Intermediate Microeconomics

Chapter 14: Consumer's Surplus

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Consumer-Financed Fiscal Stimulus: Evidence from Digital Coupons in China

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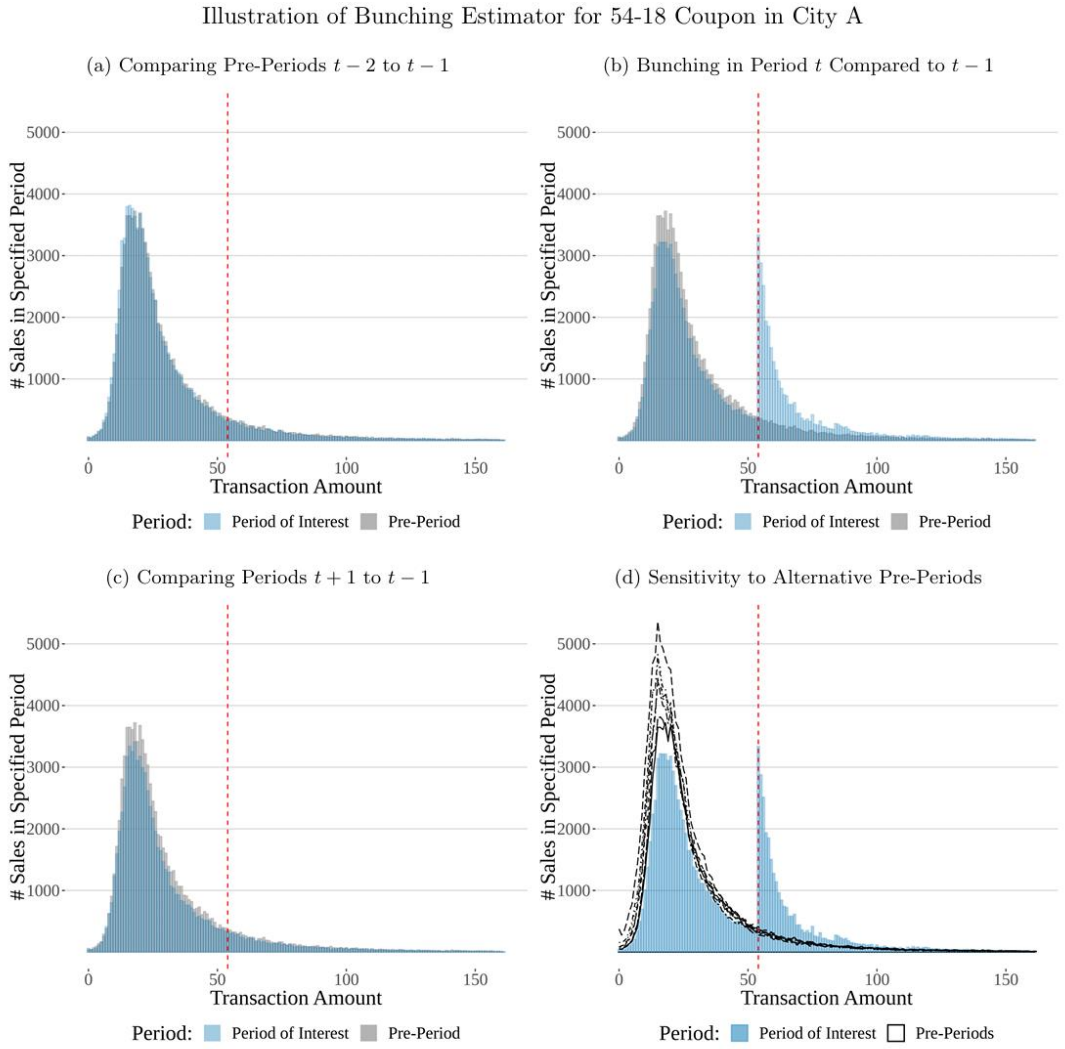
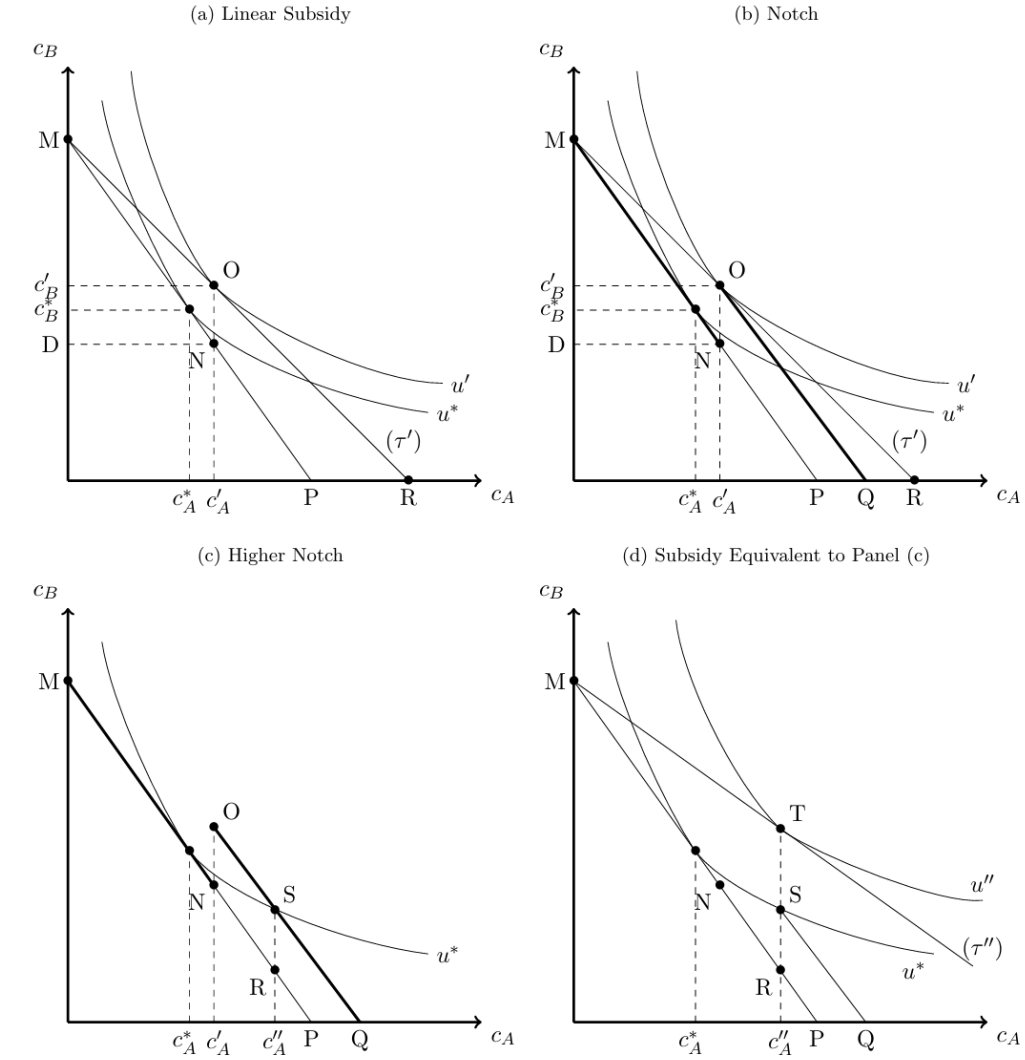
Abstract

In 2020, local governments in China began issuing digital coupons to stimulate spending in targeted categories such as restaurants and supermarkets. Using data from a large e-commerce platform and a bunching estimation approach, we find that the coupons caused large increases in spending of 3.1–3.3 yuan per yuan spent by the government. The large spending responses do not come from substitution away from non-targeted spending categories or from short-run intertemporal substitution. To rationalize these results, we develop a dynamic consumption model showing how coupons' minimum spending thresholds create temporary notches that lead to large spending responses.



Notes: This figure illustrates the bunching estimator by comparing the distribution of food delivery spending between periods around the time the coupons were distributed. Panel (a) compares the distribution of spending in the two pre-periods immediately before the coupons were distributed. Panel (b) shows the distribution of spending during the coupon wave. Panel (c) shows the distribution of spending in the period immediately after coupons were distributed. In panels (a) to (c) the pre-period $t-1$ distribution is shown for reference. Panel (d) illustrates the sensitivity to different pre-periods by comparing the distribution in the coupon period to seven pre-periods ($t-1$ through $t-7$). The analogous figure covering all of the spending categories covered by the coupon is available in the Appendix (see Figure OA.15).

Graphical Model



Notes: This figure presents a simple two-good graphical model to reassess the economics of notches versus linear subsidies. In Panel (a), the consumer responds to a linear subsidy that reduces the price of good A by a factor $(1-\tau')$. This rotates the budget constraint and leads to new choices $c_A^{'}$ and $c_B^{'}$. Panel (b) shows that the government can replicate the outcome of the linear subsidy with a notch that transfers ON to the consumer if they choose at least $c_A^{'}$ of good A. Panel (c) shows that the government can design a notch with a higher threshold where the consumer is indifferent between locating at the notch and remaining at initial endowment; this new notch has same cost to government ($ON = SR$), but leads to a large increase in consumption of good A. Lastly, Panel (d) shows the linear subsidy that is necessary to induce the consumer to increase consumption by same amount as in Panel (c). This shows that a linear subsidy is not equivalent to the notch, since to achieve the same increase in consumption of good A the linear subsidy leads to a greater increase in consumer welfare but also a larger amount of government spending (RT instead of RS).

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Monetary Measures of Gains-to-Trade

You can buy as much gasoline as you wish at $1 per gallon once you enter the gasoline market.

Q: What is the most you would pay to enter the market?

A: You would pay up to the dollar value of the gains-to-trade you would enjoy once in the market.

$ Equivalent Utility Gains

User r_1 to denote the most a consumer would pay for a 1st gallon – reservation price (保留价格) for the 1st gallon.

r_1 is the dollar equivalent of the marginal utility of the 1st unit.

User r_2 to denote the most she would pay for a 2nd gallon, i.e., her reservation price for the 2nd gallon.

r_2 is the dollar equivalent of the marginal utility of the 2nd unit.

$ Equivalent Utility Gains

Generally, if she already has n-1 gallons of gasoline then r_n denotes the most she will pay for the an nth gallon.

r_n is the dollar equivalent of the marginal utility of the nth unit.

r_1+…+ r_n will be the dollar equivalent of the total change to utility from consuming n gallons of gasoline at a price of $0.

$u(x, m) = u(x+\Delta x, m-\Delta m)$

$u(x+\Delta x, m) = u(x, m+\Delta m)$

Stage I $u(0, m)$

Stage II $u(1, m-r_1) \geq u(0, m)$

$\max r_1 \rightarrow u(1, m-r_1^*) = u(0, m)$

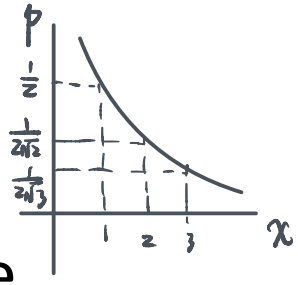
$u(2, m-r_1-r_2) \geq u(1, m-r_1^*)$

$u(n, m-\sum_{i=1}^{n} r_i^*) = u(0, m)$

$u(x_0+n, m-pn) \geq u(x_0, m)$

$CS = \sum_{i=1}^{n} r_i^* - pn$

Reservation Prices and Consumer's Surplus



What is the monetary value of our consumer's gain-to-trading in the gasoline market at a price of $p?

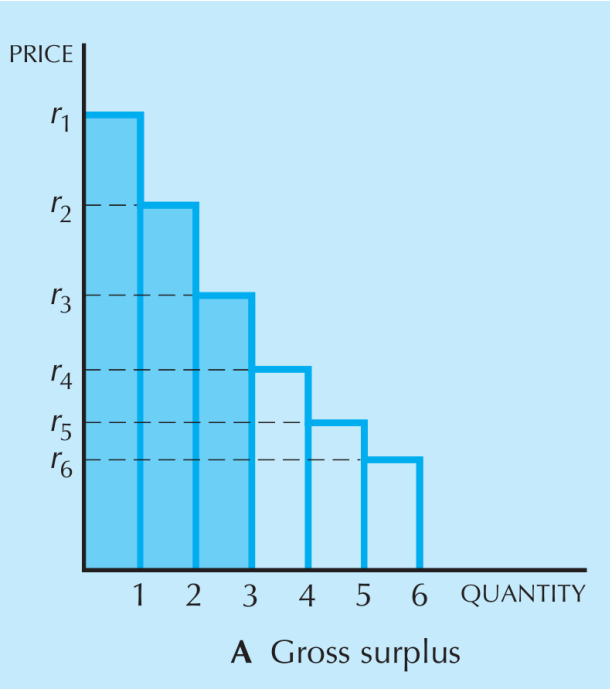
The dollar equivalent net utility gain for the 1st gallon is $ r_1-p,

and is $ r_2-p for the 2nd gallon,

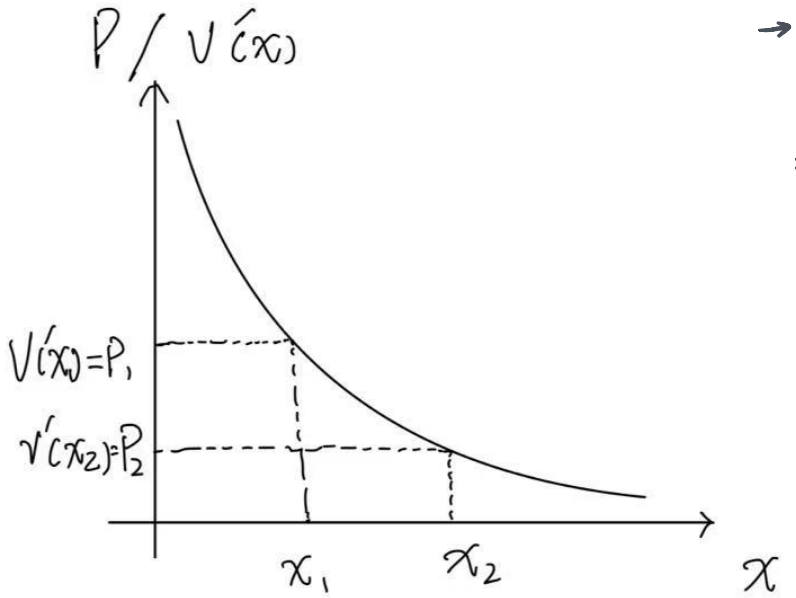
and so on, so the dollar value of the gain-to-trade is (r_1-p)+…+(r_n-p), for as long as r_n-p>0.

So, r_1+…+ r_n-np will be the dollar equivalent of the total change to utility from consuming n gallons of gasoline at a price of $p, also referred to as "consumer's surplus."

Reservation Prices and Consumer's Surplus



A Gross surplus



$\max u = m + v(x)$

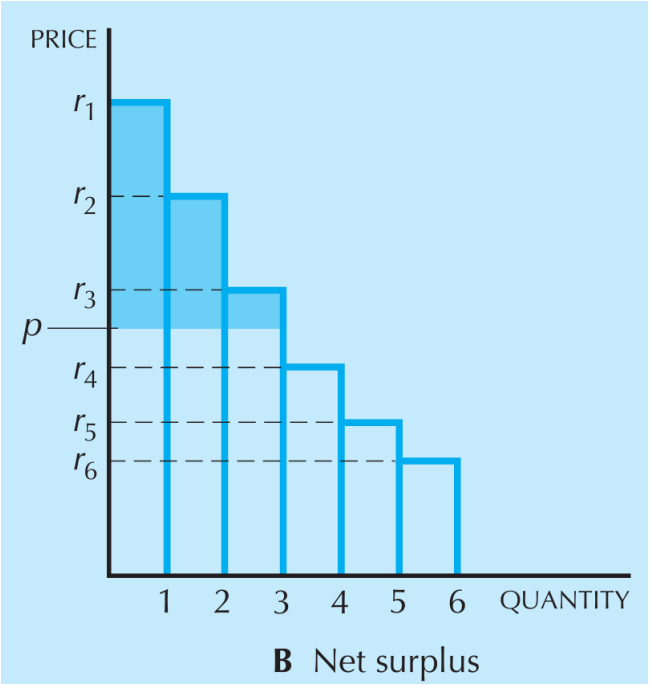
s.t $m + px = w$

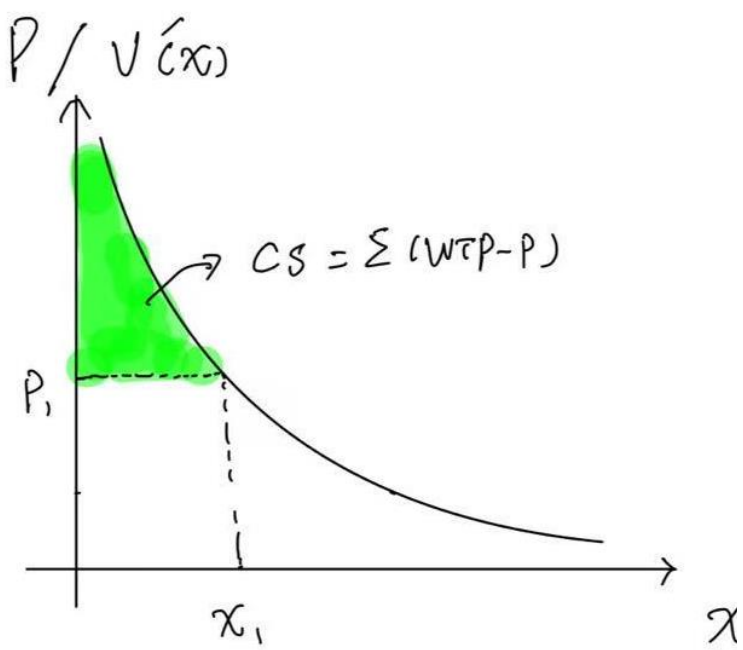
$\rightarrow u = w - px + v(x)$

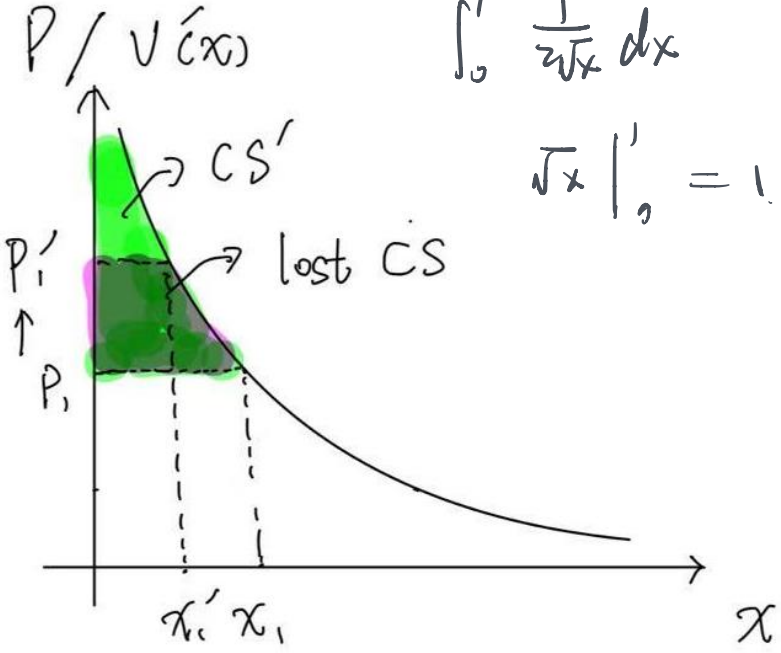
$\max u: u' = 0$

$\Rightarrow$ FOC: $v'(x) = p$.

Reservation Prices and Consumer's Surplus







$P = \frac{1}{2\sqrt{x}}$

$\int_0^1 \frac{1}{2\sqrt{x}}\,dx$

$\sqrt{x}\,\Big|_0^1 = 1$

Compensating Variation and Equivalent Variation

Two additional dollar measures of the total utility change caused by a price change are Compensating Variation and Equivalent Variation.

Compensating Variation

p_1 rises.

Q: What is the least extra income that, at the new prices, just restores the consumer's original utility level?

A: The Compensating Variation.

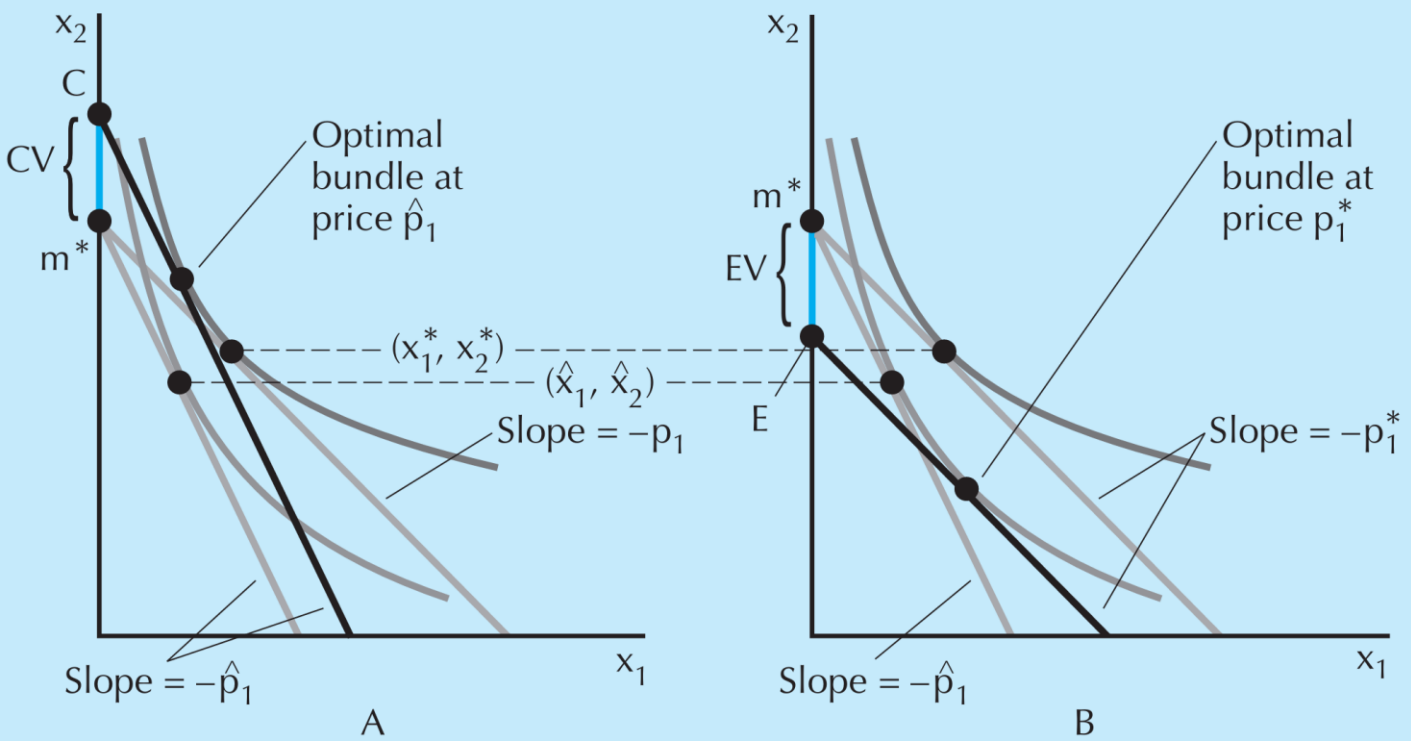
$$u(\vec{x}(p_1, p_2, \cdots, m)) = u(\vec{x}(p_1+\Delta p_1, p_2, \cdots, m+\Delta m))$$

补贴 consumer 的效率较高.

$$\Delta m = u(\vec{x}(p_1+\Delta p, p_2, \cdots, m) - u(\vec{x}(p_1, p_2, \cdots, m))$$

价格调整后效用变化.

Compensating Variation



The compensating and the equivalent variations. Panel A shows the compensating variation (CV), and panel B shows the equivalent variation (EV).

$u(x_1, x_2) = \sqrt{x_1 x_2}$, $m = 100$ $\Rightarrow$ $x_1^* = \frac{m}{2p_1}$, $x_2^* = \frac{m}{2p_2}$

$p_1 = 1, p_2 = 1$

$p_1 = 2, p_2 = 1$

CV? EV?

$u = \sqrt{x_1 x_2}$

s.t. $x_1 + x_2 = 100$

$\Rightarrow x_1^* = 50, x_2^* = 50$

$u = \sqrt{x_1 x_2}$

s.t. $2x_1 + x_2 = 100$

$\Rightarrow x_1^{**} = 25, x_2^{**} = 50$

$u = \sqrt{x_1 x_2} = 50$

s.t. $2x_1 + x_2 = m$

$\Rightarrow x_1 x_2 = 2500$

$2x_1 + x_2 = m$

$\Rightarrow x_1' = \frac{m}{4}$ $x_2' = \frac{m}{2}$

$\Rightarrow m = 100\sqrt{2}$

$CV = am - 100(\sqrt{2}-1)$

$x_1 + x_2 = m$ $x_1' = \frac{m}{2}$, $x_2' = \frac{m}{2}$

$u = \sqrt{25 \times 50} = 25\sqrt{2}$

$x_1 x_2 = 1250$ $m = 50\sqrt{2}$

$EV = 50\sqrt{2} - 100$.

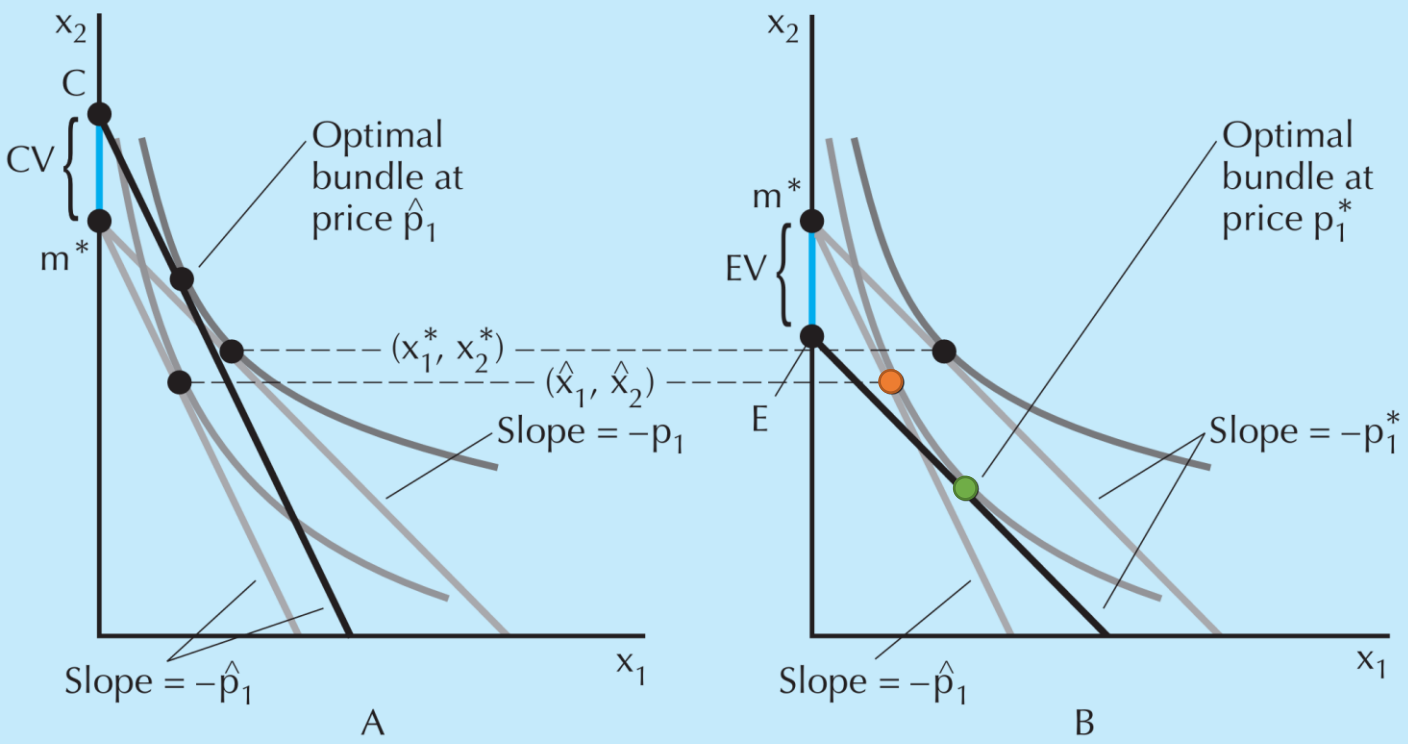
Equivalent Variation

p_1 rises.

Q: What is the least extra income that, at the original prices, just restores the consumer's original utility level?

A: The Equivalent Variation.

Equivalent Variation



The compensating and the equivalent variations. Panel A shows the compensating variation (CV), and panel B shows the equivalent variation (EV).

Consumer's Surplus, Compensating Variation and Equivalent Variation

When the consumer has quasilinear utility, we have

$$CV=EV=\Delta CS$$

But, otherwise, we have:

$$EV<\Delta CS< CV$$

Intermediate Microeconomics

Chapter 15: Market Demand

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From Individual to Market Demand Functions

Think of an economy containing n consumers, denoted by i=1, …, n.

Consumer i's ordinary demand function for commodity j is

$$x_j^{*i}(p_1, p_2, m^i)$$

When all consumers are price-takers, the market demand function for commodity j is

$$x_j\ (p_1, p_2, m^1, \ldots, m^n) = \sum_{i=1}^{n} x_j^{*i}(p_1, p_2, m^i)$$

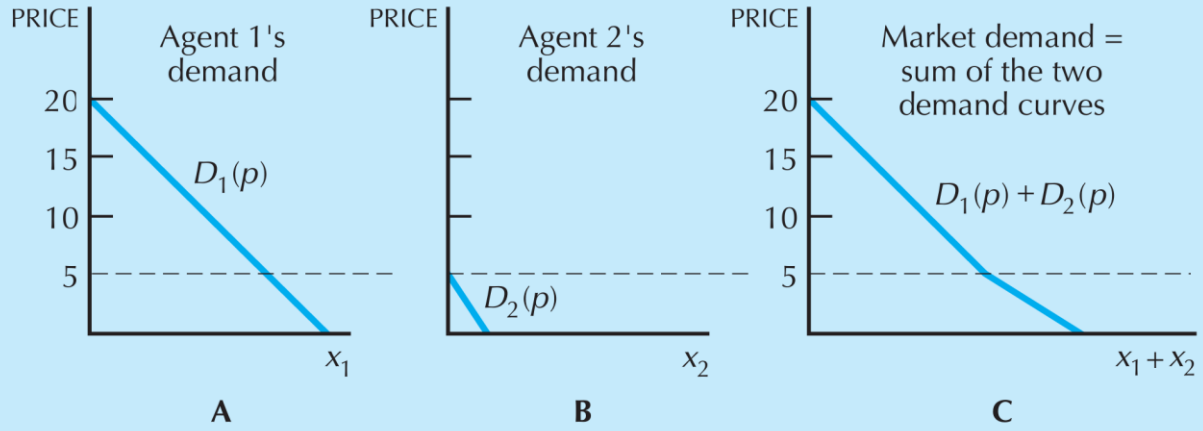
If all consumers are identical then

$$x_j\ (p_1, p_2, M) = \sum_{i=1}^{n} n \times x_j^{*}(p_1, p_2, m\ \ ),\ M = nm$$

From Individual to Market Demand Functions

The market demand curve is the “horizontal sum” of the individual consumers’ demand curves.

Suppose there are only two consumers; i=A, B.



The sum of two “linear” demand curves. Since the demand curves are only linear for positive quantities, there will typically be a kink in the market demand curve.

Elasticities

Elasticity measures the "sensitivity" of one variable with respect to another. The elasticity of variable X with respect to variable Y is

$$\varepsilon_{\mathrm{x,y}} = \frac{\%\Delta \mathrm{x}}{\%\Delta \mathrm{y}}$$

Economists use elasticities to measure the sensitivity of

1. quantity demanded of commodity i wrt the price of commodity i (own-price elasticity of demand)
2. demand for commodity i wrt the price of commodity j (cross-price elasticity of demand)
3. demand for commodity i wrt income (income elasticity of demand)
4. quantity supplied of commodity i wrt the price of commodity i (own-price elasticity of supply)

A Special Property

Weighted average of income elasticities of all goods is one with the weights being expenditure share of the goods.

In the case of 2 goods, we have

$$p_1 x_1 + p_2 x_2 = m$$

$$p_1 \frac{dx_1}{dm} + p_2 \frac{dx_2}{dm} = 1$$

$$\underbrace{p_1 \frac{x_1}{m}}_{s_1} \cdot \underbrace{\frac{dx_1}{dm} \cdot \frac{m}{x_1}}_{\eta_1} + \underbrace{p_2 \frac{x_2}{m}}_{s_2} \cdot \underbrace{\frac{dx_2}{dm} \cdot \frac{m}{x_2}}_{\eta_2} = 1$$

$$s_1\eta_1 + s_2\eta_2 = 1$$

Intermediate Microeconomics

Chapter 16: Equilibrium

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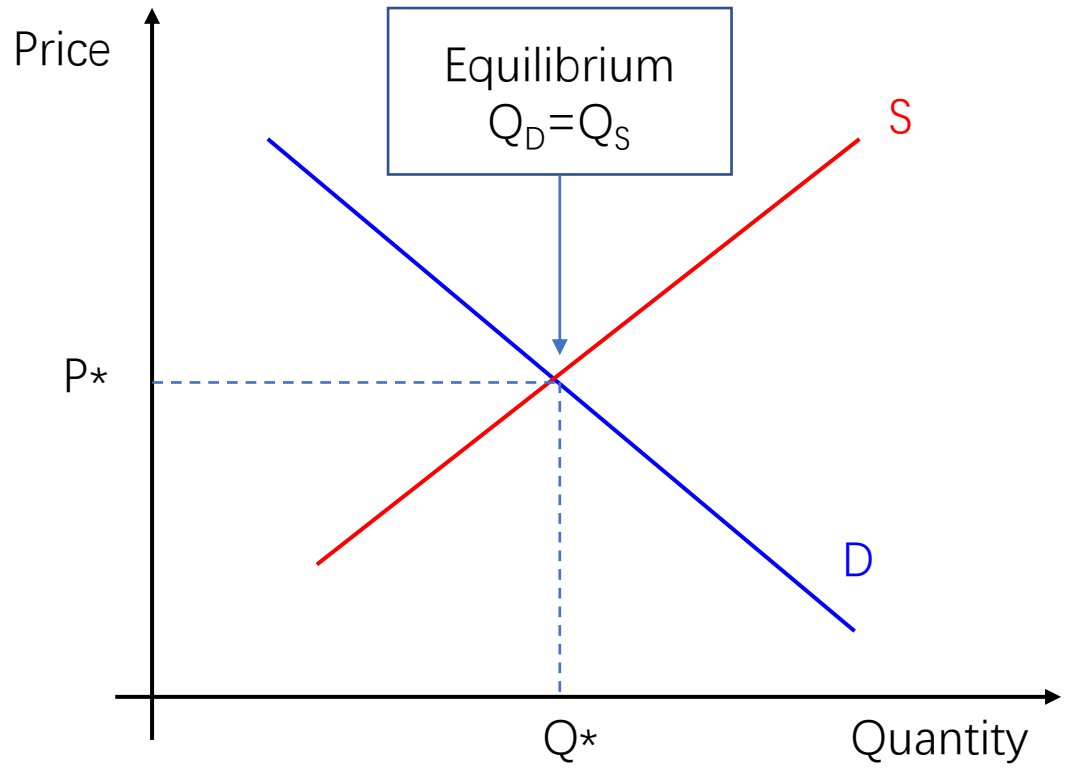
Market Equilibrium

A market is in equilibrium when total quantity demanded by buyers equals total quantity supplied by sellers.



A more general model:

$$Q_D = a - bP$$

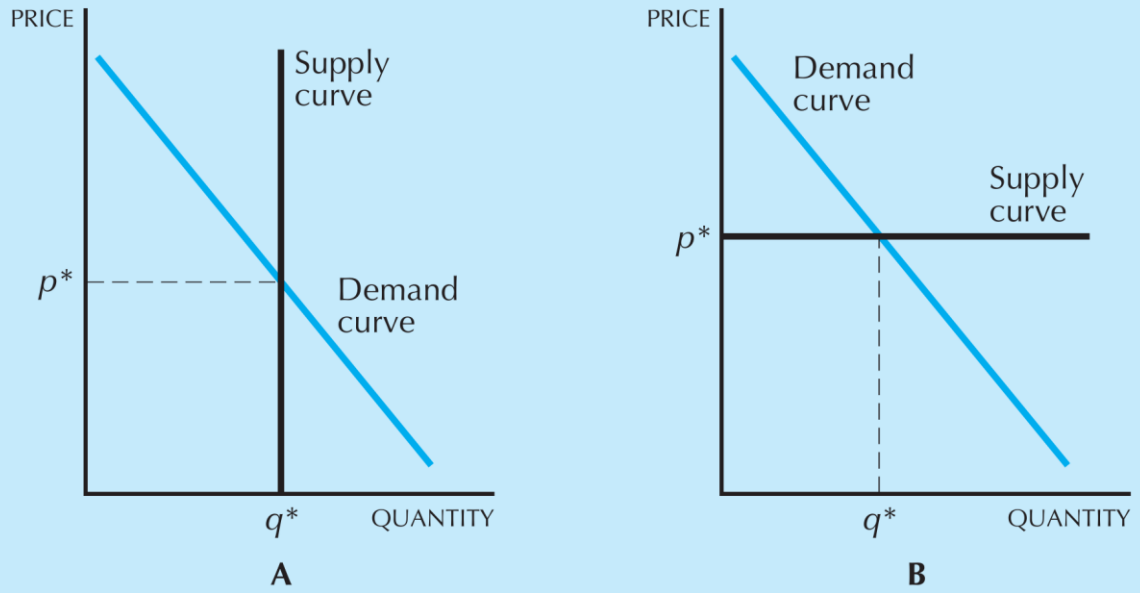
$$Q_S = c + dP$$

Equilibrium $\Rightarrow q_D = q_S$

$$a - bP = c + dP$$

$$P^* = (a-c)/(d+b)$$

Two Special Cases



Special cases of equilibrium. Case A shows a vertical supply curve where the equilibrium price is determined solely by the demand curve. Case B depicts a horizontal supply curve where the equilibrium price is determined solely by the supply curve.

Quantity Taxes

What is the effect of a quantity tax on a market's equilibrium?

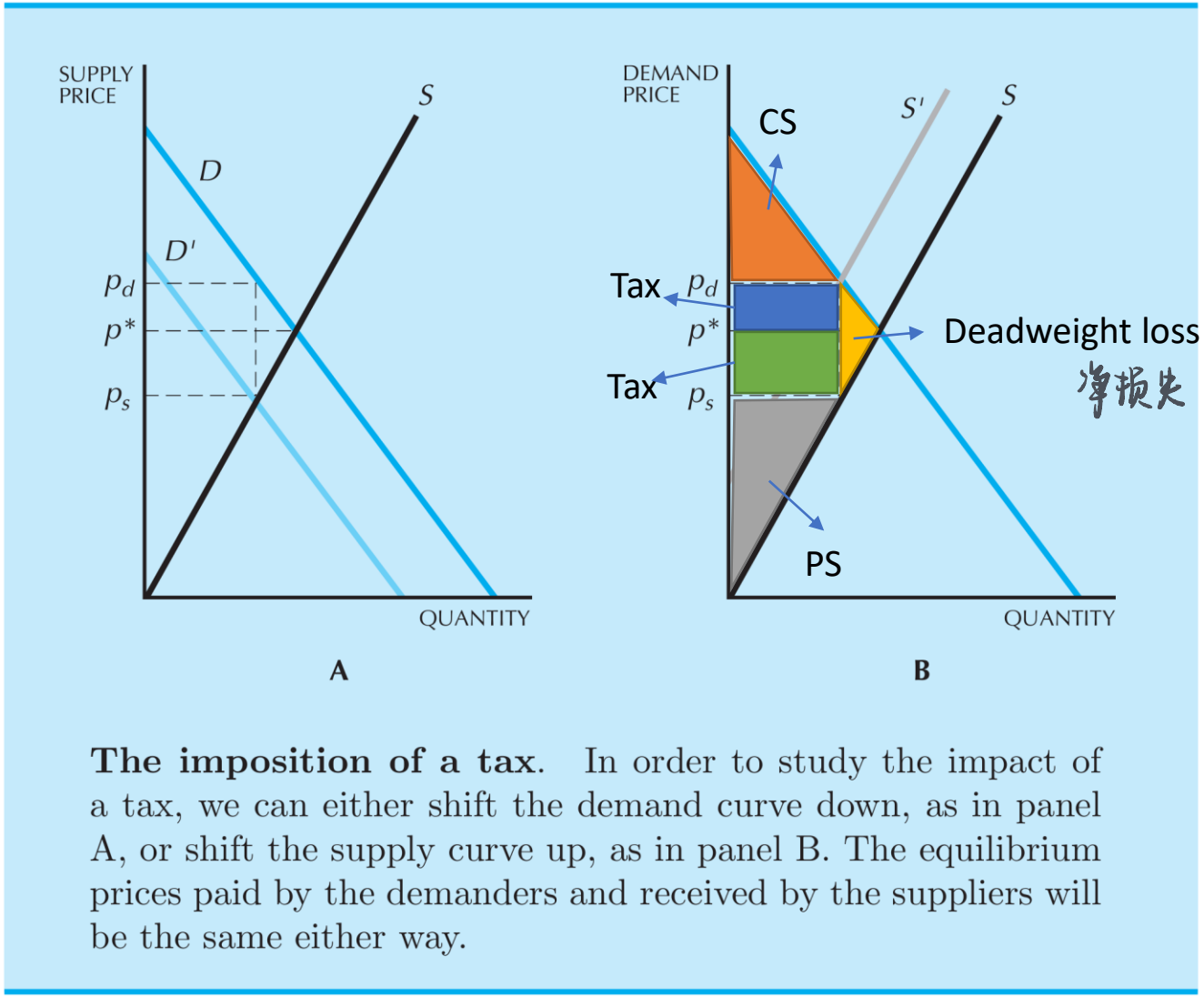
How are prices affected?

How is the quantity traded affected?

Who pays the tax?

How are gains-to-trade altered?

Quantity Taxes & Market Equilibrium



The imposition of a tax. In order to study the impact of a tax, we can either shift the demand curve down, as in panel A, or shift the supply curve up, as in panel B. The equilibrium prices paid by the demanders and received by the suppliers will be the same either way.

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Chapter 17: Measurement

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Giffen Behavior and Subsistence Consumption

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Article Information

Abstract

This paper provides the first real-world evidence of Giffen behavior, i.e., upward sloping demand. Subsidizing the prices of dietary staples for extremely poor households in two provinces of China, we find strong evidence of Giffen behavior for rice in Hunan, and weaker evidence for wheat in Gansu. The data provide new insight into the consumption behavior of the poor, who act as though maximizing utility subject to subsistence concerns. We find that their elasticity of demand depends significantly, and nonlinearly, on the severity of their poverty. Understanding this heterogeneity is important for the effective design of welfare programs for the poor. (JEL D12, O12)

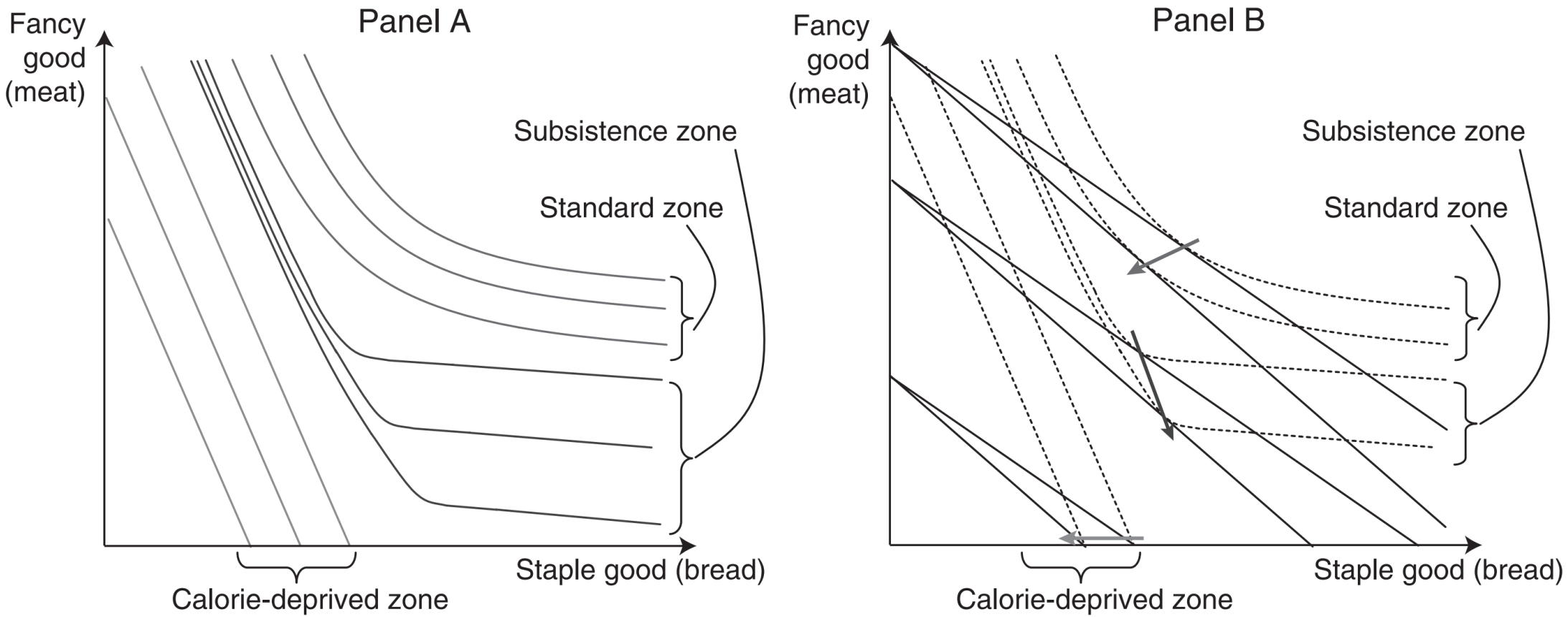

FIGURE 1. ZONES OF CONSUMER PREFERENCES

TABLE 1—MEANS AND STANDARD DEVIATIONS OF KEY VARIABLES

	Control	0.1 yuan/*jin* subsidy	0.2 yuan/*jin* subsidy	0.3 yuan/*jin* subsidy
Panel A: Hunan				
Family size	2.8	2.9	3.0	2.7
	[1.3]	[1.3]	[1.4]	[1.1]
No. of children	0.46	0.46	0.44	0.38
	[0.68]	[0.6883]	[0.6687]	[0.61]
Female head	0.34	0.37	0.37	0.40
	[0.47]	[0.4844]	[0.4844]	[0.49]
Income per capita	604	557	703	751
	[1227]	[797]	[959]	[2451]
Expenditure per capita	316	330	299	361
	[252]	[316]	[290]	[483]
Calories per capita	1767	1783	1817	1851
	[628]	[588]	[549]	[601]
Rice per capita	317	325	340	338
	[122]	[129]	[128]	[120]
Meat per capita	50.4	42.4	40.7	52.8
	[81.6]	[61.0]	[59.2]	[70.3]
Rice calorie share	0.639	0.636	0.645	0.642
	[0.188]	[0.186]	[0.158]	[0.152]
Observations	161	162	162	159
Panel B: Gansu				
Family size	2.9	2.7	2.7	2.7
	[1.1]	[1.1]	[0.95]	[1.1]
No. of children	0.56	0.55	0.54	0.54
	[0.64]	[0.69]	[0.66]	[0.60]
Female head	0.44	0.40	0.44	0.44
	[0.50]	[0.49]	[0.50]	[0.50]
Income per capita	694	694	724	726
	[663]	[652]	[800]	[697]
Expenditure per capita	202	228	198	216
	[247]	[214]	[231]	[201]
Calories per capita	1737	1732	1716	1655
	[496]	[553]	[500]	[520]
Wheat per capita	353	353	341	329
	[132]	[147]	[136]	[120]
Meat per capita	13.9	9.7	13.5	13.6
	[30.9]	[23.8]	[33.7]	[31.1]
Wheat calorie share	0.691	0.691	0.678	0.680
	[0.176]	[0.172]	[0.181]	[0.165]
Observations	163	162	162	162

Notes: Standard deviations in brackets. All consumption figures are in grams per capita. Calorie share is the percent of total calories attributable to the particular food category. Income and expenditure per capita are in 2006 yuan (Rmb). 1 *jin* = 500g. The only pair-wise difference that is statistically significant (at the 10 percent level) is meat per capita consumption in Hunan for the 0.3yuan/*jin* versus 0.2yuan/*jin* groups.

TABLE 3—CONSUMPTION RESPONSE TO THE PRICE SUBSIDY: HUNAN

	Dependent variable: Rice							*Dependent variable: Meat*	
	Full sample (1)	Full sample (2)	ISCS ≤0.80 (3)	ISCS ≤0.80 (4)	ISCS >0.80 (5)	ISCS >0.80 (6)	ISCS 0.60–0.80 (7)	Full sample (8)	Initial intake >50g (9)
%ΔPrice(rice)	0.224	0.235*	0.451***	0.466***	−0.61**	−0.585**	0.640***	−0.325	−1.125*
	(0.149)	(0.140)	(0.170)	(0.159)	(0.296)	(0.262)	(0.192)	(0.472)	(0.625)
%Δ Earned		0.043***		0.047***		0.024	0.030	0.028	0.105
		(0.014)		(0.016)		(0.023)	(0.019)	(0.050)	(0.069)
%ΔUnearned		−0.044*		−0.038		−0.058	−0.053*	0.061	0.084
		(0.025)		(0.030)		(0.049)	(0.030)	(0.079)	(0.104)
%ΔPeople		0.89***		0.83***		1.16***	0.79***	−0.08	0.03
		(0.08)		(0.09)		(0.15)	(0.14)	(0.27)	(0.36)
Constant		4.1***		5.7***		−1.8	0.8	−12.3***	−49.0***
		(1.0)		(1.1)		(1.7)	(1.3)	(3.1)	(3.7)
Observations	1,258	1,258	997	997	261	261	513	997	452
R^2	0.08	0.19	0.09	0.20	0.15	0.33	0.24	0.09	0.28

Notes: Regressions include *County*Time* fixed effects. The dependent variable in columns 1–7 is the arc percent change in household rice consumption, and in columns 8–9 it is the arc percent change in household meat consumption. Standard errors clustered at the household level. %ΔPrice(rice) is the change in the subsidy, measured as a percentage of the average price of rice; %ΔEarned is the arc percent change in the household earnings from work; %ΔUnearned is the arc percent change in the household income from unearned sources (government payments, pensions, remittances, rent, and interest from assets); %ΔPeople is the arc percent change in the number of people living in the household. ISCS (Initial Staple Calorie Share) refers to the share of calories consumed as rice in the preintervention period. *Significant at 10 percent level. **Significant at 5 percent level. ***Significant at 1 percent level.

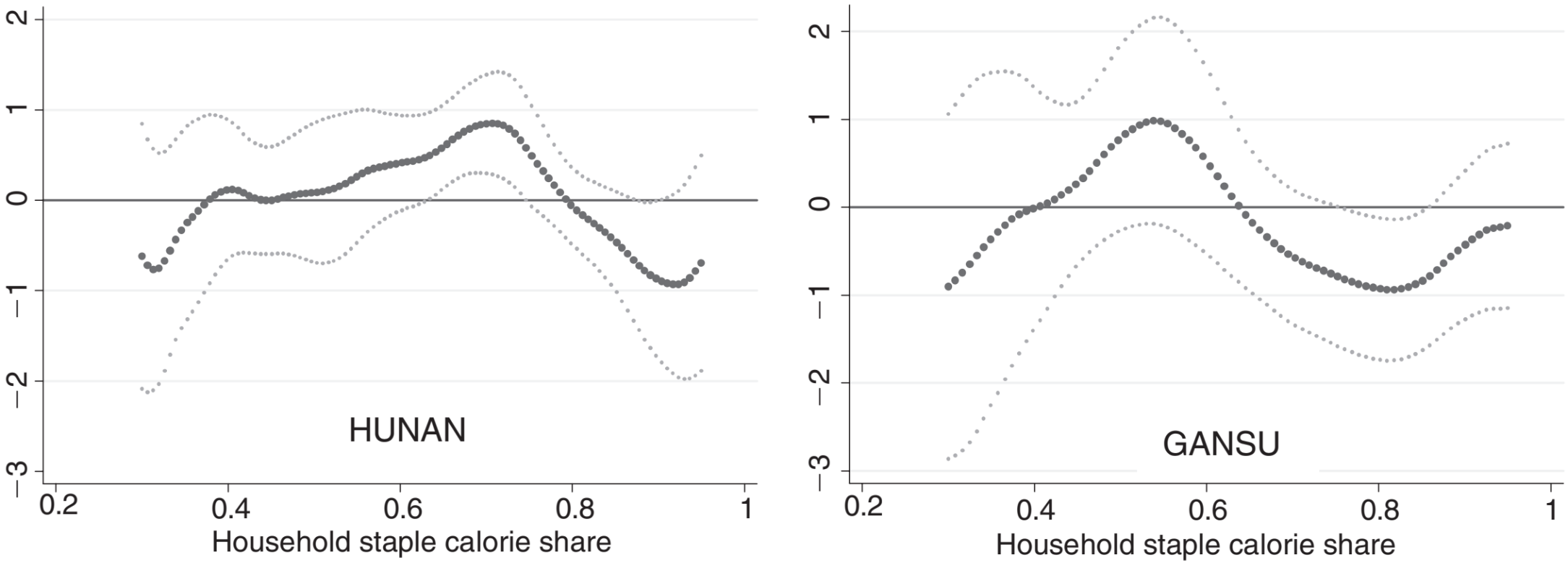

FIGURE 2. COEFFICIENT PLOTS