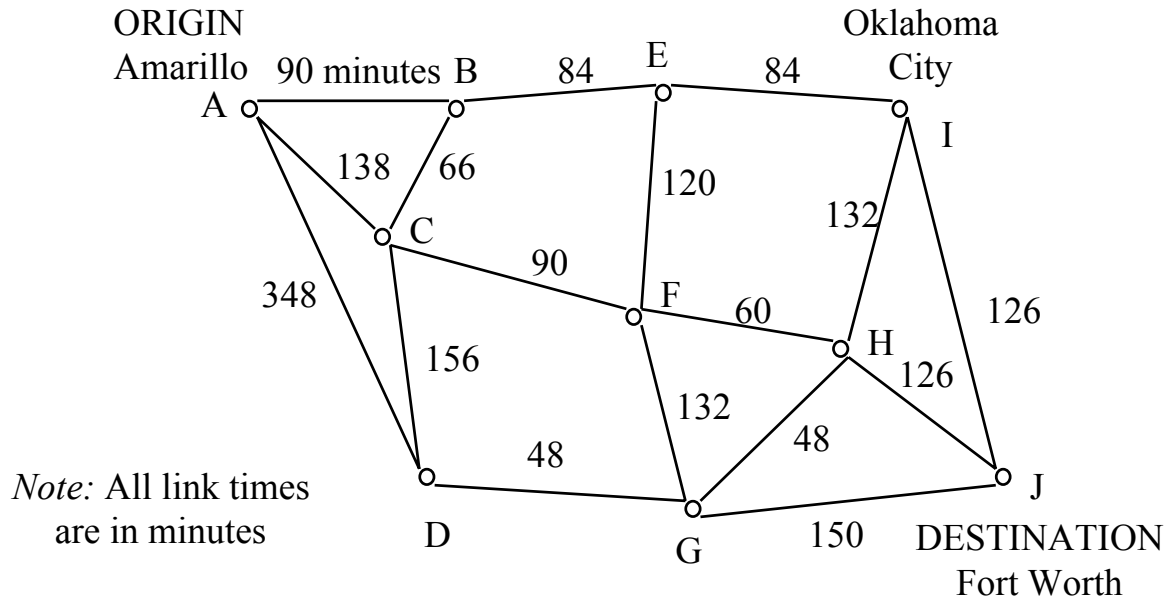
- 运输成本决定于：
  - 本批次运输使用运载工具的数量，而单位运输工具所承载货物的数量受到：运输工具容积和额定载重量的限制
  - 运输的距离
  - 中转等特殊服务
- 节约运输成本，可以：
  - 尽量提高所运输货物的密度——改进包装方式
  - 增加单位运载工具所运输货物的重量——集拼作业
  - 缩短运输距离——寻找最短路径
  - 避免多次中转、装卸作业

集拼作业


collection
shipper1
collection
shipper2
collection
shipper3
consolidation
cargo
carrier
Transport
forwarder
Break in bulk
delivery
receiver1
delivery
receiver2
delivery
receiver3

最短路径问题

Given a network with (non-negative) costs on the arcs, find a "shortest-path" from a given origin node to a destination node.



举例: Fort Worth 食品工厂

	From				
	Fort Worth	Day 1	Day 2	Day 3	Consolidated
TO	Topeka	5,000	25,000	18,000	48, 000
	Kansas	7, 000	12, 000	21, 000	40, 000
	Wichita	42, 000	38, 000	61, 000	141, 000

rate level				
	Day 1	Day 2	Day 3	Consolidated
Topeka	16.41	9.91	14.90	7.09
Kansas	15. 87	14. 38	9. 55	6. 83
Wichita	6. 33	6. 33	6. 33	6. 33

cost comparison				
	Day 1	Day 2	Day 3	Consolidated
Topeka	82,050.00	247,750.00	268,200.00	340,320.00
Kansas	111,090.00	172,560.00	200,550.00	273,200.00
Wichita	265,860.00	240,540.00	386,130.00	892,530.00
Total	459, 000. 00	660, 850. 00	854, 880. 00	1, 506, 050. 00
Totals			1, 974, 730. 00	
savings in transportation costs				*468, 680. 00*

To decide whether or not the consolidation is desirable, the effect on revenues of a lengthened order cycle time has to be compared with the transportation cost savings.

5.4 运输费率

Product-related factors

- Bulk Density: weight-bulk ratio
- Stowability: utilization of space
- Easiness of handling
- Risk characteristics

Market-related factors

- Inter/Intra mode competition
- Distance to the market
- Regulatory factor
- Seasonality
- Direction,etc.

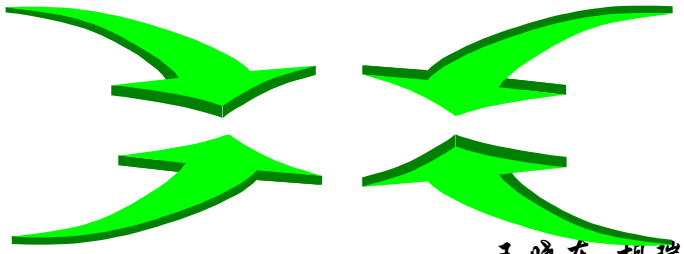
Pricing

Service Characteristics

- Reliability: consistence, continuity
- Delivery time
- Coverage
- Flexibility
- Loss and damage
- Capability of providing related service

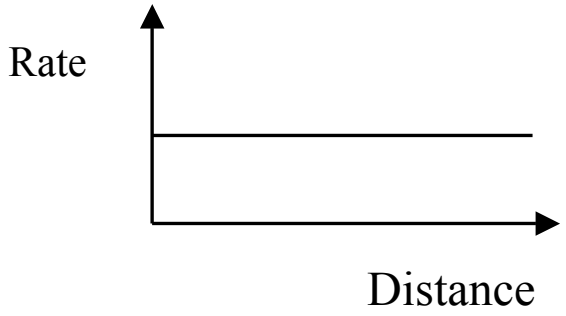
运价种类

- 与距离相关的运价Distance related rate
- 与需求相关的运价Demand related rate
- 等级运价Class rate

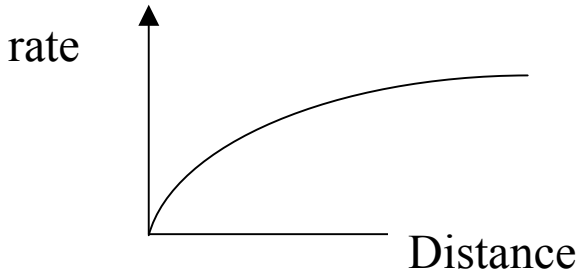


与距离相关的运价

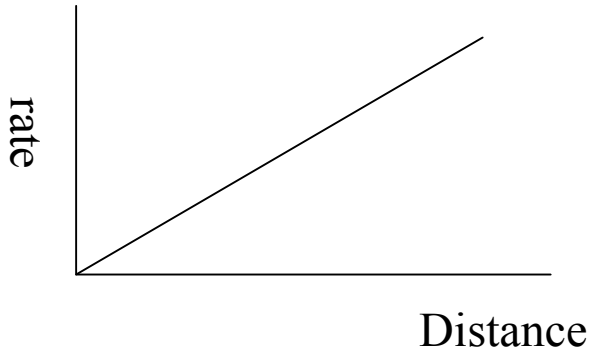
Uniform rate - postcard



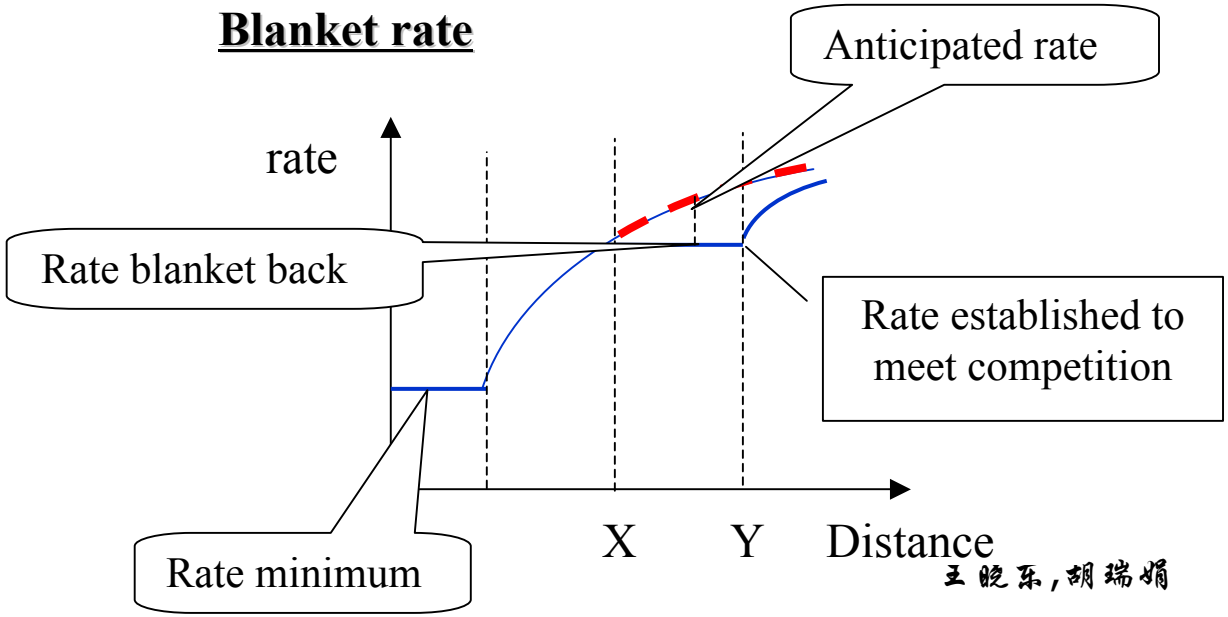
Tapering rates - rail rates



Proportional rate



Blanket rate

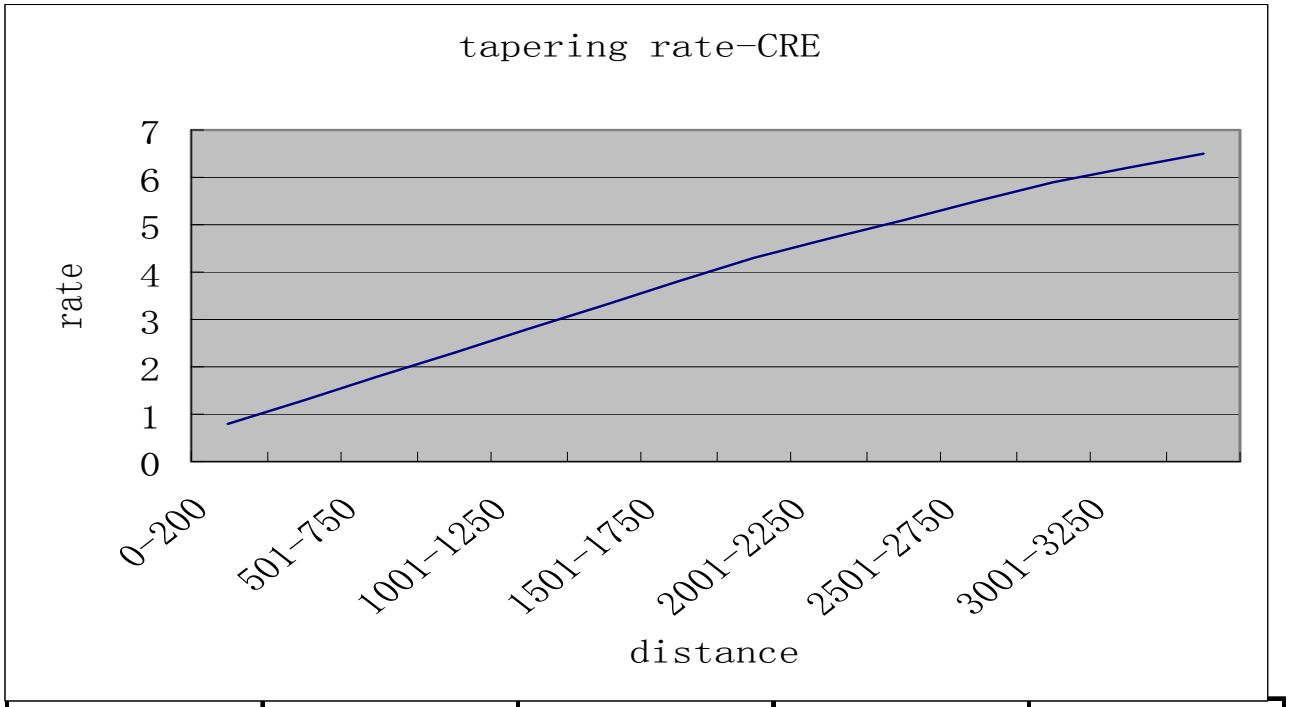


举例：中国铁路特快运费

Rail freight tariff

Y=a +bX

- **Y is rate in CNY per ton**
- **X is distance**
- **a, b are coefficients determined by the regulatory authority (MOR)**



origin	destination	Rate(CNY)	Distance	Service level
Beijing	Shanghai	3. 3	1463	Door-to-door
Beijing	Guangzhou	5. 1	2300	Door-to-door

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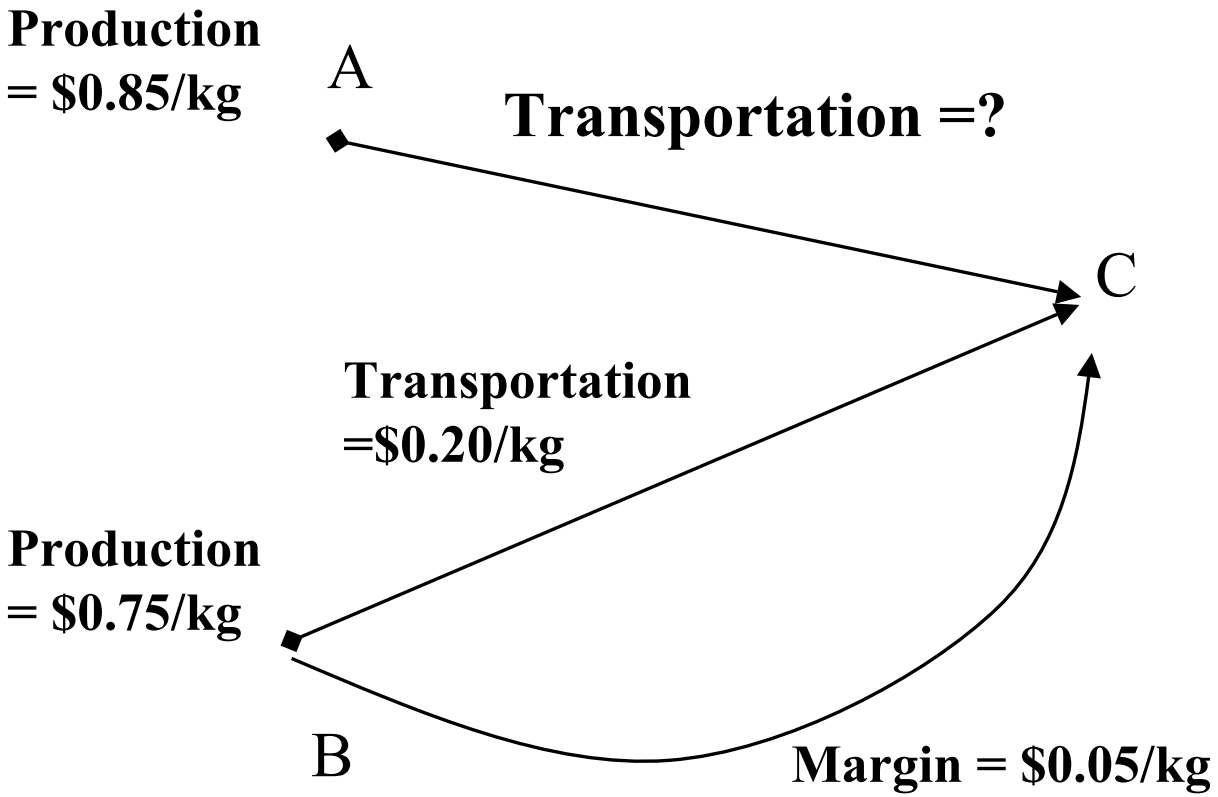
与需求相关的运价：竞争因素



等级运价

- A function of the distance between shipment origin and destination points as well as other factors.
- Shippers do not always pay the rates for the quantities exactly as shown in tariff list. The quantity at which the break occurs can be found by the following formula:

$$Breakweight = \frac{Rate_{Next} \times Weight_{Next}}{Rate_{Current}}$$

- Where
  - *Break weight* = weight above which the next higher weight- break rate should be used for lower transport costs
  - $Rate_{Next}$ = Rate for next higher weight break
  - $Weight_{Next}$ = Minimum weight of next higher weight break
  - $Rate_{Next}$ = Rate for true weight of shipment

举例：中国航空的货物运费

airline	Distance (km)	Minimum rate	Basic rate (CNY/kg)	45kg	100kg	300kg
Beijing--Shanghai	1178	30	5.9	4.7	4.1	3.5

How much do you anticipate to pay for 90kg cargo?

Price you pay = $30+90\times4.7 = 453$CNY

What is the break weight ?

$$Breakweight = \frac{Rate_{Next}\times Weight_{Next}}{Rate_{Current}} = \frac{3.5\times100}{4.1} = 87.5$$

Thus, the airline will charge as if you checked in 100kg cargo?

Price you actually pay = $30+100\times4.1 = 440$CNY < 453CNY

5.5 运输决策

- 自营运输的优劣:
- 使用外部运输服务:
  - 选择承运人
  - 运输方式、线路;
  - 费率谈判;
  - 其他

（其中多项决策可能同时作出）

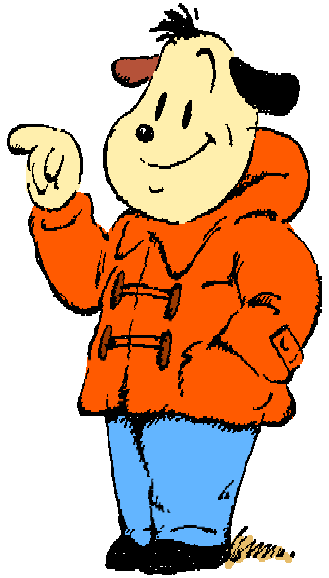
影响自营或外包的因素

- 一次性投资 **One-time investment**
- 日常维护成本 **Maintenance cost**
- 对货物控制、管理的力度 **Control of goods and management**
- 运输技术的专业性 **Specialized technology**
- 运输工具的利用率 **Utilization of vehicle**
- 其他

Outsource or Not?

评价运输服务的主要指标

- 价格：端点费用+途中运费
- 平均运送时间：门到门
- 运送时间的波动：衡量服务的可靠程度
- 破损情况
- 运力
- 运输服务的频率
- 货物信息的可得性
- 其他特殊服务



对运输服务的选择

Selection determinants	User implication
Transport cost	Landed costs
Transit time	Inventory, stockout costs, marketing
Reliability	Inventory, stockout costs, marketing
Accessibility	Transit time, freight costs
Capability	Meet physical/marketing needs
Security / Safety	Inventory, stockout costs

Source: The Management of Business Logistics, pp342

成本因素

- 尽管客户往往不愿意承认，在承运人选择中，运输成本是最重要的决定因素。
- 运输成本因素又包括费率（**Rates**）、起码计费重量（ **Minimum Weights** ）、装卸费用（**Loading and Unloading**）、包装费用（ **Packaging**）、破损情况（**Loss and Damage**）和所提供的特殊服务等因素（ **Special Services Available**）。
- 上述因素会因不同企业、产品、情况而异。
- 随着一体化物流管理概念的普及，运输成本因素的要重性有所下降，企业将从总成本角度重新评估运输服务

运输时间与可靠性

- 运输时间（ **Transit time** ）是从托运人（ **consignor** ）托运货物到承运人将货物送到收货人（ **consignee** ）手中其间所经过的所有时间。包括装卸、中转服务和从始发站到终点站运送服务所需要的所有时间
- 可靠性（ **Reliability** ）之承运人所提供的运输服务所用运输时间的一致性

运输时间与可靠性（2）

- 运输时间与可靠性会影响库存水平和缺货成本。运输时间缩短可以降低库存，可靠性水平提高可以降低库存（安全库存）和缺货成本
- 如果提前期稳定，企业很容易使库存成本最小化，但如果运输时间不一致，企业就不得不增加库存水平。

运输服务的可得性

- 指客户是否可以使用承运人提供的运输服务
- 运输服务的可得性决定于运输方式的特点，也取决于承运人服务网络的地理范围、服务种类的多样性和服务的频率

运输服务的安全性

- 多指货物载运输过程中出现的灭失或损坏的情况
- 不同的运输方式、运输线路、运载工具、运输包装方式，以及货物的固有属性、承运人对服务质量的管理能力都会影响货物的破损率和丢失率

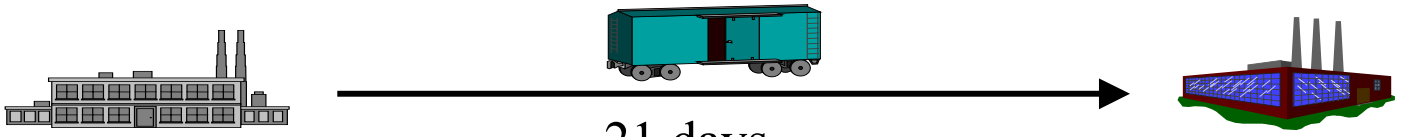
评估承运人的主要指标

Determinant	Importance rank
Transit time reliability or consistency	1
Door-to-door transportation rates or costs	2
Total door-to-door transit time	3
Willingness of carrier to negotiate rate changes	4
Financial stability of the carrier	5
Equipment availability	6
Frequency of service	7
Pickup and delivery service	8
Freight loss and damage	9
Shipment expediting	10
Quality of operating personnel	11
Shipment tracing	12
Willingness of carrier to negotiate service changes	13
Scheduling flexibility	14

Source: Edward, J. Bardi, Prabir Bagchi, and T.S. Raghurathan, 'Motor Carrier Seletion in a Deregulated Environment,' Transport Jounal 29, no.1 (Fall 1989):4-11.

Case1 : Carry-All Company

- Annual demand: 700,000 units of luggage
- Inventory carrying cost: 30% of unit value ($30)
- Current distribution plan:



East Coast Plant

Inventory=200,000units

West Coast Warehouse

Inventory=200,000units

- Average inventory can be reduce by 1% with one day reduction of the transit time.
- The company can use the following transport service:

Transport Service	Rail	Piggyback	Truck	Air
Rate,$/Unit	0. 1	0.15	0. 2	1. 4
Door-to-Door Transit Time, Days	21	14	5	2
Size of Shipments	200, 000	100, 000	100, 000	50, 000

Solution

Cost Type	Method of computation	Modal Choice: Rail	Piggyback	Truck	Air
Transportation	R*D	0.10*700,000=	0.15*700,000=	0.20*700,000=	1.40*700,000=
		70000	105000	140000	980000
In-transit inventory	ICDT/365	(0.3*30*700,000*21)/365=	(0.3*30*700,000*14)/365=	(0.3*30*700,000*5)/365=	(0.3*30*700,000*2)/365=
		362,465.75	241,643.84	86,301.37	34,520.55
Plant inventory	ICQ/2	0.3*30*200,000/2=	0.3*30*100,000/2=	0.3*30*100,000/2=	0.3*30*50,000/2=
		$900,000	$450,000	$450,000	$225,000
Field Inventory	IC'Q/2	0.3*(30+0.1)*200,000/2=	0.3*(30+0.15)*100,000/2=	0.3*(30+0.2)*100,000/2*=	0.3*(30+1.4)*50,000/2=
		$903,000	$452,250	$453,000	$235,500
Total cost		2,235,465.75	1,248,893.84	1,129,301.37	1,475,020.55
		most expensive			cheapest

Note:

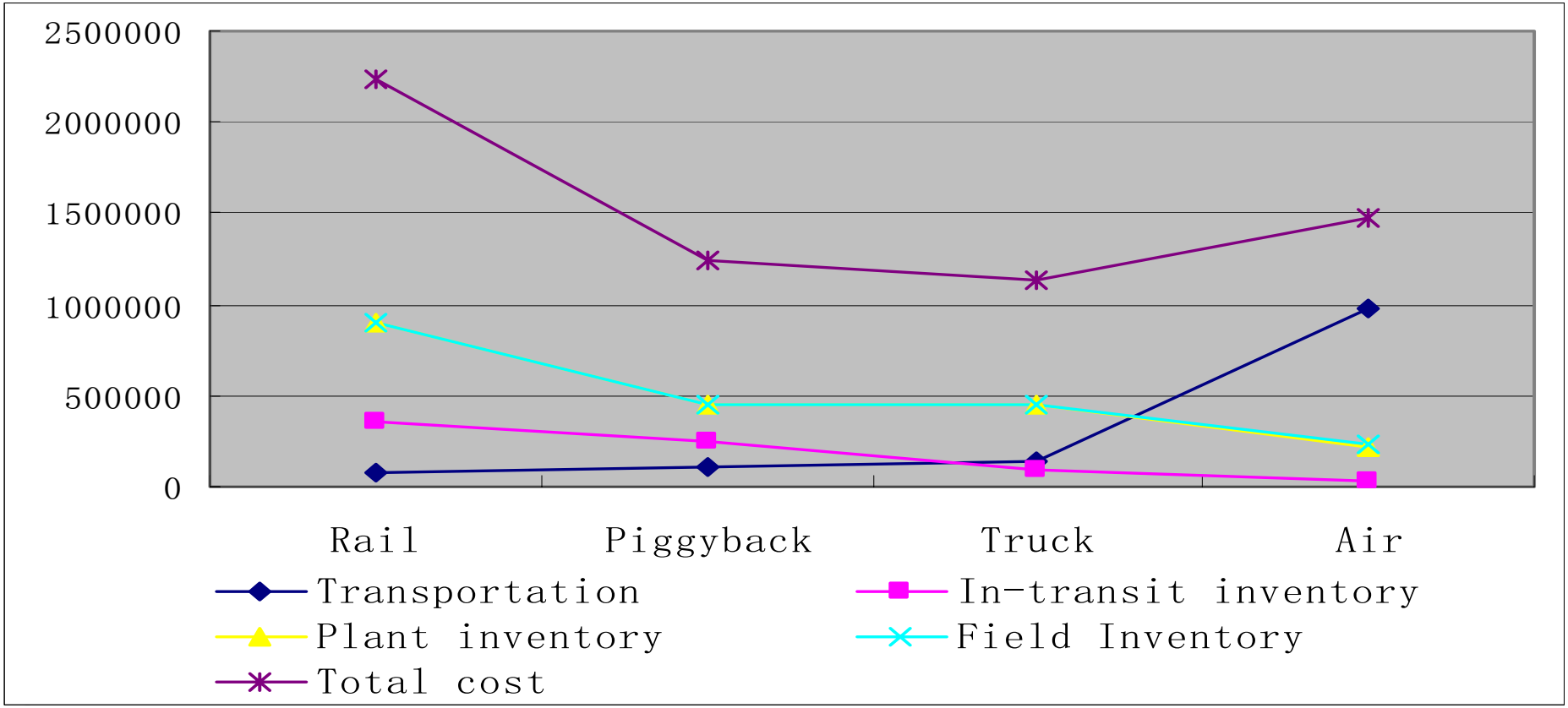
Demand is uniform distributed, thus

average inventory = 1/2 (beginning inventory + ending inventory) or 1/2 shipment

成本之间的权衡

Trade-off between transportation costs and inventory costs

--- the most frequent trade-off in logistics decisions



Case 2: Appliance manufacturer

total purchases	3,000				
value per case	$100				
supplier A	1,500	when uses rail			
supplier B	1,500	when uses rail			
5% of total purchase or 150 cases will be shifted to supplier for each day's reduction of average delivery time					
average margin before transportation charges			20%		

Transport mode	Transport rate (per case)	Delivery time (days)
Rail	$2.50	7
Truck	$6	4
Air	$10.35	2

Profit Comparison for Supplier A's Transport Modal Choices

Transport Mode	Cases Sold	Gross Profit	Transport Cost	Net Profit
Rail	1500	$30,000	3750.000	26250.000
Truck	1950	$39,000	11700.000	27300.000
Air	2250	$45,000	23287.500	21712.500

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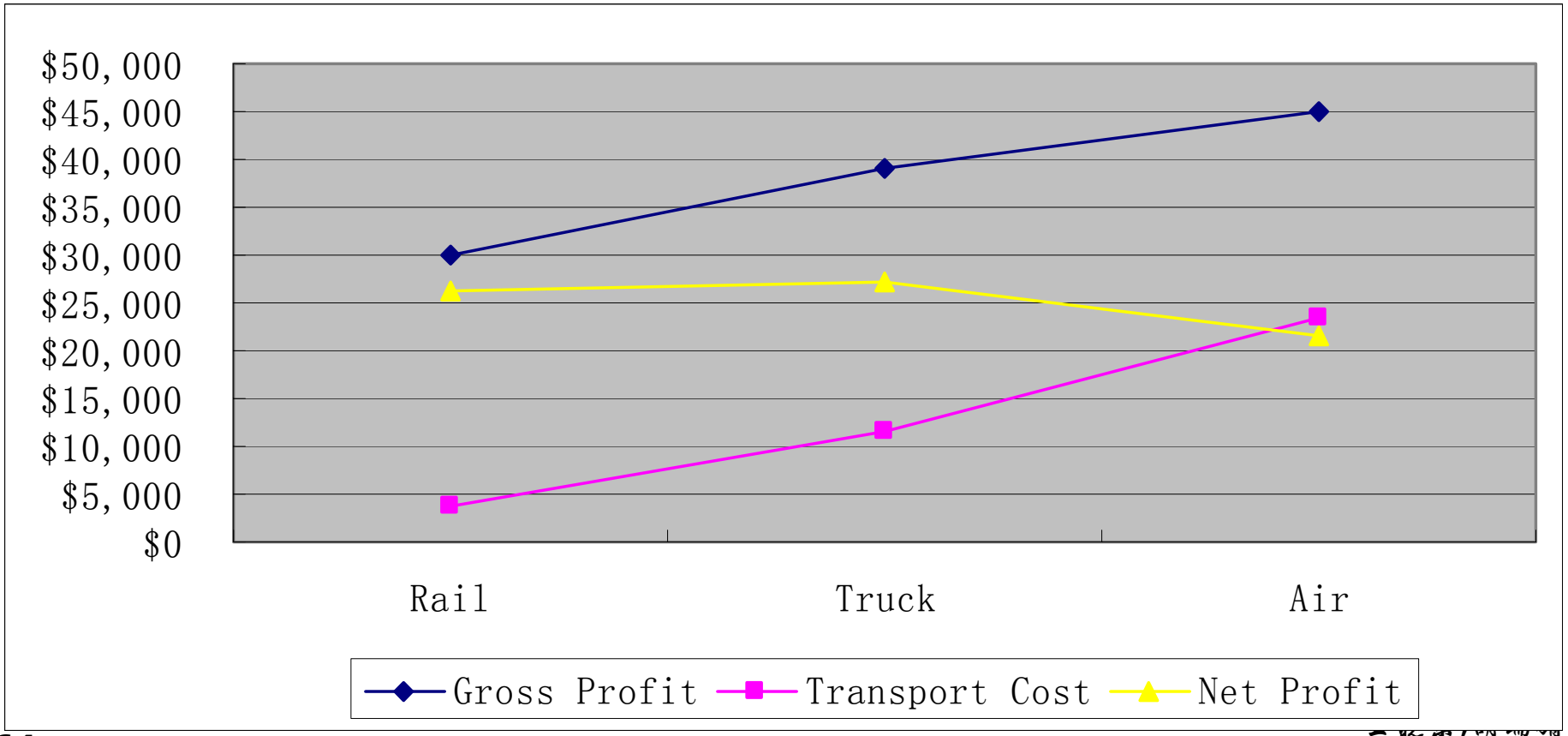
成本之间的权衡

Trade-off between the transportation cost and sales.



思考题

- 如何理解运输在物流管理中的重要作用
- 五大基本运输方式是什么？各有什么特征？
- 运输成本都受哪些因素影响？企业该如何降低运输成本？
- 哪些因素可以决定运价？常见的运价有哪几种？
- 运输决策都包括哪些内容？如何选择合适的承运人？
- 评估运输服务的指标有哪些？他们如何影响客户的物流成本？