2020年度寡占理論 (8)
Optimality of Emission Pricing Policies Based on Emission Intensity Targets under Imperfect Competition

今日の講義の構成

(a) 超低炭素社会

(b) Optimal Carbon Pricing vs 原単位規制

(c) Combination of Carbon Pricing and Emission Intensity Regulation

(d) Today's paper

報告論文情報

Title
(a) The Equivalence of Emission Tax with Tax-Revenue Refund and Emission Intensity Regulation.
(b) Optimality of Emission Pricing Policies Based on Emission Intensity Targets under Imperfect Competition
Co-author
Hiroaki Ino (関西学院大学准教授, 2003年度-2006年度寡占理論受講)
Journal
(a) Economics Letters, 182, 126-128, 2019
(b) Discussion Paper

Low Emission Economy

Low Emission Society

(1) Bio Society

(2) Hydrogen Society （水素社会）

(3) Electrification Society （電化社会）

Electrification Society

Oil, Gas, Coal → Electricity

Decarbonization of the power supply

Conventional Fuel Thermal⇒Nuclear, Renewable, Fuel Thermal +CCSU

Electrification + Decarbonization of the power supply

⇒Ultra Low-Carbon Economy

Hydrogen and Bio can also play important roles in electrification society.

Near-Zero Emission Society

ICPP: almost zero net emission by 2050

Japan: 80% reduction of CO2 by 2050

To meet this standard,

(a) High level of energy saving,

(b) Electrification

(c) The emission of current heavy emission industries such as electric power supply, steal, cement, must be close to zero.

Zero Emission of Electricity Industry

Renewable

Nuclear

Fuel Thermal + CSSU⇒I strongly doubt the cost efficiency of CCS in Japan.

electric power demand-supply adjusting reservation capacity →Hydrogen from renewable, Bio thermal, Pumped-storage hydropower, Battery, DR(Demand Response)

Emission Intensity Regulation

Emission Cap versus Emission Intensity

Emission Cap Regulation ~ Restriction of Total Emission

Emission Intensity Regulation ~ Restriction of Total Emission per Output (Restriction of Unit Emission)

Emission Cap Regulation (Emission Tax) versus Emission Intensity Regulation

Japanese government traditionally prefers emission intensity regulation to emission cap regulation, but it is repeatedly criticized by other governments and environment protection group.

Firm has a weaker incentive to reduce its output level under emission intensity regulation than emission cap regulation.

Carbon Pricing

Carbon tax that is equal to the marginal damage of CO2 emission (Pigovian Tax) internalizes the negative externality and yields the first-best outcome under perfect competition.

Introducing the carbon tax in electric power market may be an obstacle for electrification because it raise the electricity price and harm the competitive advantage of electricity over gas, oil, and so on.

However, it provides a strong incentive for reducing emission intensity and is useful for decarbonization in the industry.

To mitigate the former defect, EPA planned to use tax revenue to reduce the electricity price.

Carbon Pricing and Refunding

To promote electrification, EPA planned to use tax revenue to reduce the electricity price.

Carbon pricing + refunding of tax revenue

⇒ Eliminating consumption reducing effect from carbon pricing

~ A similar effect of emission intensity regulation

The Equivalence of Emission Tax with Tax-Revenue Refund and Emission Intensity Regulation

２つの政策の同値性

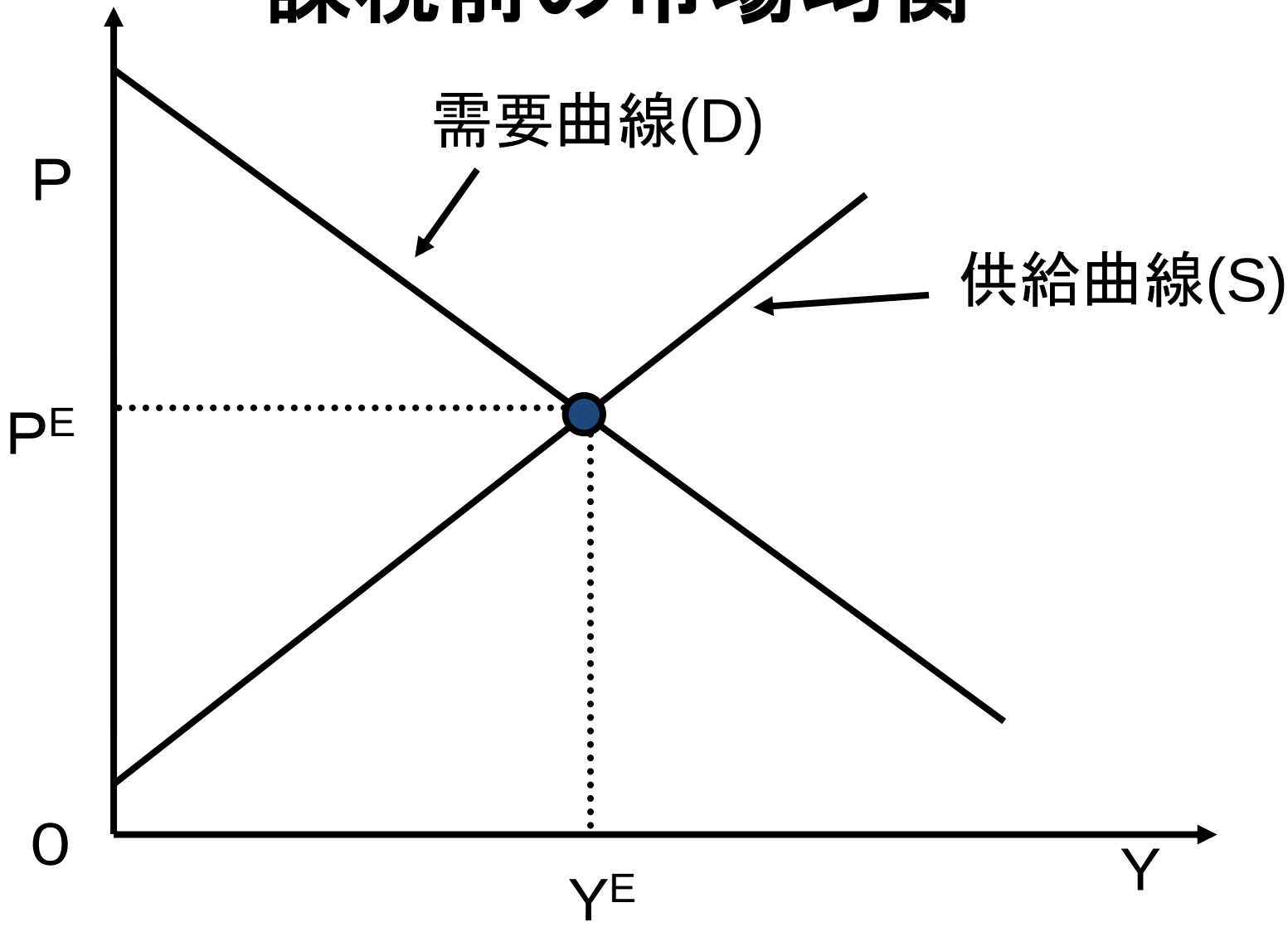
emission intensity regulation

→生産量を増やすと排出枠が増える

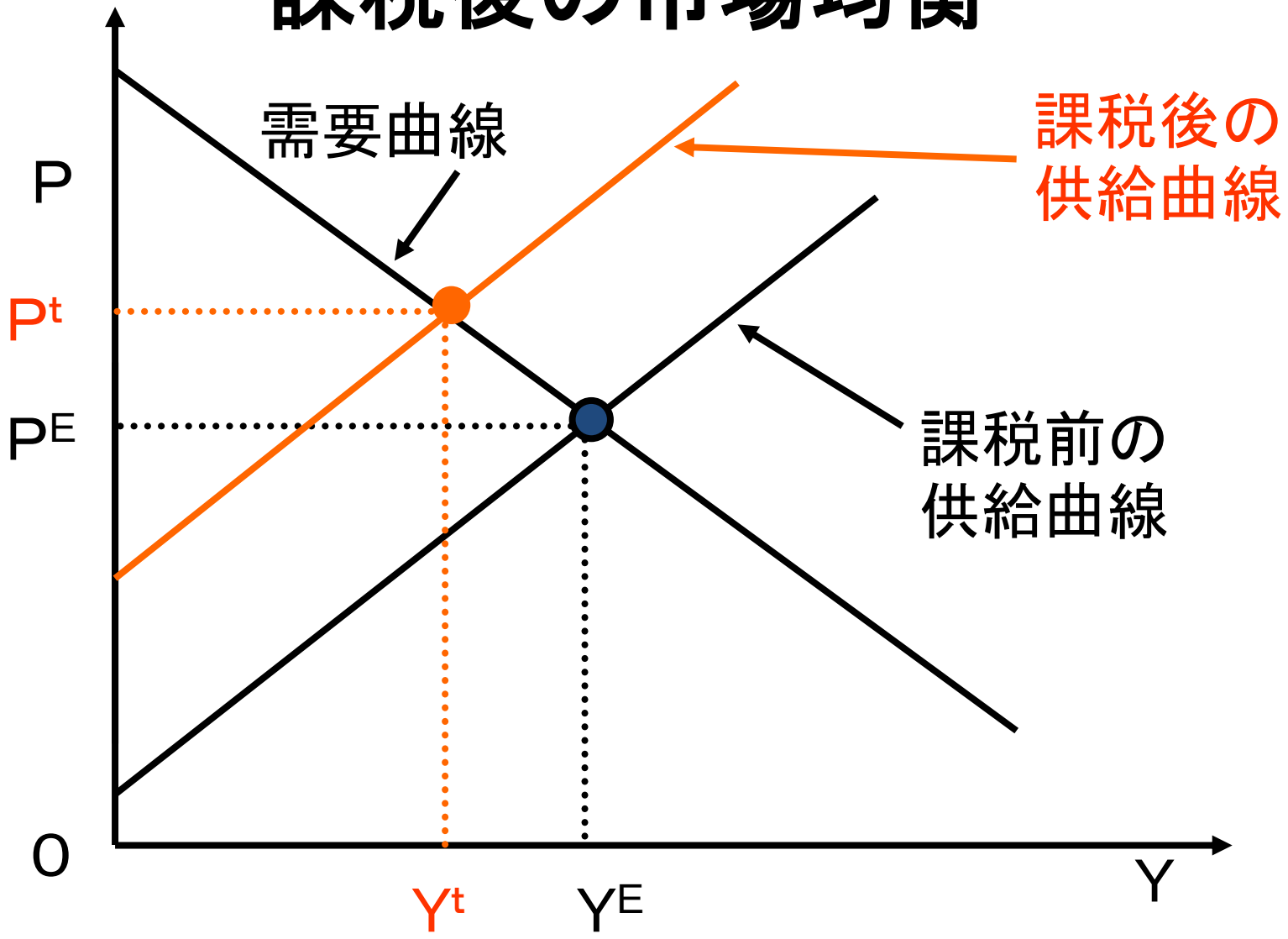
排出枠の帰属価格×枠の増加効果に等しい生産補助金を得ているのと同じ効果

消費者が補助金を得ても生産者が補助金を得ても均衡に与える影響は同じ

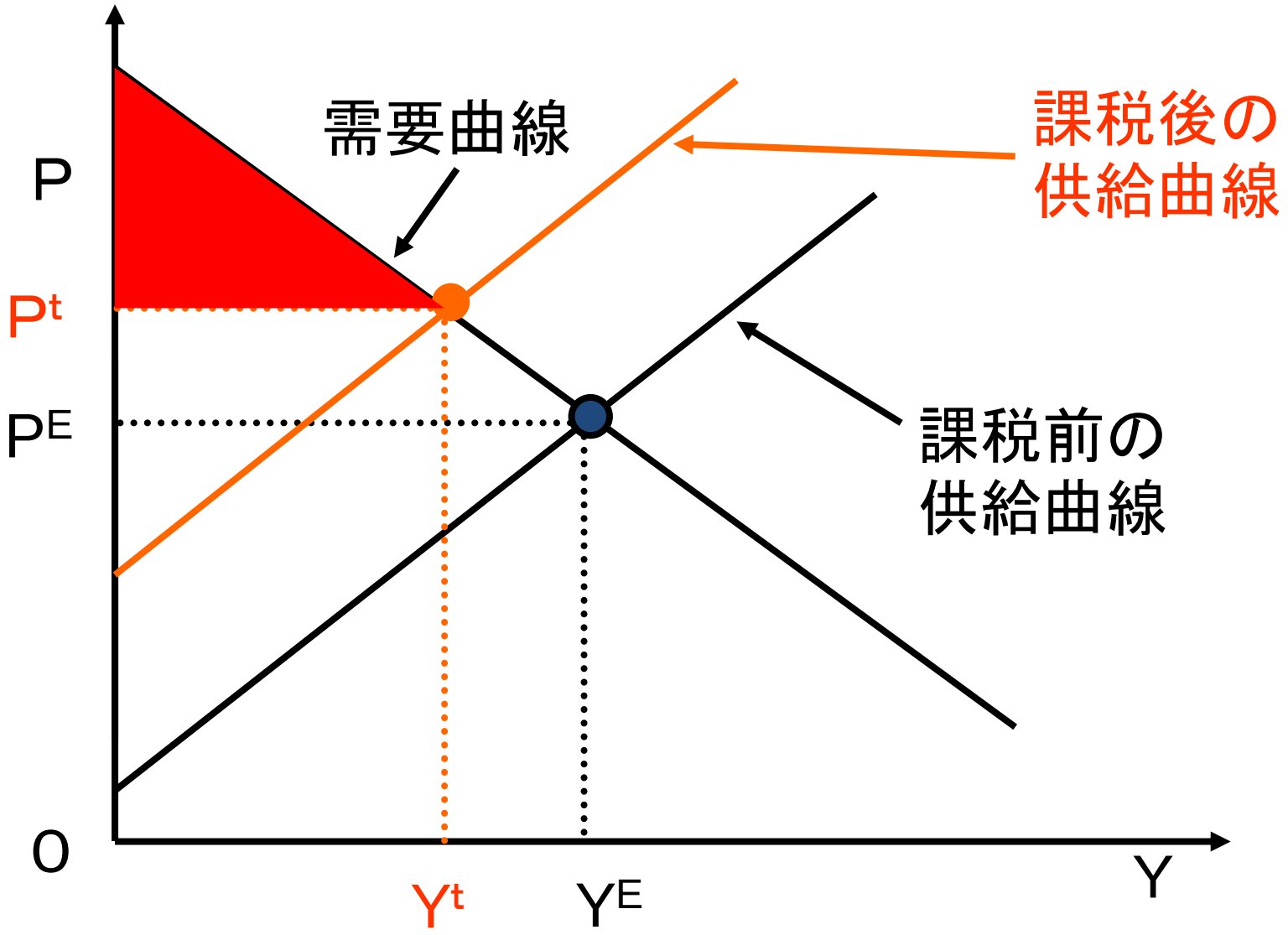
課税前の市場均衡



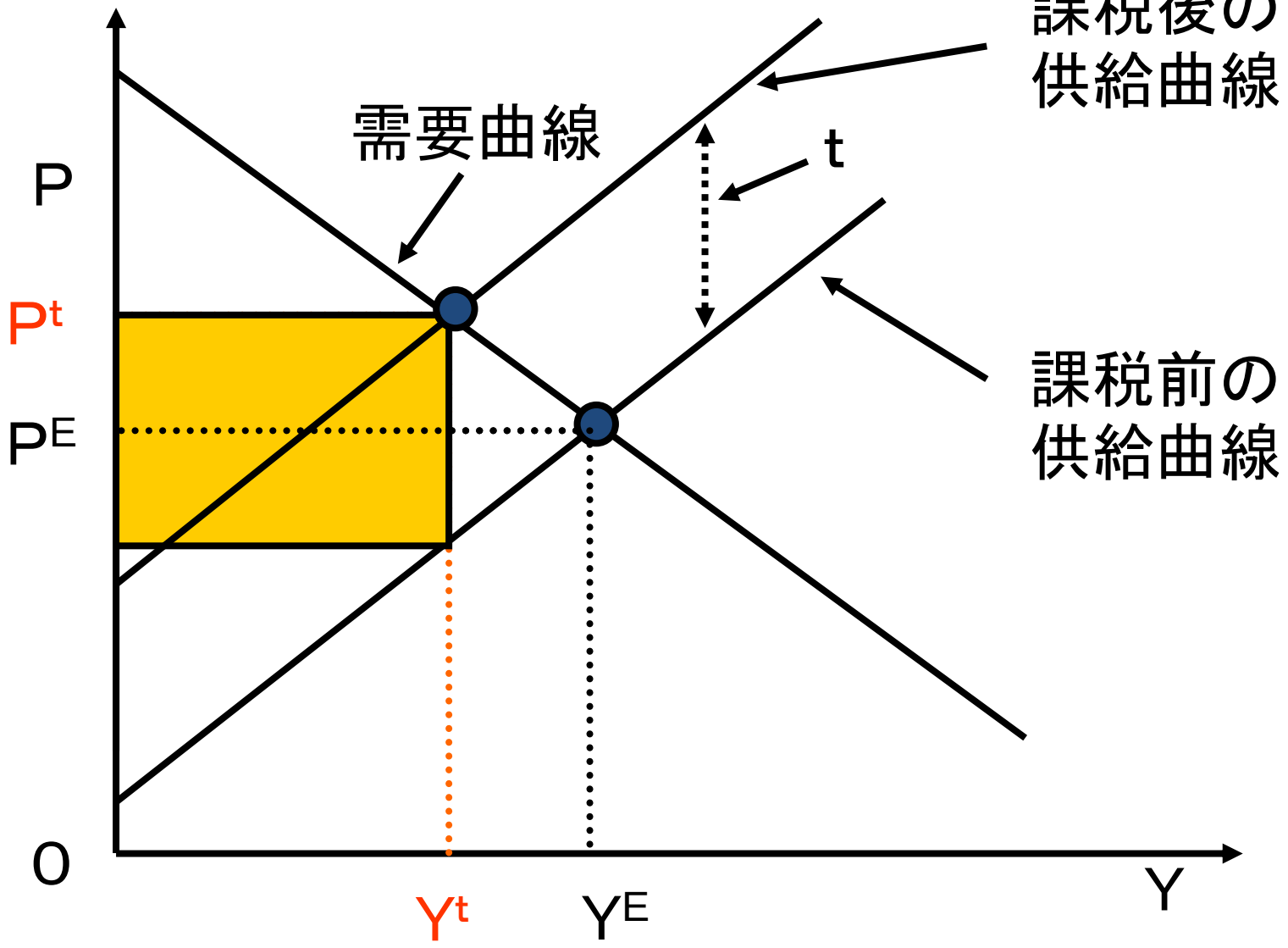
課税後の市場均衡



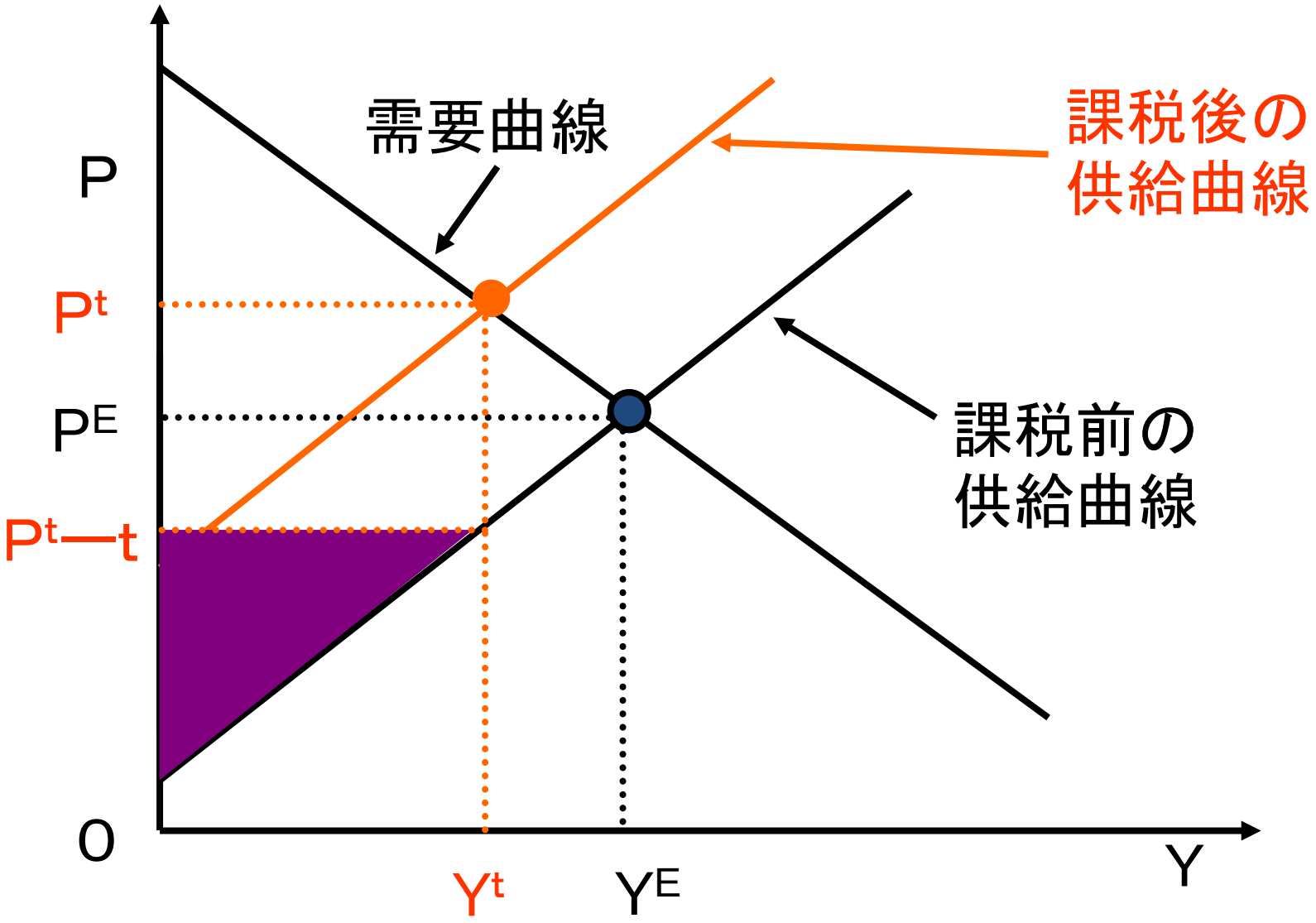
課税後の消費者余剰



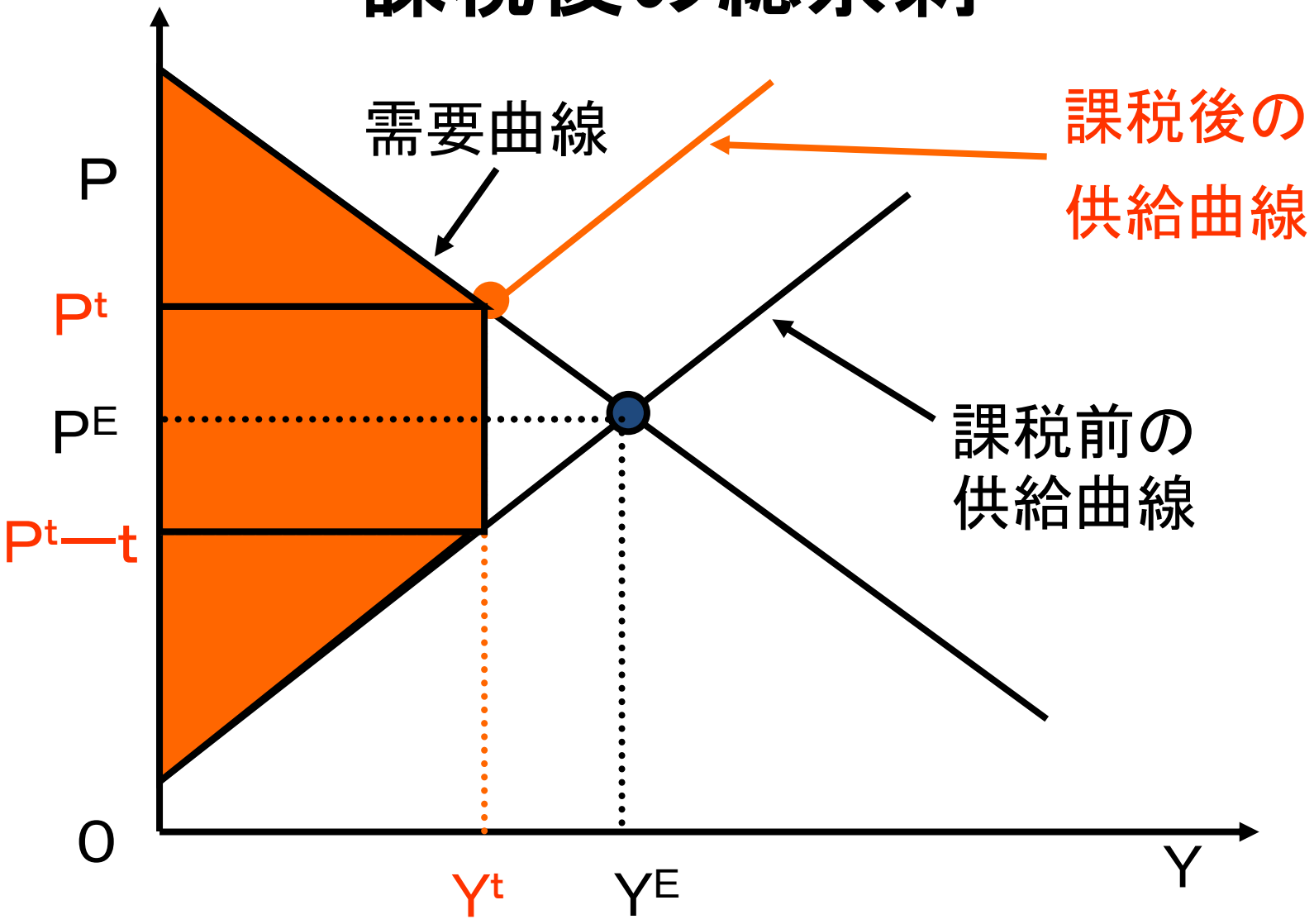
税収



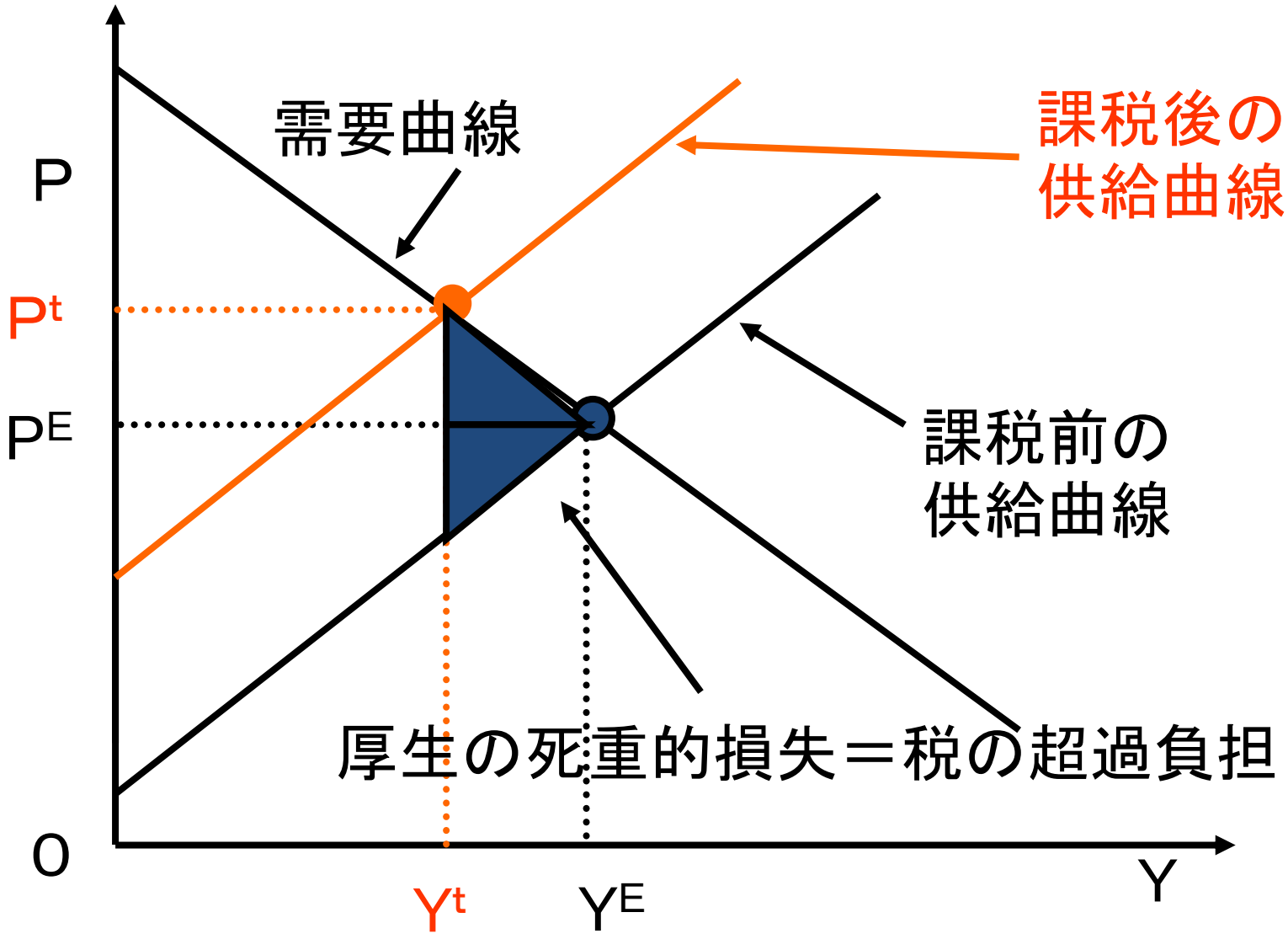
課税後の生産者余剰



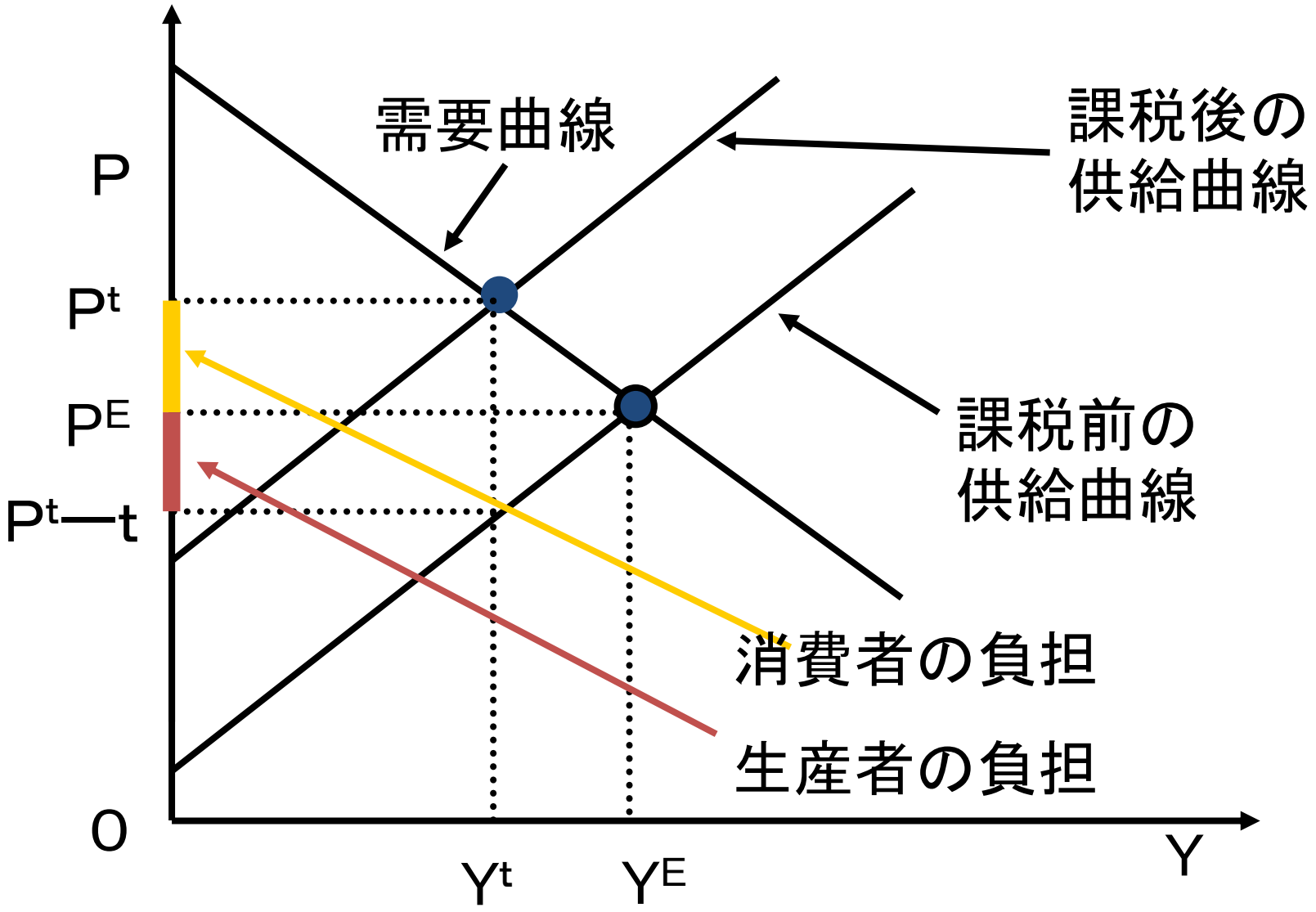
課税後の総余剰



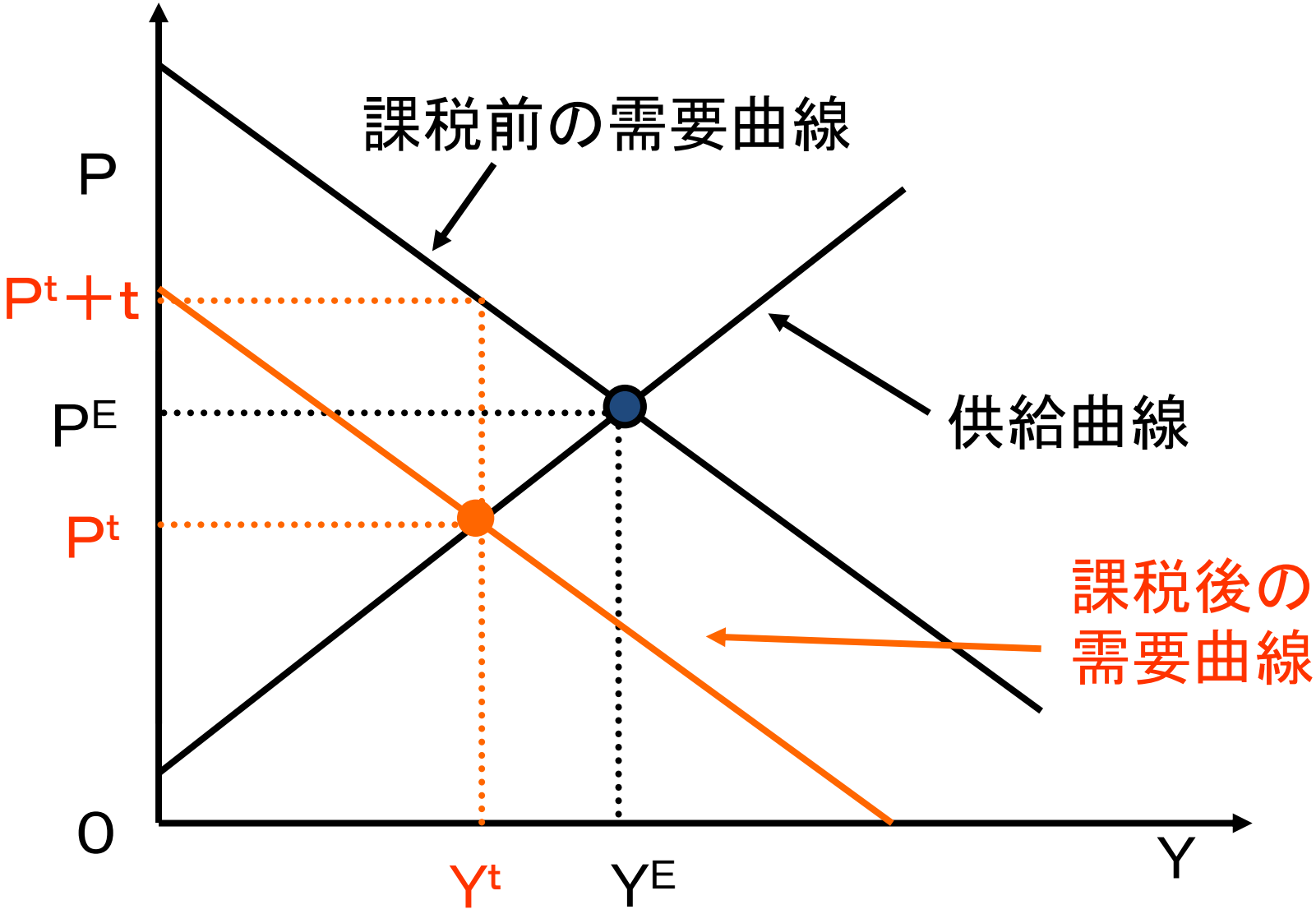
厚生の死重的損失



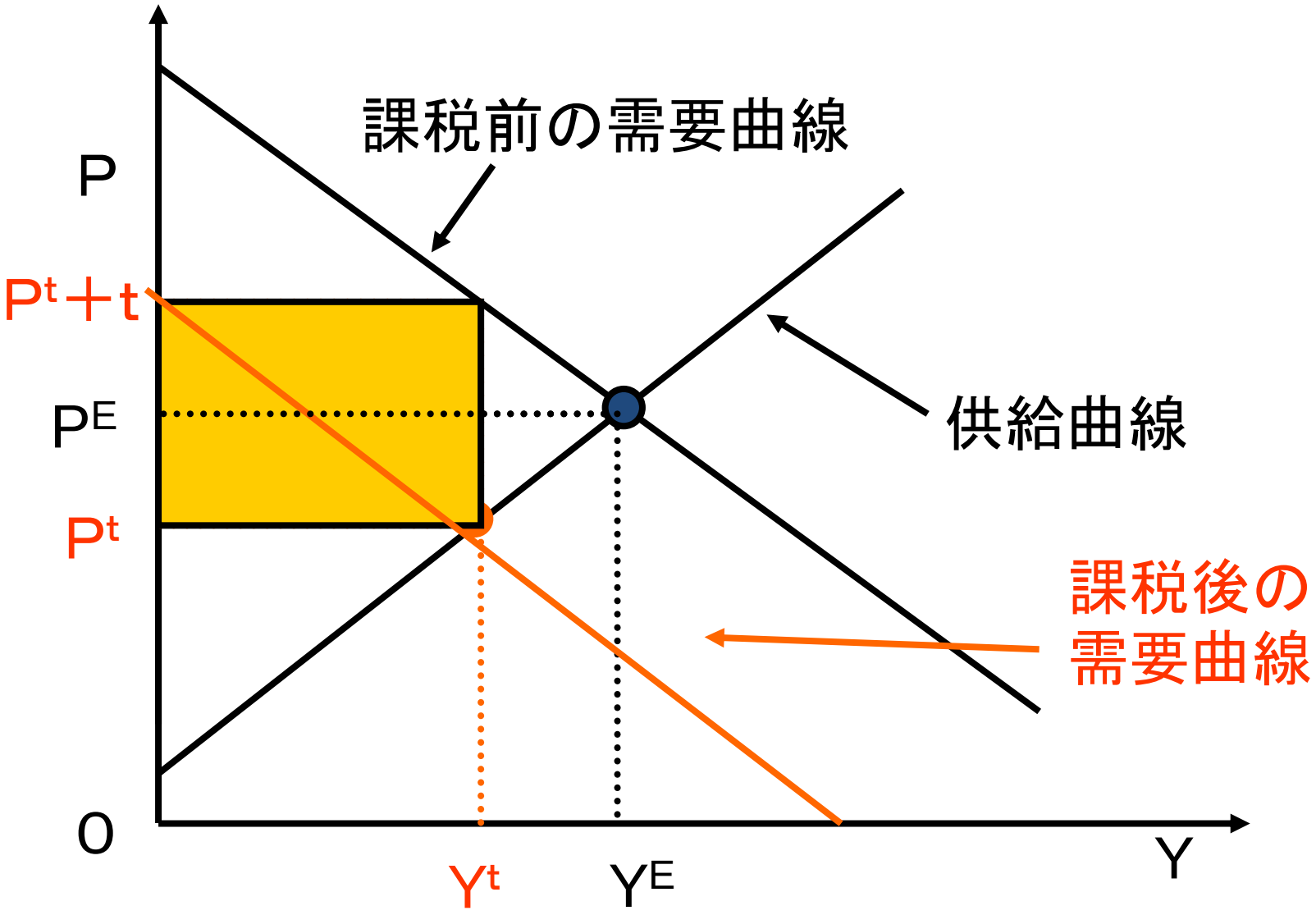
税の転嫁



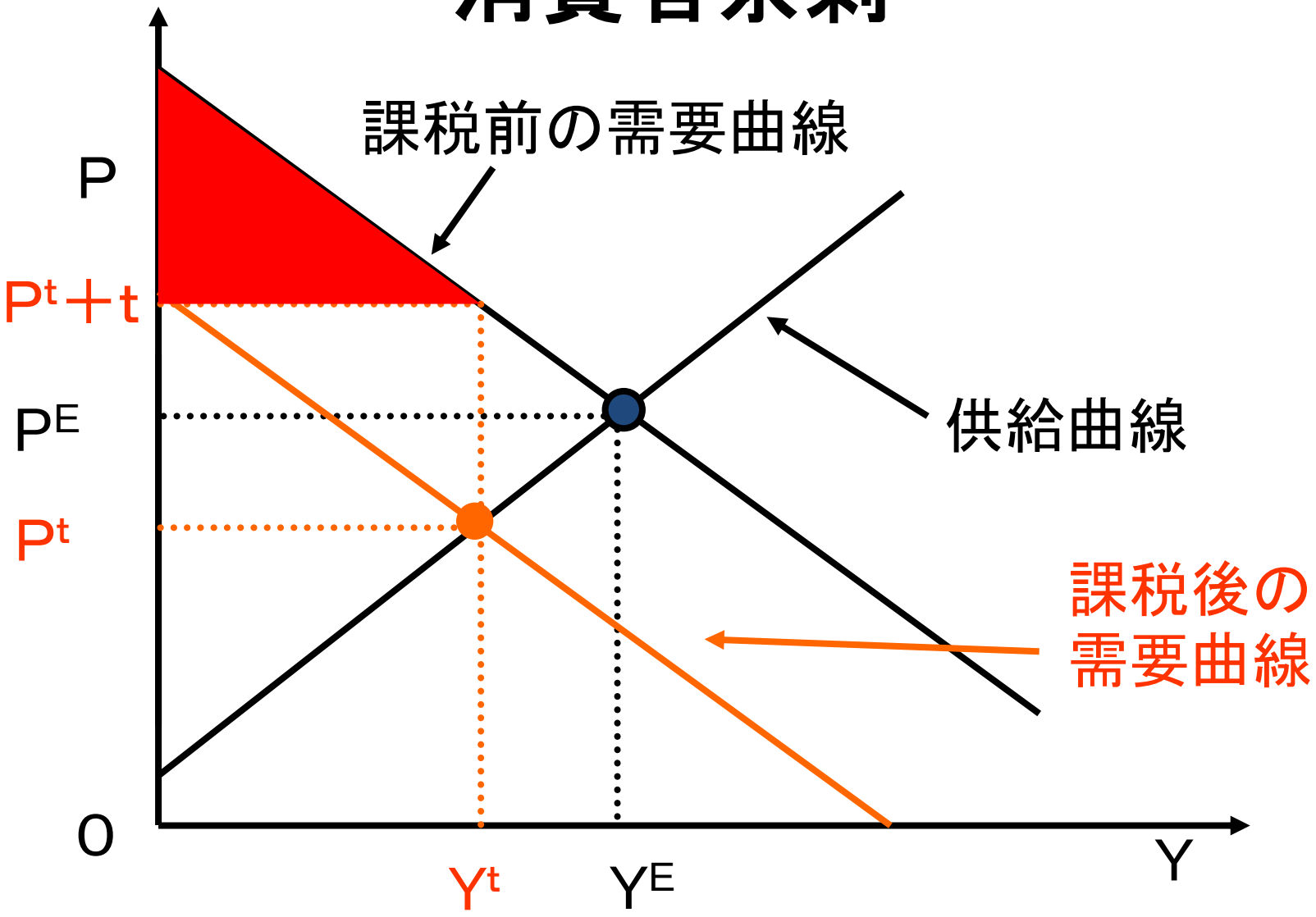
消費者に税をかけたら？



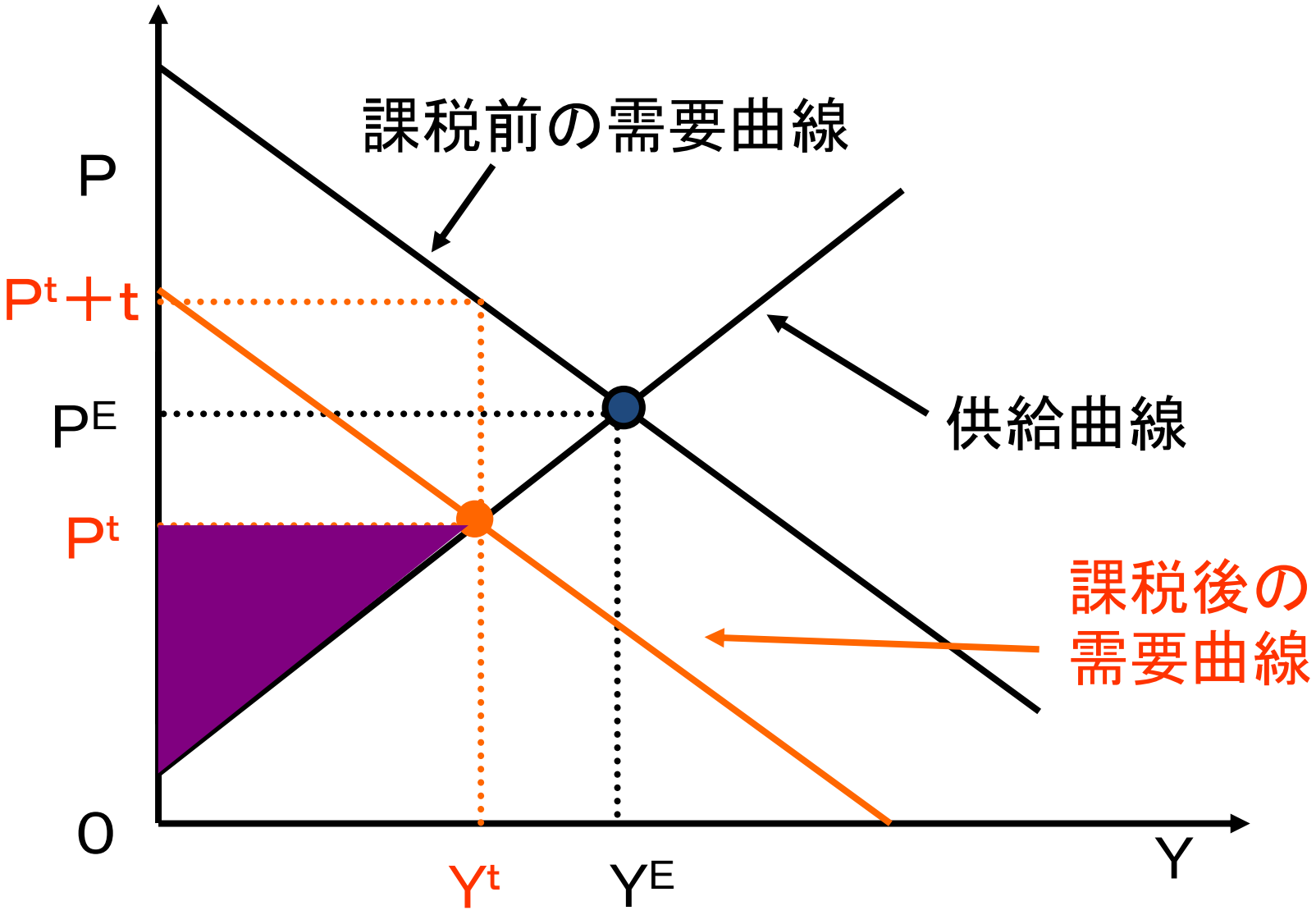
税収



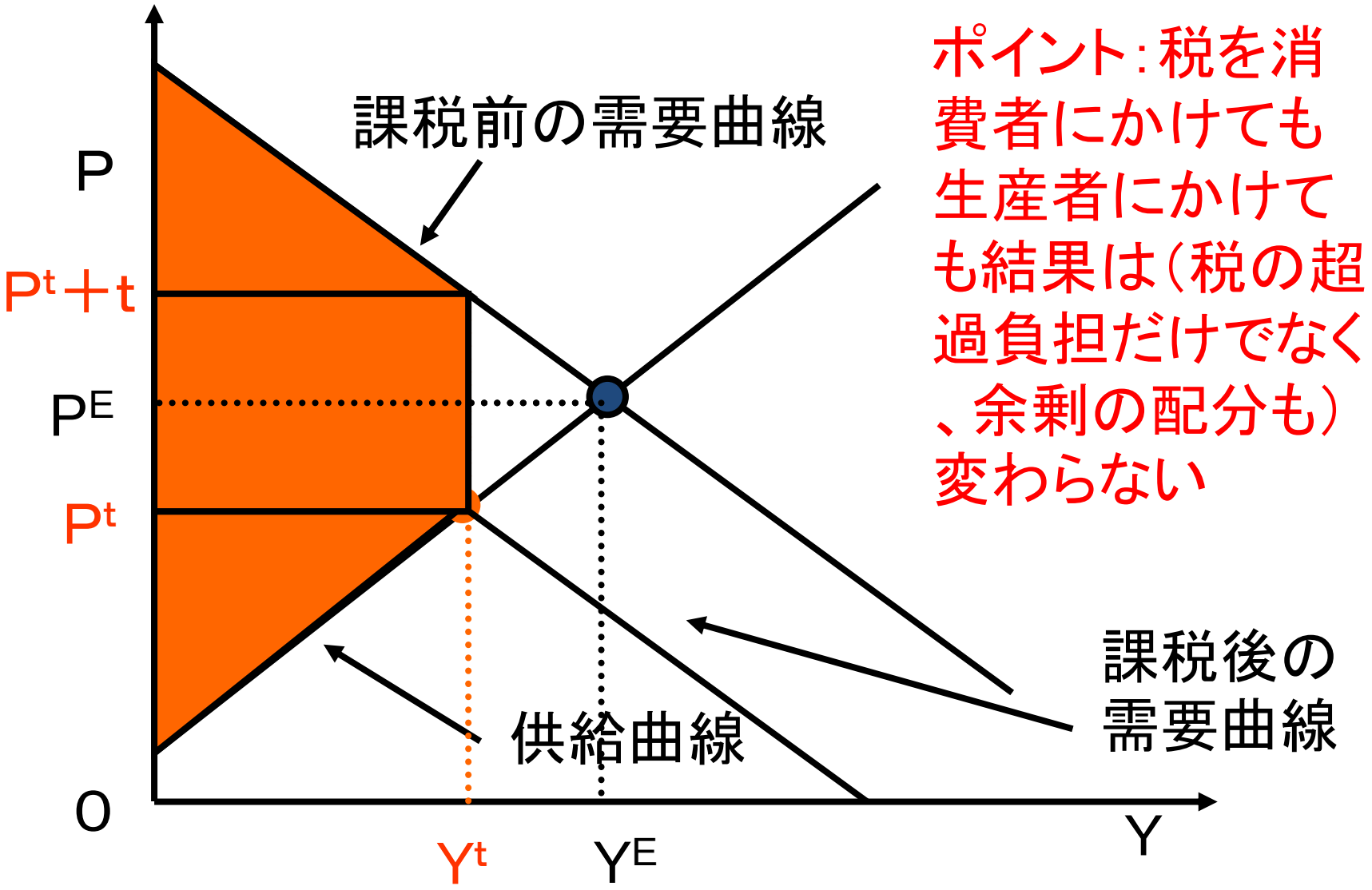
消費者余剰



生産者余剰



総余剰



ポイント：税を消費者にかけても生産者にかけても結果は（税の超過負担だけでなく、余剰の配分も）変わらない

Efficiency of Emission Tax

Under perfect competition, Pigovian tax yields the first-best outcome (i.e., optimal tax rate is equal to the marginal social cost of emission).

Emission tax with refunding yields the excessive consumption and causes distortion. Thus, emission intensity regulation is also suboptimal.

Emission intensity regulation may be better for welfare than emission tax policy under imperfect competition (Hirose and Matsumura, 2020, the paper presented in the second lecture), but not optimal.

Optimality of Emission Pricing Policies Based on Emission Intensity Targets under Imperfect Competition

Combination of Emission Intensity Regulation and Emission Tax

不完全競争市場では、emission tax でもemission intensity regulationでもfirst best は達成できない。

2つを組み合わせれば first bestは達成できる。

emission intensity regulationを課し、未達成分の排出に関して税をかける（超過達成分に補助金を出す）。

emission intensity regulationを課し、未達成分の排出に関して排出権を購入（超過達成分を売却）する。

The Model

Cournot oligopolies.

Firms choose their output and emission abatement.

⇒We allow heterogeneity among firms.

Notations

q_i: output quantity of firm i (i=1,2,…,n)
p(Q): demand function
$c_i\,(q_i,\ a_i)$ cost function
a_i: abatement level of firm i
$e_i\ (q_i,\ a_i)$ emission function
θ_i: emission intensity target
$D(\sum_{i=1}^{n} e_i)$:social cost of the emission
t: tax rate

Notations

superscript *: the equilibrium outcomes

superscript o: the first-best outcomes

superscript oo: the second-best outcomes in which the government chooses the emission tax only

First-Best Outcomes

The first-order conditions:

$p = \partial c_i/\partial q_i + D' \partial e_i/\partial q_i$

$-D' e_i/\partial a_i = \partial c_i/\partial a_i$

この2ｎ本の式から2ｎ個の変数の値を決める

Equilibrium Outcomes

The first-order conditions:

$p + p' q_i + t\theta_i = \partial c_i/\partial q_i + t\, \partial e_i/\partial q_i$

$-t\, e_i/\partial a_i = \partial c_i/\partial a_i$

この2ｎ本の式から2ｎ個の変数の値を決める

Main Results

Proposition 1:

There exists (θ1, . . . , θn) such that the policy attains the first-best optimality if and only if the tax rate is Pigovian (i.e., t= D').

(1) この政策で最適解が得られる。

(2) 最適税率はピグー税。過少生産への対応は排出係数の設定で調整すればよい。

Propositions 2-3　First-Bestがtradable permitsでも差別化された財のBertrand競争下でも得られる。

Second-Best Emission Tax Policyとの比較

総余剰を最大化するようにemission tax rate を決める～second best emission tax policy

一般にfirst bestは達成できない。

税収は（私たちが提案した政策より）大きくなる。

←私たちの提案した政策のデメリット

Extension

同じメカニズムがPortfolio Standard 政策にも適用できる。

Portfolio Standard の例

Zero emission自動車の割合を規制

Zero emission 電源の割合を規制

zero emissionでないものを導入する外部不経済に対応し、かつ最適割合が内点解であるとき、同じ政策でfirst-bestが達成できる。

⇒第１０講の論文へ

Thank you very much for your kind attention

非常感謝