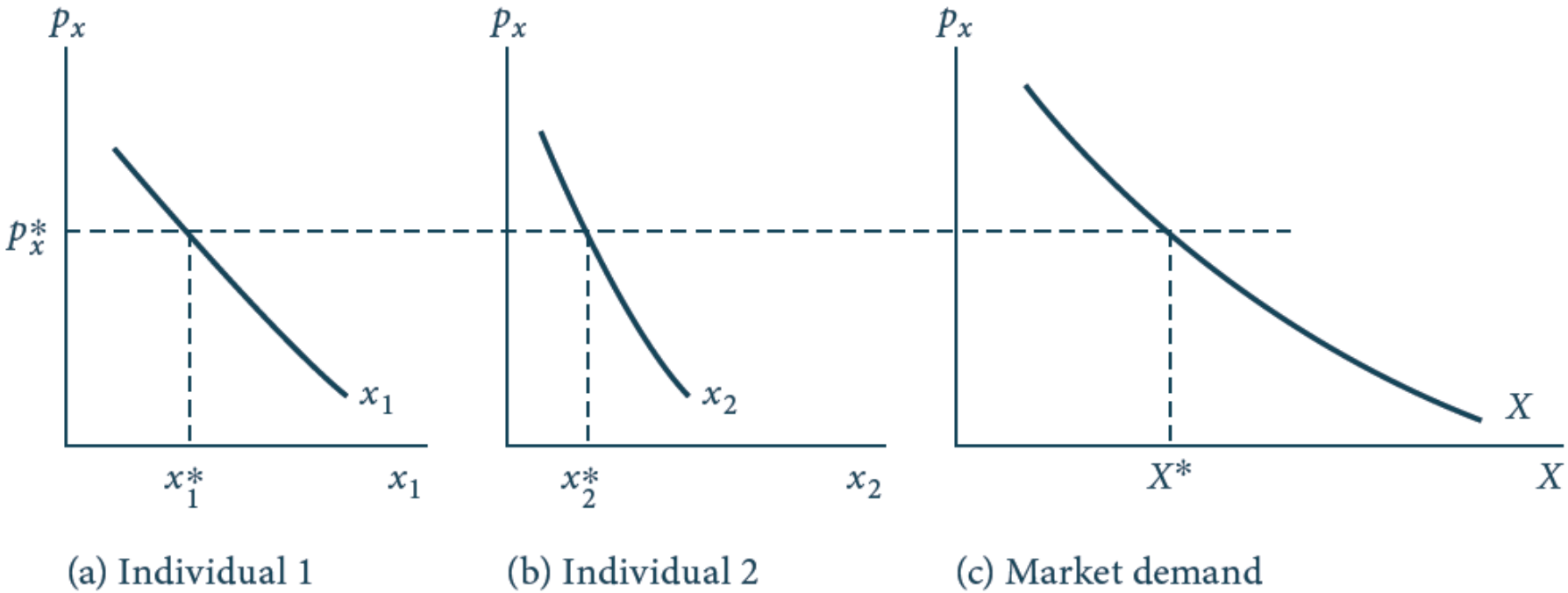
Partial Equilibrium Competitive Model

Demand

- Market demand

$$X(p_x) = \sum_{i=1}^{n} x_i(p_x, p_y, I_i)$$

  - Recall that consumer's demand curve is derived from utility maximization problem
  - movement along the demand curve by varying p_x
  - shifting the demand curve by varying p_y and I



(a) Individual 1 (b) Individual 2 (c) Market demand

Demand

- Example 12.1

$$x_1 = 10 - 2p_x + 0.1I_1 + 0.5p_y$$
$$x_2 = 17 - p_x + 0.05I_2 + 0.5p_y$$

  - $I_1 = 40$, $I_2 = 20$, $p_y = 4$
  - p_y increases to 6

- partial equilibrium notation: $Q_D(P, P', I)$ or $Q_D(P)$

Demand

- Demand elasticity
  - elasticity of market demand w.r.t. its own price

$$e_{Q,p} = \frac{\partial Q_D(P, P', I)}{\partial P} \frac{P}{Q_D} \begin{cases} < -1 & \text{elastic} \\ \in (-1, 0) & \text{inelastic} \\ > 0 & \text{Giffen good} \end{cases}$$

  - cross price elasticity of market demand

$$e_{Q,p'} = \frac{\partial Q_D(P, P', I)}{\partial P'} \frac{P'}{Q_D} \begin{cases} > 0 & \text{gross substitute} \\ < 0 & \text{gross complement} \end{cases}$$

  - income price elasticity of market demand

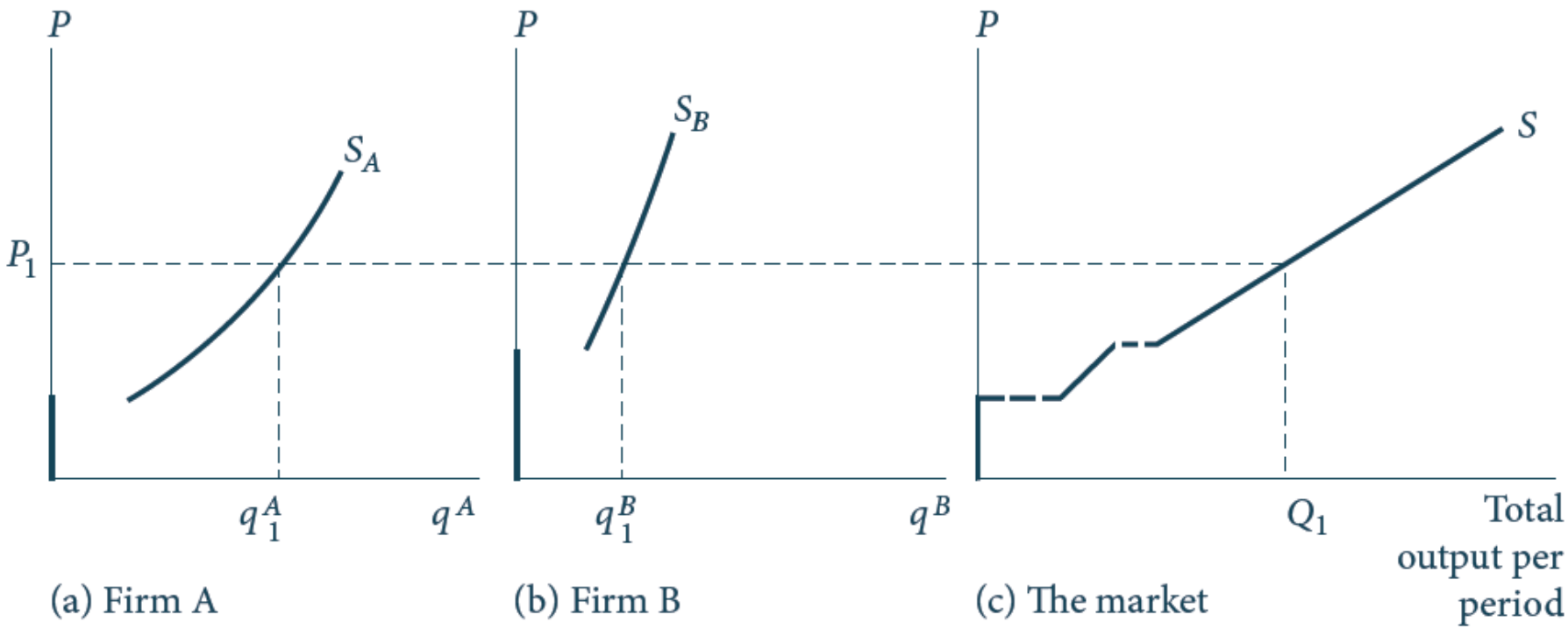
$$e_{Q,I} = \frac{\partial Q_D(P, P', I)}{\partial I} \frac{I}{Q_D} \begin{cases} > 1 & \text{luxury} \\ \in (0, 1) & \text{necessity} \\ < 0 & \text{inferior good} \end{cases}$$

Short-run Equilibrium

- Short-run market supply

$$Q_S(P, v, w) = \sum_{i=1}^{n} q_i(P, v, w)$$

  - We assume perfect competition here: firm is price taker.
  - When there are more firms, supply curve tends to be flatter.
  - supply elasticity $e_{S,P} = \frac{\partial Q_S}{\partial P} \frac{P}{Q_S}$



Short-run Equilibrium

- Example 12.2

$$q_i(P) = \frac{10}{3}P, \quad i = 1, 2, ..., n$$

There are n identical firm

$$Q_S(P) = \sum_{i=1}^{n} q_i(P)$$

  - market supply
  - effect of increasing w

Short-Run Equilibrium

- Example 12.3

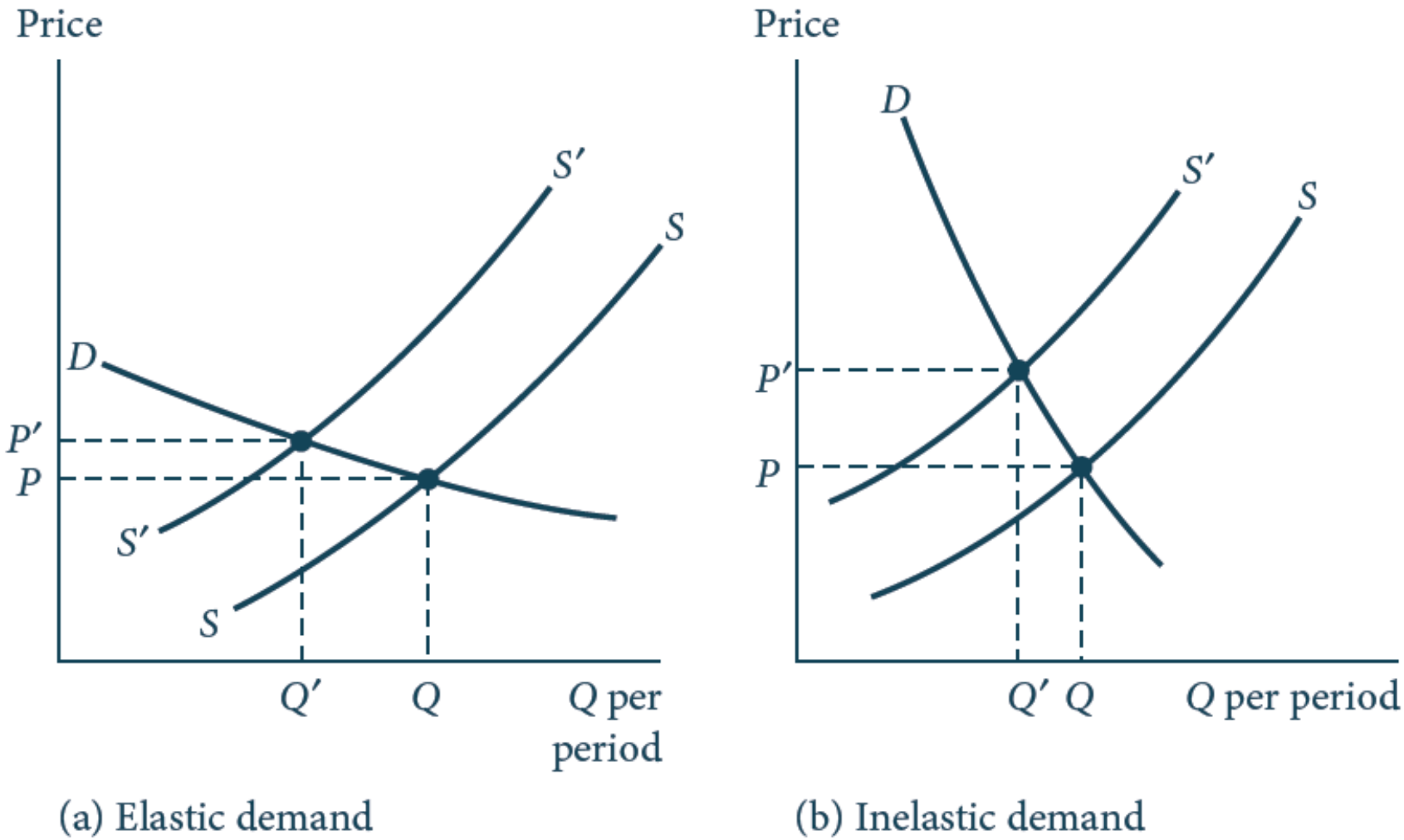
$$Q_D(P, I) = 0.1 \times P^{-1.2} I^3$$

$$Q_S(P, w) = 6400 \times P w^{-0.5}$$

  - find elasticities, equilibrium prices, and quantity
  - prediction of the change of equilibrium price
  - method of approximation by elasticity

Comparative Statics

- Comparative statics of partial equilibrium



Comparative Statics

- Equilibrium price determination

$$\begin{cases} Q_D(P,\alpha) \\ Q_S(P,\beta) \end{cases} \Rightarrow \text{Equilibrium} \begin{cases} Q^* = Q_D(P^*,\alpha) = Q_S(P^*,\beta) \\ P^* = P(\alpha,\beta) \end{cases}$$

  - α represents demand shifters such as income, price of substitute, chance in preference.
  - β represents supply shifters such as input prices, technology chance, or number of firms

- Shift in demand and shift in supply
  - shape and elasticity
  - comparative statics: how equilibrium price shift with respect to α or β
  - elasticity interpretation

$$e_{P,\alpha} = \frac{dP}{d\alpha}\frac{\alpha}{P} = \frac{e_{D,\alpha}}{e_{S,P} - e_{D,P}}.$$

Comparative Statics

- Demand shock: differentiate $Q_D(P(\alpha,\beta),\alpha) = Q_S(P(\alpha,\beta),\beta)$ w.r.t. α

$$\frac{dQ_D}{d\alpha} = \frac{dQ_S}{d\alpha} \Rightarrow \frac{dP}{d\alpha} = \frac{\frac{\partial Q_D}{\partial \alpha}}{\frac{\partial Q_S}{\partial P} - \frac{\partial Q_D}{\partial P}}$$

$$\Rightarrow \frac{dP}{d\alpha}\frac{\alpha}{P} = \frac{\frac{\partial Q_D}{\partial \alpha}\frac{\alpha}{Q}}{\frac{\partial Q_S}{\partial P}\frac{P}{Q} - \frac{\partial Q_D}{\partial P}\frac{P}{Q}} \Rightarrow e_{P,\alpha} = \frac{e_{D,\alpha}}{e_{S,P} - e_{D,P}}$$

- Supply shock: differentiate $Q_D(P(\alpha,\beta),\alpha) = Q_S(P(\alpha,\beta),\beta)$ w.r.t. β,

$$\frac{dQ_D}{d\beta} = \frac{dQ_S}{d\beta} \Rightarrow \frac{dP}{d\beta} = \frac{\frac{\partial Q_S}{\partial \beta}}{\frac{\partial Q_D}{\partial P} - \frac{\partial Q_S}{\partial P}}$$

$$\Rightarrow \frac{dP}{d\alpha}\frac{\beta}{P} = \frac{\frac{\partial Q_S}{\partial \beta}\frac{\beta}{Q}}{\frac{\partial Q_D}{\partial P}\frac{P}{Q} - \frac{\partial Q_S}{\partial P}\frac{P}{Q}} \Rightarrow e_{P,\beta} = \frac{e_{S,\beta}}{e_{D,P} - e_{S,P}}$$

Comparative Statics

- Equilibrium quantity change

$$e_{Q,\alpha} = e_{S,\alpha} = \frac{dQ_S}{d\alpha}\frac{\alpha}{Q} = \frac{\partial Q_S}{\partial P}\frac{\partial P}{\partial \alpha}\frac{\alpha}{Q}$$
$$= \frac{\partial Q_S}{\partial P}\frac{P}{Q} \times \frac{\partial P}{\partial \alpha}\frac{\alpha}{P} = e_{S,P}e_{P,\alpha}$$

$$e_{Q,\alpha} = e_{D,\alpha} = \frac{dQ_D}{d\alpha}\frac{\alpha}{Q} = \left(\frac{\partial Q_D}{\partial P}\frac{\partial P}{\partial \alpha} + \frac{\partial Q_D}{\partial \alpha}\right)\frac{\alpha}{Q}$$
$$= \frac{\partial Q_D}{\partial P}\frac{P}{Q}\frac{\partial P}{\partial \alpha}\frac{\alpha}{P} + \frac{\partial Q_D}{\partial \alpha}\frac{\alpha}{Q}$$
$$= e_{D,P}e_{P,\alpha} + e_{D,\alpha}$$

We can show that

$$e_{S,\alpha} = e_{D,\alpha} = \frac{e_{S,P}e_{D,\alpha}}{e_{S,P} - e_{D,P}}$$

Comparative Statics

- Predict the percentage change

$$e_{P,\alpha} = \frac{e_{D,\alpha}}{e_{S,P} - e_{D,P}}, \quad e_{P,\beta} = \frac{e_{S,\beta}}{e_{D,P} - e_{S,P}}$$

$$e_{Q,\alpha} = e_{S,P} e_{P,\alpha}, \quad e_{Q,\beta} = e_{D,P} e_{P,\beta}$$

$$\% \text{ change of price} = e_{P,\alpha} \times \% \text{ change of } \alpha$$

$$\% \text{ change of quantity} = e_{Q,\alpha} \times \% \text{ change of } \alpha$$

Comparative Statics

- Empirical estimates of demand elasticity

TABLE 12.3 REPRESENTATIVE PRICE AND INCOME ELASTICITIES OF DEMAND		
	Price Elasticity	**Income Elasticity**
Food	−0.21	+0.28
Medical services	−0.18	+0.22
Housing		
Rental	−0.18	+1.00
Owner occupied	−1.20	+1.20
Electricity	−1.14	+0.61
Automobiles	−1.20	+3.00
Gasoline	−0.55	+1.60
Beer	−0.26	+0.38
Wine	−0.88	+0.97
Marijuana	−1.50	0.00
Cigarettes	−0.35	+0.50
Abortions	−0.81	+0.79
Transatlantic air travel	−1.30	+1.40
Imports	−0.58	+2.73
Money	−0.40	+1.00

Comparative Statics

- Empirical estimates of supply elasticity

TABLE 12.2 SELECTED ESTIMATES OF LONG-RUN SUPPLY ELASTICITIES	
Agricultural acreage	
Corn	0.18
Cotton	0.67
Wheat	0.93
Aluminum	Nearly infinite
Chromium	0–3.0
Coal (eastern reserves)	15.0–30.0
Natural gas (U.S. reserves)	0.20
Oil (U.S. reserves)	0.76
Urban housing	
Density	5.3
Quality	3.8

SOURCES: Agricultural acreage—M. Nerlove, "Estimates of the Elasticities of Supply of Selected Agricultural Commodities," *Journal of Farm Economics* 38 (May 1956): 496–509. Aluminum and chromium—estimated from U.S. Department of Interior, *Critical Materials Commodity Action Analysis* (Washington, DC: U.S. Government Printing Office, 1975). Coal—estimated from M. B. Zimmerman, "The Supply of Coal in the Long Run: The Case of Eastern Deep Coal," MIT Energy Laboratory Report No. MITEL 75–021 (September 1975). Natural gas—based on estimate for oil (see text) and J. D. Khazzoom, "The FPC Staff's Econometric Model of Natural Gas Supply in the United States," *The Bell Journal of Economics and Management Science* (Spring 1971): 103–17. Oil—E. W. Erickson, S. W. Millsaps, and R. M. Spann, "Oil Supply and Tax Incentives," *Brookings Papers on Economic Activity* 2 (1974): 449–78. Urban housing—B. A. Smith, "The Supply of Urban Housing," *Journal of Political Economy* 40 (August 1976): 389–405.

Long-run Equilibrium

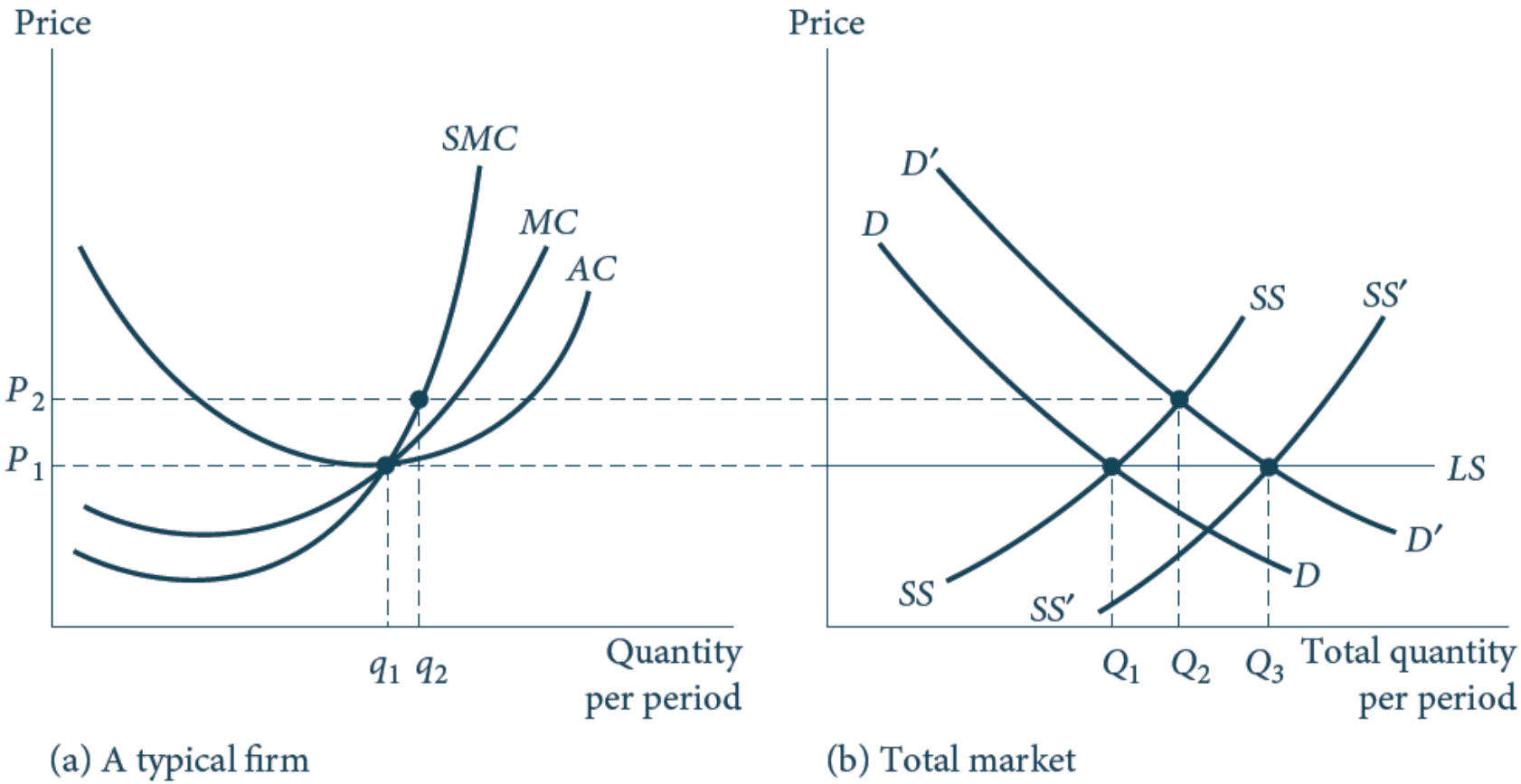
- Equilibrium condition in the long run
  - free entry and exit of an industry (no entry barrier)
  - main driving force: zero-profit condition
  - Each firm operates at the minimum efficient scale.
  - Long-run equilibrium p_{LR},Q_{LR}, n_{LR}
- Example 12.4, 12.5

$$C(q) = q^3 - 20q^2 + 100q + 8000$$

$$Q_D = 2500 - 3P$$

Long-run Equilibrium

- Long-run equilibrium

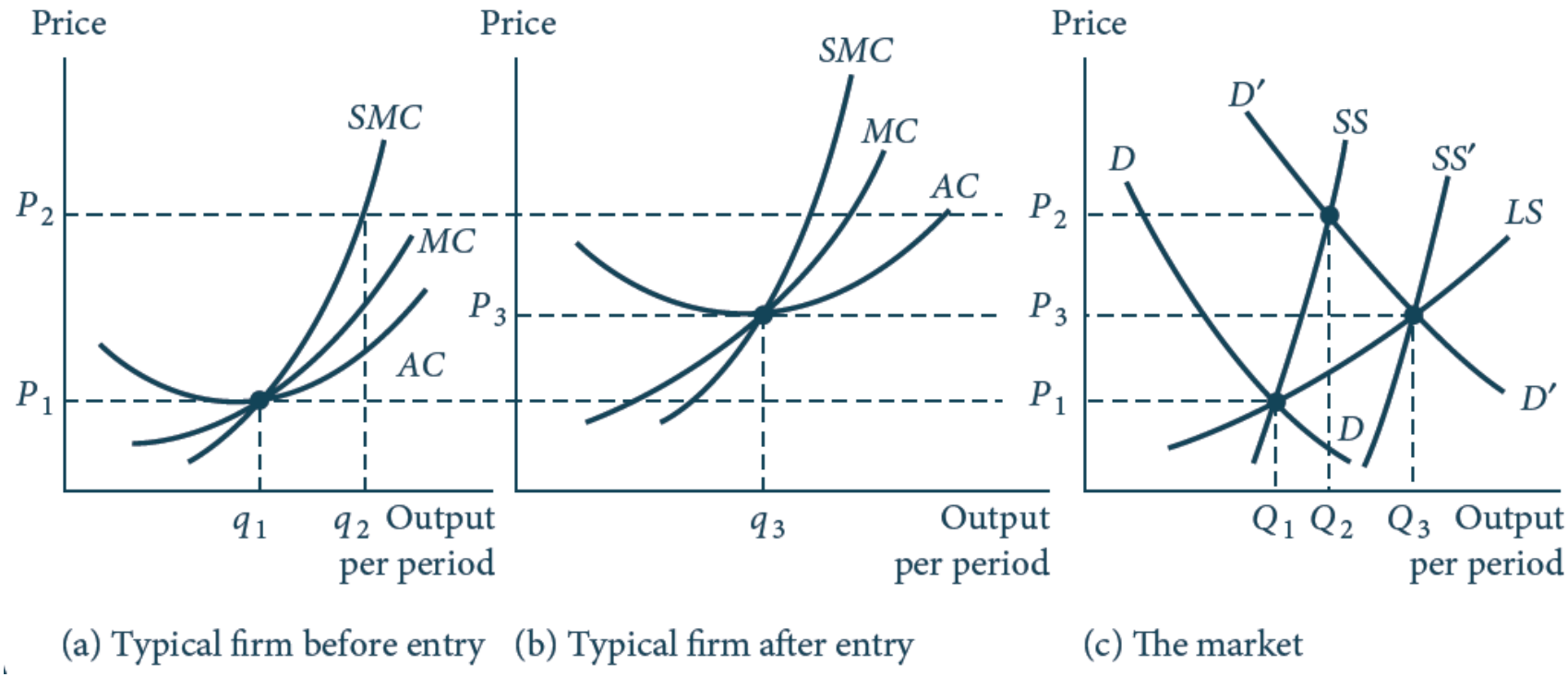


Long-run Equilibrium

- Shape of long-run supply*
  - Increasing cost industry: new firm imposes negative externality to existing firms (input price rises)
  - Decreasing cost industry: new firm provides positive externality to existing firms (critical mass of industrialization, network effect)
  - Long-run elasticity of supply
- Industry structure
  - demand shift: equilibrium quantity increases from Q_0 to Q_1
  - change of input price
  - the key role of the minimum of average cost.

Long-run Equilibrium

- Shape of long-run supply*

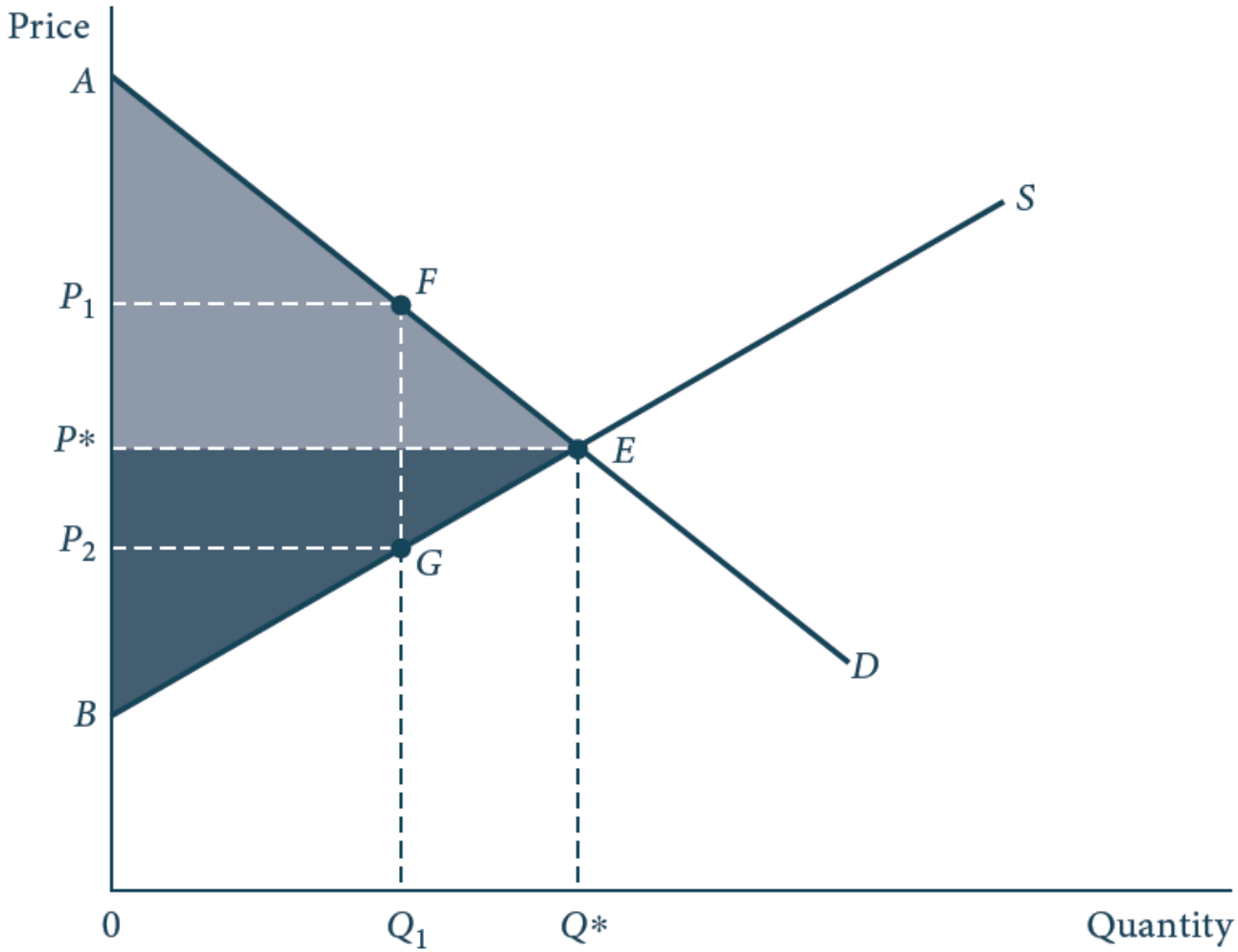


(a) Typical firm before entry (b) Typical firm after entry (c) The market

Welfare Analysis

- Welfare: summation of value obtained by market participants by being able to make market transaction

  consumer surplus+producer surplus+(surplus of other economic agents)



Welfare Analysis

- Welfare analysis on price control policies
  - e.g. rent control, minimum wage
  - triangle approximation
  - inequality issues
- First welfare theorem: welfare is maximized at the competitive market equilibrium when there is no market failure.
- Example 12.6

$$\begin{cases} D(P) = 10 - P \\ S(P) = P - 2 \end{cases}$$

Impose output restriction $\bar{Q} = 3$.

Welfare Analysis

- Tax incidence (burden)
  - demand-supply method
  - elasticity method
  - demand side and supply side "share" tax by relative elasticity

- Per-unit tax t,

$$P_D(t) - t = P_S(t), \text{ or } P_D(t) = P_S(t) + t$$

$$Q' = Q_D(P_D(t)) = Q_S(P_D(t) - t)$$

Differentiate both sides w.r.t. t,

$$\frac{dQ_D}{dP} \times \frac{dP_D}{dt} = \frac{dQ_S}{dP} \times \left(\frac{dP_D}{dt} - 1 \right)$$

$$\begin{cases} \frac{dP_D}{dt} = \frac{e_{S,P}}{e_{S,P} - e_{D,P}} \\ \frac{dP_S}{dt} = \frac{e_{D,P}}{e_{S,P} - e_{D,P}} \end{cases} \Rightarrow \left| \frac{\frac{dP_S}{dt}}{\frac{dP_D}{dt}} \right| = \left| \frac{e_{D,P}}{e_{S,P}} \right|$$

Welfare Analysis

- Deadweight loss

$$e_{D,P} = \frac{dQ}{dP}\frac{P}{Q} = \frac{\frac{dQ}{dt}}{\frac{dP_D}{dt}}\frac{P}{Q}$$

$$\Rightarrow \frac{dQ}{dt} = e_{D,P} \times \frac{dP_D}{dt}\frac{Q}{P} = \frac{e_{S,P}e_{D,P}}{e_{S,P} - e_{D,P}}\frac{Q}{P}$$

$$DW = -0.5 \times t\frac{dQ}{dt} \times t = -0.5 \times t^2 \times \frac{dQ}{dt}$$
$$= -0.5 \times t^2 \times \frac{e_{S,P}e_{D,P}}{e_{S,P} - e_{D,P}}\frac{Q}{P}$$

Welfare Analysis

- Example 12.6, 12.7

$$\begin{cases} D(P) = 200P^{-1.2} \\ S(P) = 1.3P \end{cases}$$

  - Quantity restriction at $\bar{Q} = 11$.
  - Use a tax t to achieve $\bar{Q} = 11$.

International Trade

- Partial equilibrium model of international trade
- Welfare analysis international trade
  - measuring gain of trade
  - tariff and quota
  - welfare loss from trade protection
- Why protection (trade war)?
  - FDI and loss of jobs
  - trade imbalance
  - intellectual property, research & development
  - infant industry, firm dynamics, and global value chain

International Trade

- Table from "How costly is protectionism?"

Table 1

Annual Cost of U.S. Import Protection

(billion dollars, years around 1985)

	U.S. Deadweight Loss (B + D)	*Quota Rents (C or C + E)*	*Foreign Dead-Weight Loss (F)*
Automobiles	0.2–1.2[a,b]	2.2–7.9[a,c]	0–3[d]
Dairy	1.4[b]	0.25[c]	0.02[e]
Steel	0.1–0.3[a,b]	0.7–2.0[a,c]	0.1[f]
Sugar	0.1[b]	0.4–1.3[c,g]	0.2[g]
Textiles & Apparel	4.9–5.9[a,b]	4.0–6.1[a,c]	4–15.5[h]
Average Tariffs	1.2 – 3.4[i]	0	n.a.
Total*	7.9–12.3	7.3–17.3	4.3–18.8

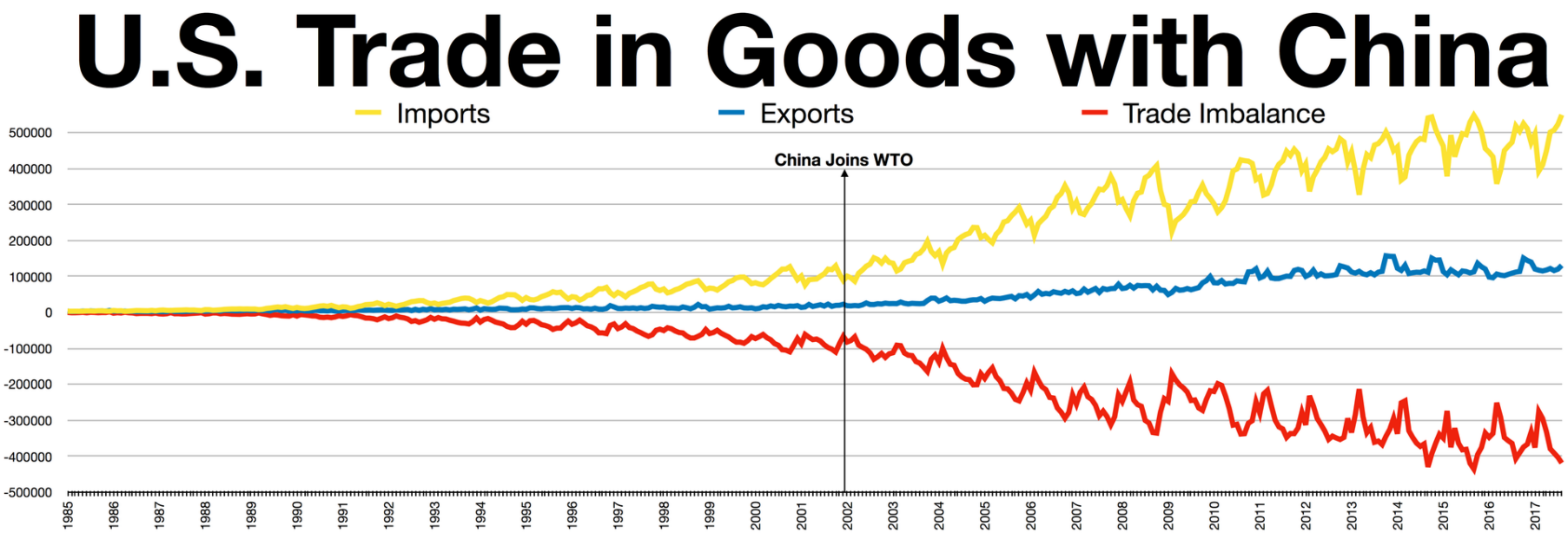
*In dairy the quota rents are earned by U.S. importers, and so are not included in the total.
n.a.—not available

Sources:

a de Melo and Tarr (1990)
b Hufbauer, Berliner and Elliott (1986)
c Bergsten et al (1987, Table 3.3)
d Feenstra (1988)
e Anderson (1985)
f Boorstein (1987)
g Leu, Schmitz and Knutson (1987)
h Trela and Whalley (1988, 1990, 1991)
i Rousslang and Tokarick (1991)

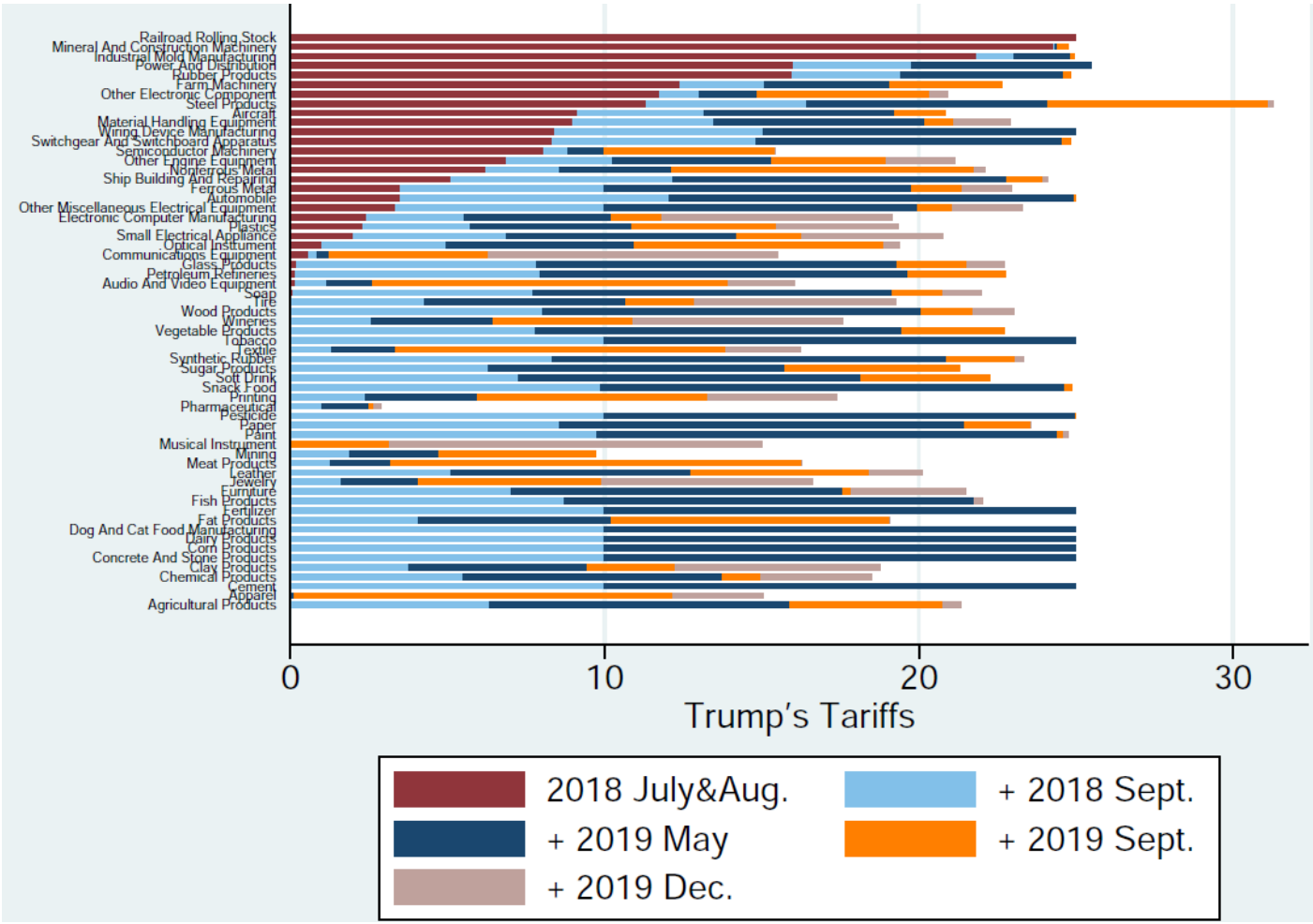
International Trade

- Figure from Wikipedia (en.wikipedia.org/wiki/China–United_States_trade_war)



International Trade

- Trump's tax, Figure from "Trade Wars and Industrial Policies along the Global Value Chains"



International Trade

- Table from US–China phase 1 trade deal

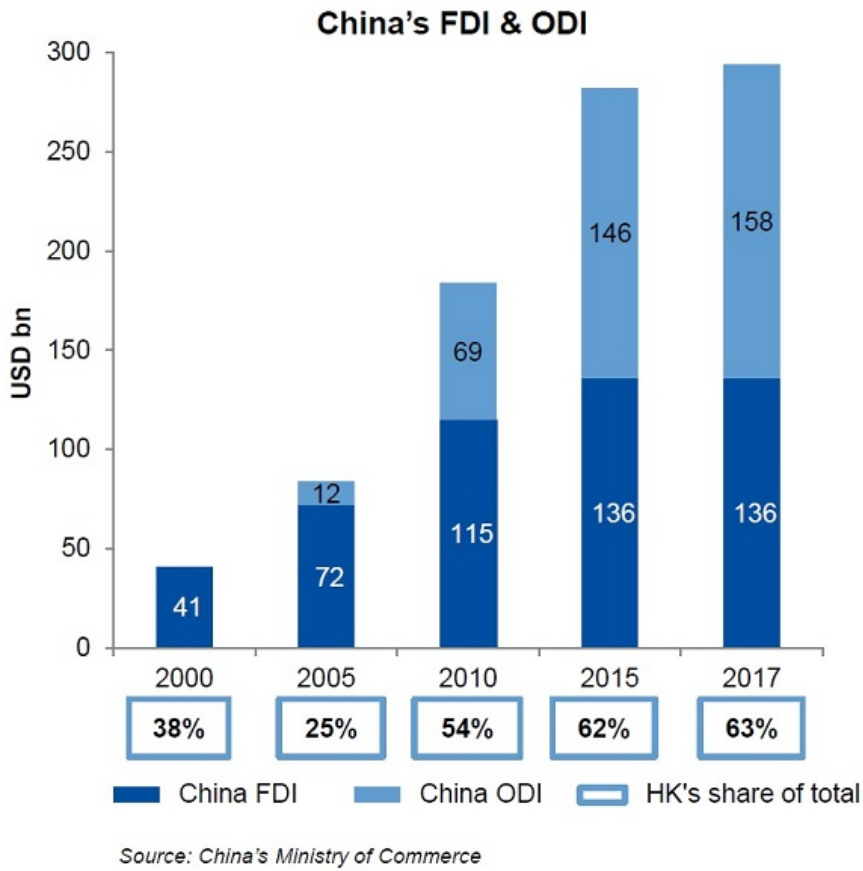
ANNEX 6.1
INCREASES IN U.S. EXPORTS TO CHINA OVER 2 YEARS

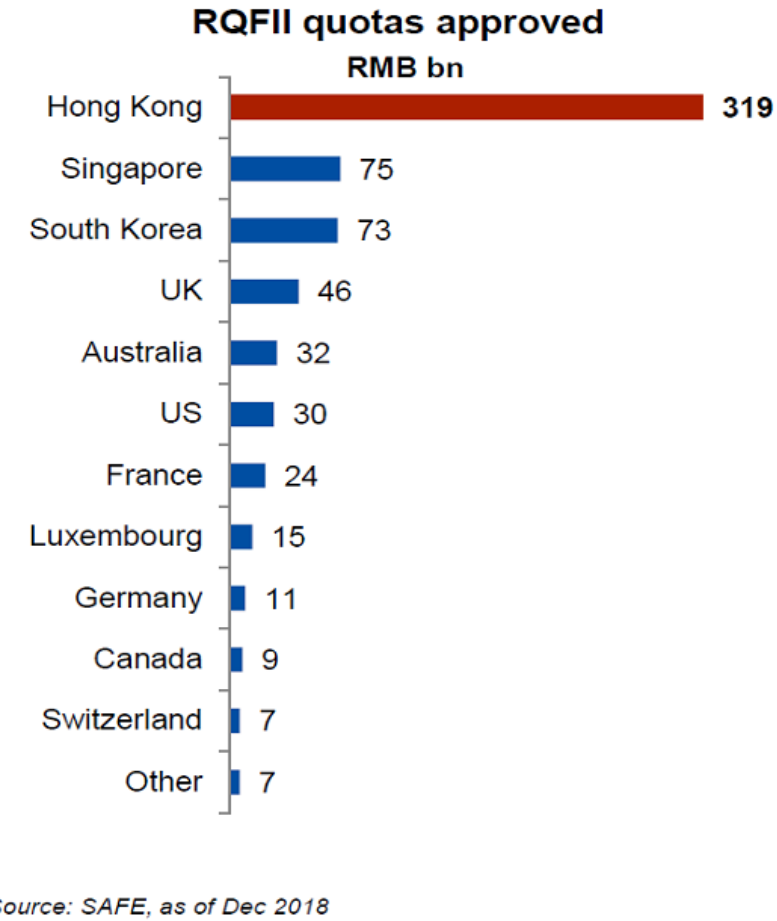
Unit: USD Billion

Product Category		Additional U.S. Exports to China on Top of 2017 Baseline		
		Year 1	Year 2	2-Year Total
1. Manufactured Goods		**32.9**	**44.8**	**77.7**
1	Industrial machinery			
2	Electrical equipment and machinery			
3	Pharmaceutical products			
4	Aircraft (orders and deliveries)			
5	Vehicles			
6	Optical and medical instruments			
7	Iron and steel			
8	Other manufactured goods[a]			
2. Agriculture[b]		**12.5**	**19.5**	**32.0**
9	Oilseeds			
10	Meat			
11	Cereals			
12	Cotton			
13	Other agricultural commodities[c]			
14	Seafood[d]			
3. Energy		**18.5**	**33.9**	**52.4**
15	Liquefied natural gas			
16	Crude oil			
17	Refined products			
18	Coal[e]			
4. Services[f]		**12.8**	**25.1**	**37.9**
19	Charges for use of IP			
20	Business travel and tourism			
21	Financial services and insurance			
22	Other services			
23	Cloud and related services			
TOTAL		**76.7**	**123.3**	**200.0**

International Trade

- FDI net inflow to China
  data.worldbank.org/indicator/BX.KLT.DINV.CD.WD?locations=CN
- Figures from Hong Kong Monetary Authority





International Trade

- Smiling curve, Figure from "Location, control and innovation in knowledge-intensive industries"

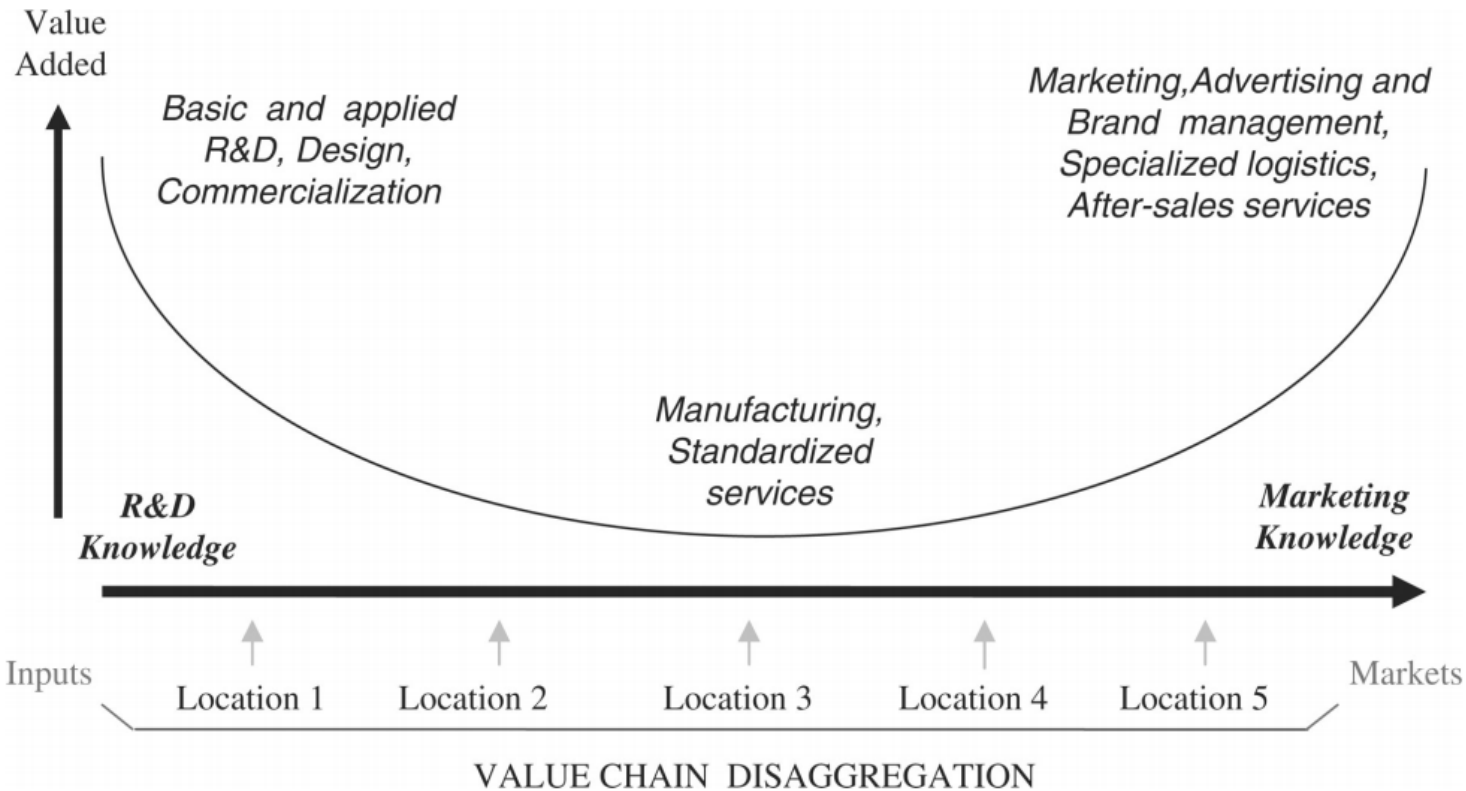


Figure 1: Conceptual framework of the smile curve

Discussion

- First welfare theorem: a market will tend toward a competitive equilibrium that is efficient when
  - all agents are price-taking (no monopolists, easy to enter or exit);
  - complete markets with no transaction costs (implying each agent has perfect information).
- When first welfare theorem holds
  - Decentralized decisions from agents generate efficient allocation.
  - Policy usually bring in distortion and welfare loss.
  - Use policy for equity or allocation purpose.
- When first welfare theorem fails (market failure)
  - Decentralized decisions from agents is not efficient.
  - Policy may improve efficiency.

Discussion

- Quote from Adam Smith, *The Wealth of Nations*

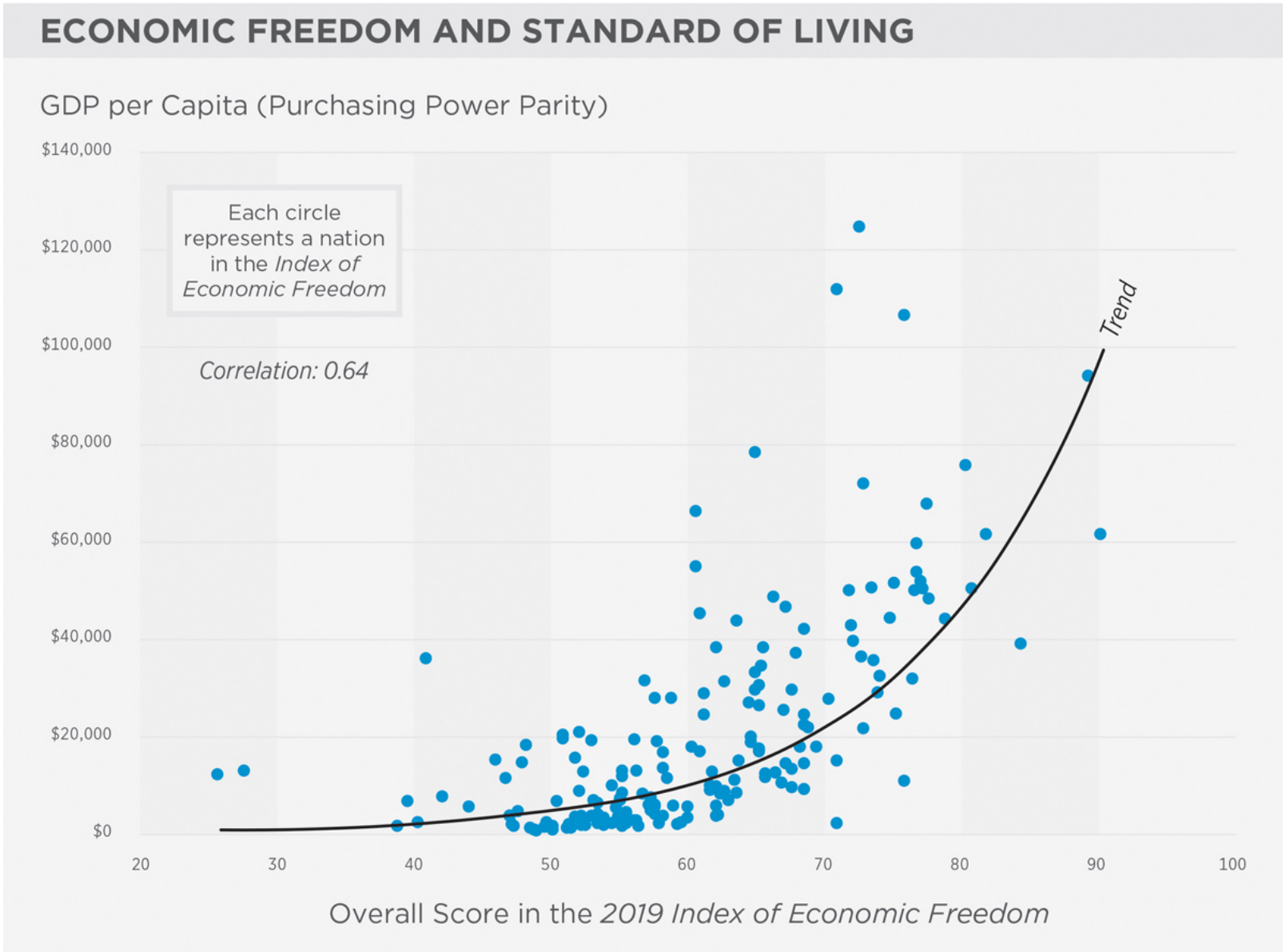
"As every individual, therefore, endeavours as much as he can both to employ his capital in the support of domestic industry, and so to direct that industry that its produce may be of the greatest value, every individual necessarily labours to render the annual revenue of the society as great as he can. He generally, indeed, neither intends to promote the public interest, nor knows how much he is promoting it. By preferring the support of domestic to that of foreign industry, he intends only his own security; and by directing that industry in such a manner as its produce may be of the greatest value, he intends only his own gain, and he is in this, as in many other cases, led by an **invisible hand** to promote an end which was no part of his intention. Nor is it always the worse for the society that it was not part of it. By pursuing his own interest he frequently promotes that of the society more effectually than when he really intends to promote it."

Discussion

- Should we trust the free market (or the government)?
- Index of economic freedom by the Heritage Foundation
  - "We measure economic freedom based on 12 quantitative and qualitative factors, grouped into four broad categories, or pillars, of economic freedom:
    - ⋆ Rule of law (property rights, government integrity, judicial effectiveness)
    - ⋆ Government size (government spending, tax burden, fiscal health)
    - ⋆ Regulatory efficiency (business freedom, labor freedom, monetary freedom)
    - ⋆ Open markets (trade freedom, investment freedom, financial freedom)
  - www.heritage.org/index/ranking
- Milton Freedman, Free to Choose TV series
  www.youtube.com/watch?v=D3N2sNnGwa4

Discussion

- Figure from he Heritage Foundation

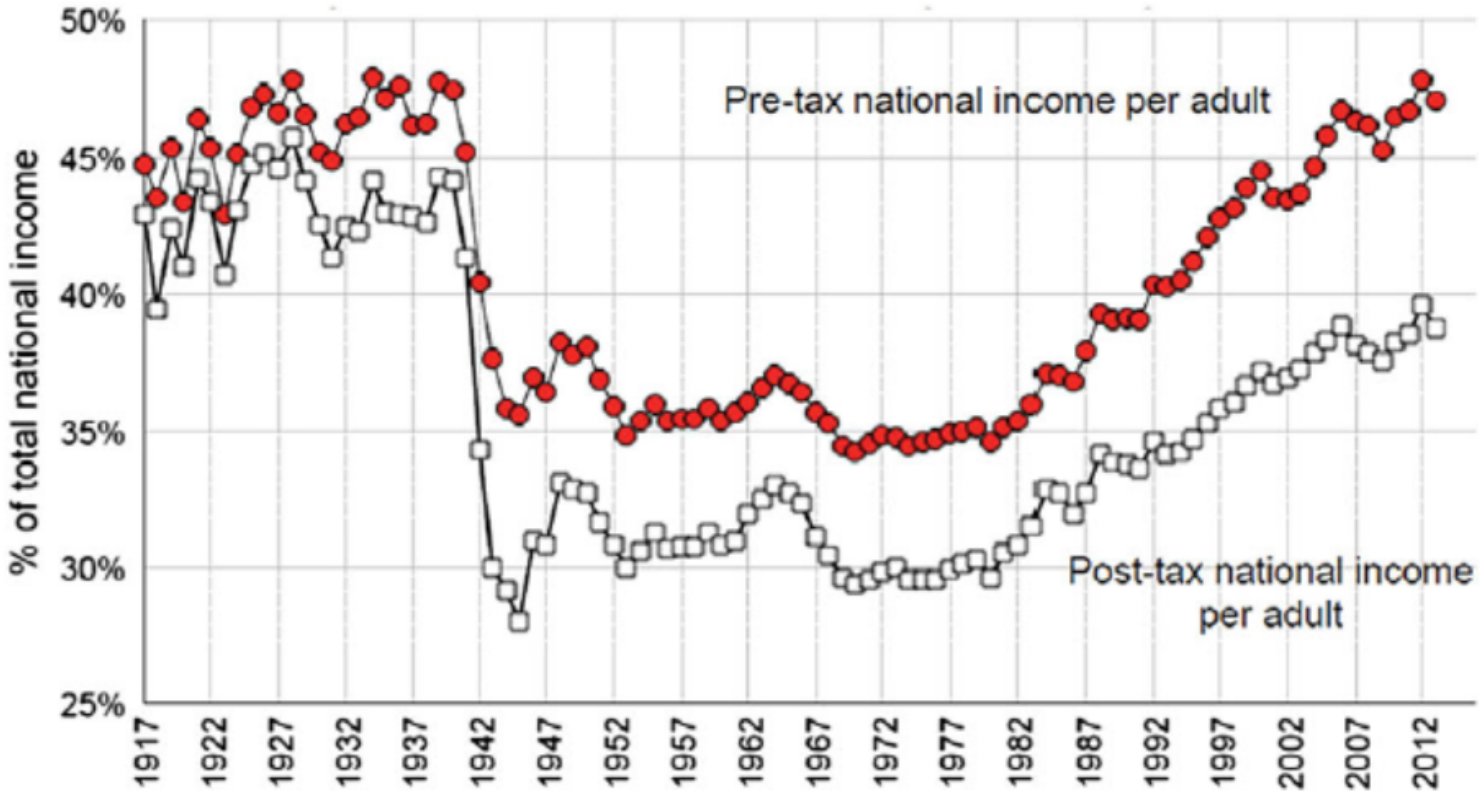


Discussion

- Rising inequality in U.S. Figure from "Income and wealth inequality: evidence and policy implications."

FIGURE 5

Top 10% U.S. National Income Share: Pre-tax versus Post-tax

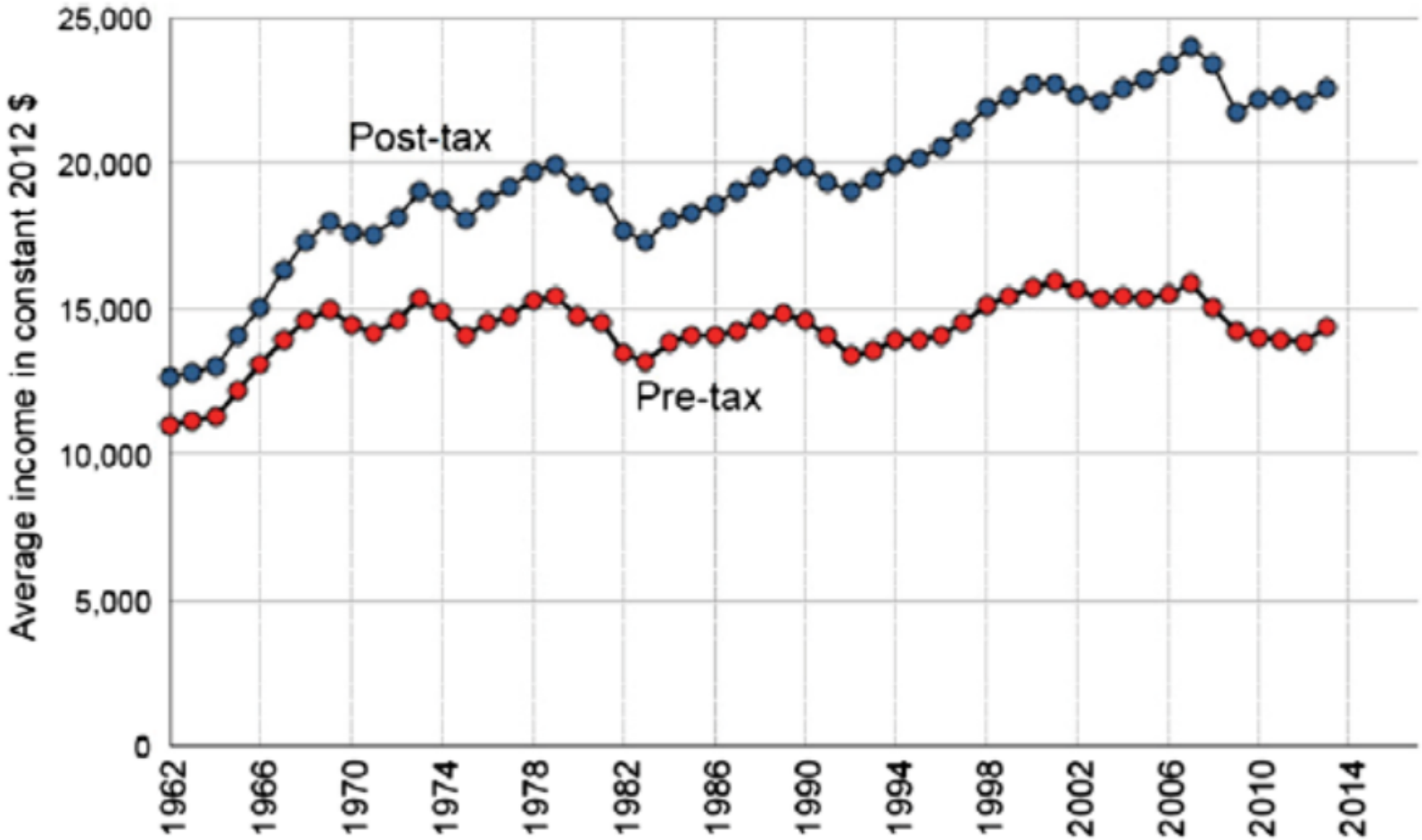


Discussion

- Transfer payment helps bottom 50%.

FIGURE 8

Stagnating U.S. Real Income of Bottom 50% Adults: Pre-tax vs. Post-tax

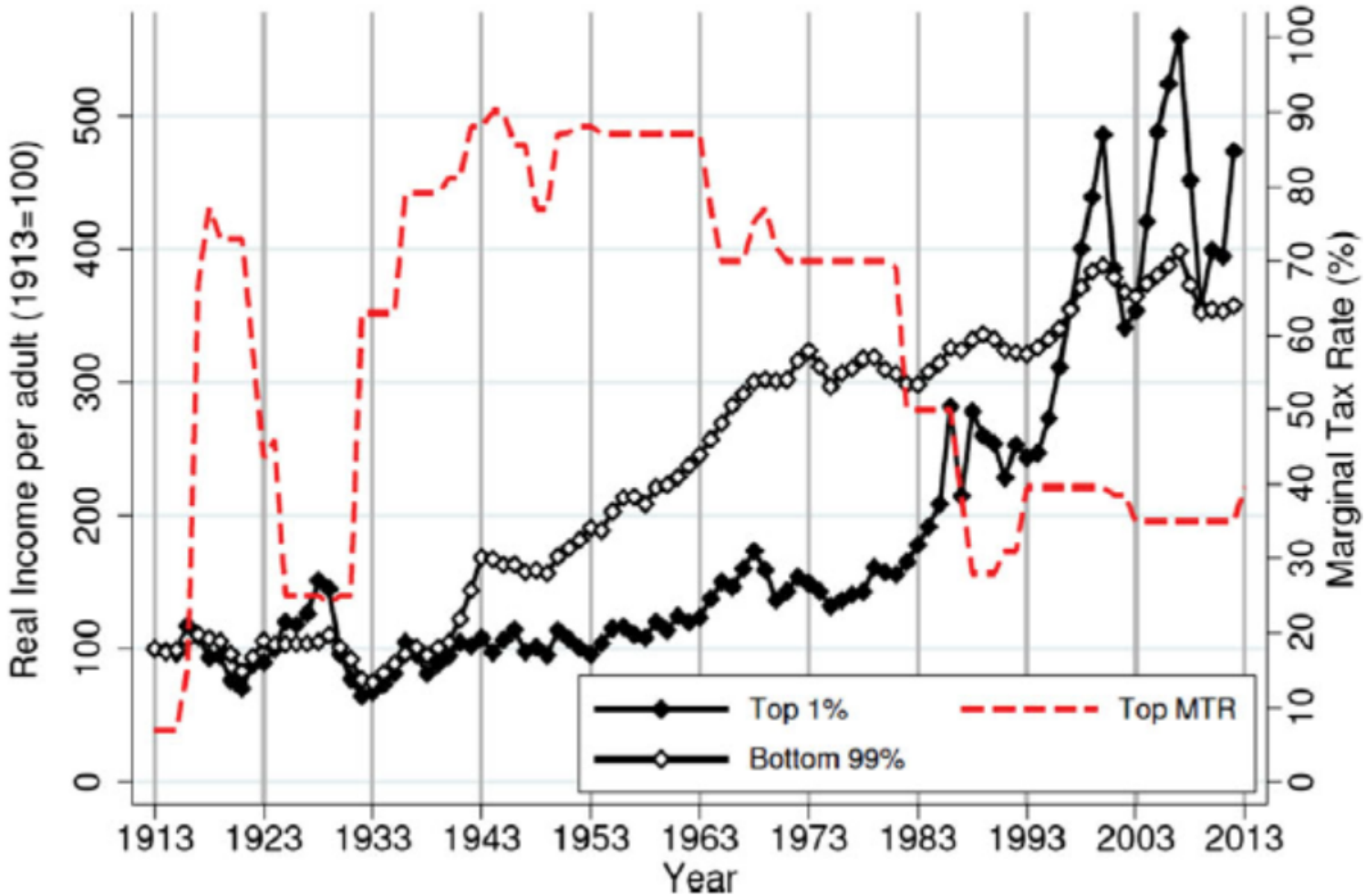


Discussion

- U.S. top marginal tax rate

FIGURE 21

U.S. Top 1% and Bottom 99% Income Growth and Marginal Tax Rates

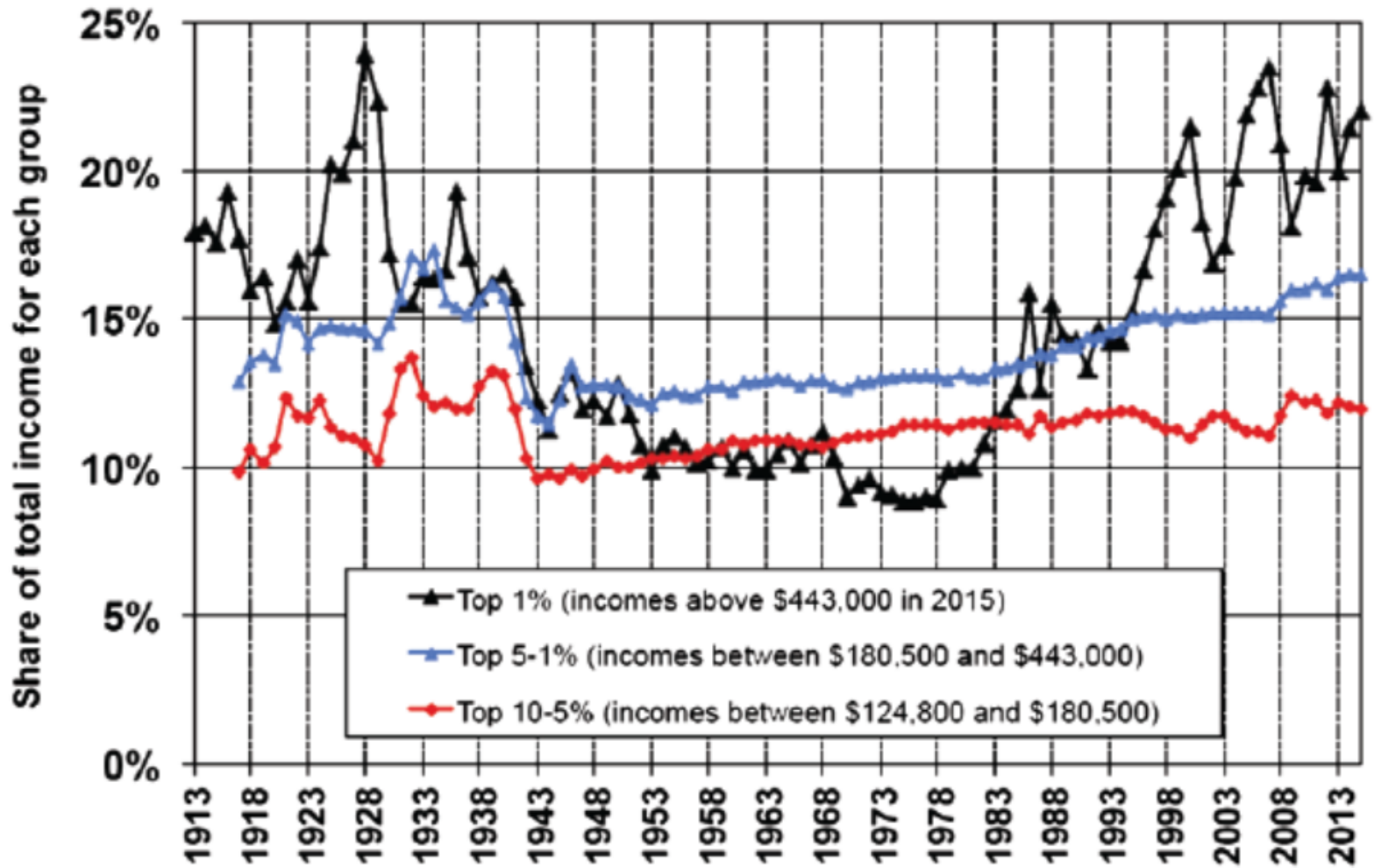


Discussion

- Top 1% grows the most in recent decades.

FIGURE 2

Decomposing the U.S. Top 10% Pre-tax Income into Three Groups, 1913–2015

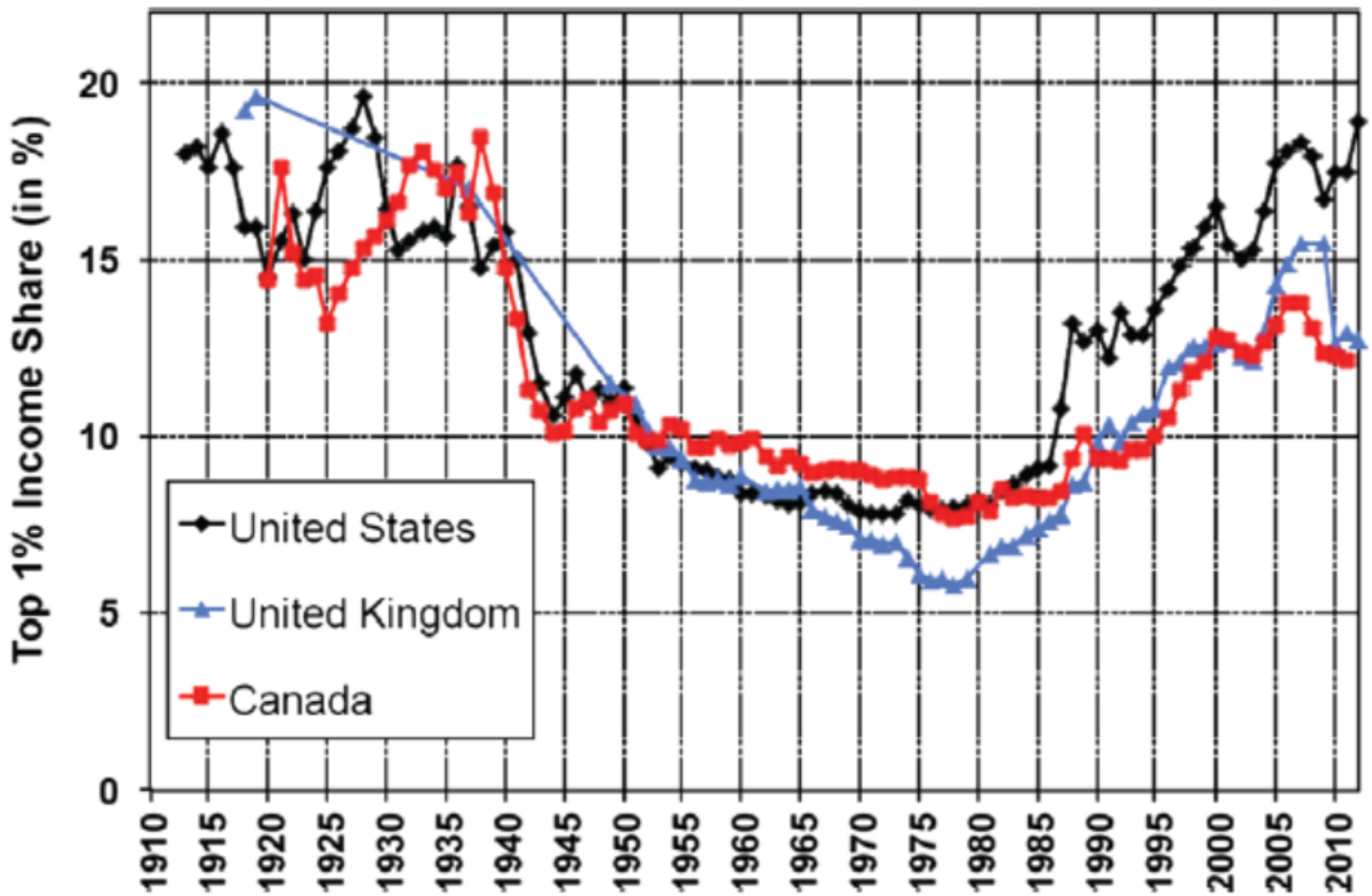


Discussion

- Similar pattern in UK and Canada.

FIGURE 13

Top 1% Income Share: English Speaking Countries (U-shaped)

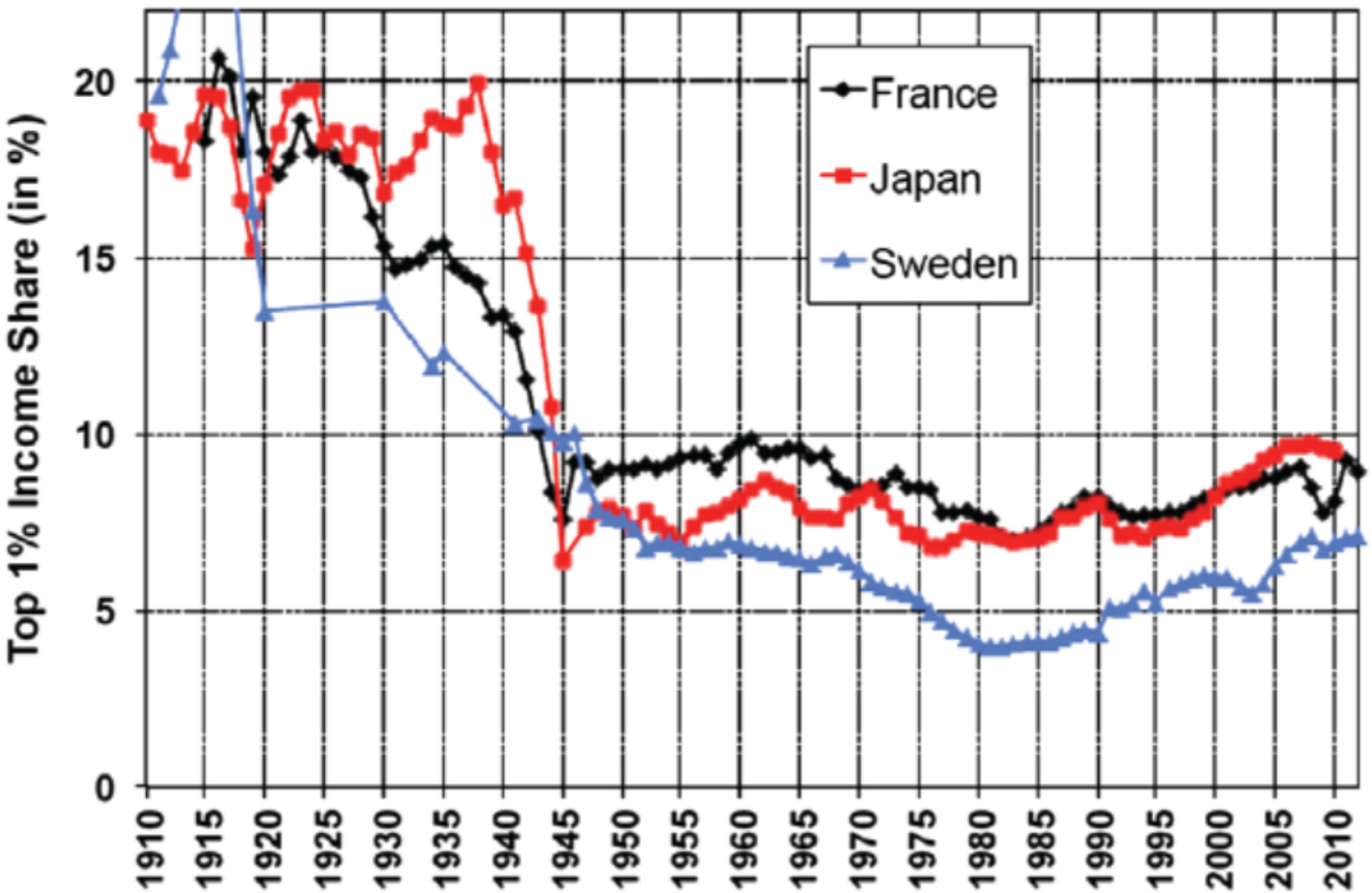


Discussion

- But not so in some other developed countries.

FIGURE 14

Top 1% Income Share: Continental Europe and Japan (L-shaped)



Discussion

- Don't forget wealth inequality.

FIGURE 12

Real Average Wealth of Bottom 90% and Top 1% U.S. Families