Outline

- Sellers in a Perfectly Competitive Market
- The Seller's Problem
- From the Sell's Problem to the Supply Curve
- Producer Surplus
- From the Short Run to the Long Run
- From the Firm to the Market: Long-Run Competitive Equilibrium

Part II: Foundation of Microeconomics

- 5. Consumers and Incentives
- 6. Sellers and Incentives
- 7. Perfect Competition and the Invisible Hand
- 8. Trade
- 9. Externalities and Public Goods
- 10. The Government in the Economy: Taxation and Regulation
- 11. Markets for Factors of Production

Outline

Sellers in a Perfectly Competitive Market

The Seller's Problem

From the Sell's Problem to the Supply Curve

Producer Surplus

From the Short Run to the Long Run

From the Firm to the Market: Long-Run Competitive Equilibrium

Chapter 6 Sellers and Incentives

2015.10.16.

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2/42

Outline

- Sellers in a Perfectly Competitive Market
- The Seller's Problem
- From the Sell's Problem to the Supply Curve
- Producer Surplus
- From the Short Run to the Long Run
- From the Firm to the Market: Long-Run Competitive Equilibrium

Sellers in a Perfectly Competitive Market

From the Sell's Problem to the Supply Curve

- 2 The Seller's Problem
- 3
 - 4 Producer Surplus
 - 5 From the Short Run to the Long Run
 - 6
 - From the Firm to the Market: Long-Run Competitive Equilibrium

Outline

- Sellers in a Perfectly Competitive Market
- The Seller's Problem
- From the Sell's Problem to the Supply Curve
- Producer Surplus
- From the Short Run to the Long Run
- From the Firm to the Market: Long-Run Competitive Equilibrium



- The seller's problem has three parts: production, costs, and revenues.
 - An optimizing seller makes decisions at the margin.
 - The supply curve reflects a willingness to sell a good or service at various price levels.

Outline

- Sellers in a Perfectly Competitive Market
- The Seller's Problem
- From the Sell's Problem to the Supply Curve
- Producer Surplus
- From the Short Run to the Long Run
- From the Firm to the Market: Long-Run Competitive Equilibrium



- Producer surplus is the difference between the market price and the marginal cost curve.
- Sellers enter and exit markets based on profit opportunities.

Outline

Sellers in a Perfectly Competitive Market

The Seller's Problem

From the Sell's Problem to the Supply Curve

Producer Surplus

From the Short Run to the Long Run

From the Firm to the Market: Long-Run Competitive Equilibrium

Evidence-Based Economics



Q: How would an ethanol subsidy affect ethanol (乙醇) producers ?

Outline

Sellers in a Perfectly Competitive Market

The Seller's Problem

From the Sell's Problem to the Supply Curve

Producer Surplus

From the Short Run to the Long Run

From the Firm to the Market: Long-Run Competitive Equilibrium 6.1 Sellers in a Perfectly Competitive Market

Three conditions characterize perfectly competitive markets:

- 1. No buyer or seller in the market is big enough to influence the market price.
- 2. Sellers in the market produce identical goods.
- 3. There is free entry and exit in the market.

Conditions 1 and 2 ensure that agents in this type of market are price-takers.

Outline

Sellers in a Perfectly Competitive Market

The Seller's Problem

From the Sell's Problem to the Supply Curve

Producer Surplus

From the Short Run to the Long Run

From the Firm to the Market: Long-Run Competitive Equilibrium

The Seller's Problem

The goal of the seller is to maximize profit. To achieve this goal, sellers must solve three problems:

- Making the good (production)
- The cost of doing business (cost)
- The rewards of doing business (revenue)

Outline

Sellers in a Perfectly Competitive Market

The Seller's Problem

From the Sell's Problem to the Supply Curve

Producer Surplus

From the Short Run to the Long Run

From the Firm to the Market: Long-Run Competitive Equilibrium

Making the Goods: How Inputs Are Turned into Outputs

- **Production** is the process by which the transformation of inputs (such as labor and machines) to outputs (such as goods and services) occurs.
- The relationship between the quantity of inputs and the quantity of outputs produced is called the *production function*.

Outline

Sellers in a Perfectly Competitive Market

The Seller's Problem

- From the Sell's Problem to the Supply Curve
- Producer Surplus
- From the Short Run to the Long Run
- From the Firm to the Market: Long-Run Competitive Equilibrium

- In this chapter, we use a real-life company— The Wisconsin Cheeseman— as an example.
- One of the services that it provides is packing cheese into cheese boxes.
- Short run is a period of time when only some of the firm's inputs can be varied— such as labor.
- Long run is a period of time when all of the firm's inputs— such as oven, kitchen, can be changed.
- Therefore, physical capital is a fixed factor of production and labor is a variable factor of production.

Outline

Sellers in a Perfectly Competitive Market

The Seller's Problem

From the Sell's Problem to the Supply Curve

Producer Surplus

From the Short Run to the Long Run

From the Firm to the Market: Long-Run Competitive Equilibrium

| Details of Production | | | | | | |
|-----------------------|----------------|----------------------|--|--|--|--|
| (1) Output Per Day | (2) # Employed | (3) Marginal Product | | | | |
| 0 | 0 | | | | | |
| 100 | 1 | 100 | | | | |
| 207 | 2 | 107 | | | | |
| 321 | 3 | 114 | | | | |
| 444 | 4 | 123 | | | | |
| 558 | 5 | 114 | | | | |
| 664 | 6 | 106 | | | | |
| 762 | 7 | 98 | | | | |
| 854 | 8 | 92 | | | | |
| 939 | 9 | 85 | | | | |
| 1019 | 10 | 80 | | | | |
| 1092 | 11 | 73 | | | | |
| 1161 | 12 | 69 | | | | |
| 1225 | 13 | 64 | | | | |
| 1284 | 14 | 59 | | | | |
| 1339 | 15 | 55 | | | | |
| 1390 | 16 | 51 | | | | |
| 1438 | 17 | 48 | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| 1934 | 38 | 10 | | | | |
| 1834 | 39 | -100 | | | | |

Exhibit 6.1 Production Data for The Wisconsin Cheeseman

Outline

Sellers in a Perfectly Competitive Market

The Seller's Problem

From the Sell's Problem to the Supply Curve

Producer Surplus

From the Short Run to the Long Run

From the Firm to the Market: Long-Run Competitive Equilibrium Three important characteristics of production for The Cheeseman.

- 1. The marginal product increases with the first few workers.
 - Marginal product is the additional amount of output obtained from adding one more unit of input (in this case, workers)
 - The marginal product increases with the first few workers because of specialization.

Outline

Sellers in a Perfectly Competitive Market

The Seller's Problem

- From the Sell's Problem to the Supply Curve
- Producer Surplus
- From the Short Run to the Long Run
- From the Firm to the Market: Long-Run Competitive Equilibrium

- 2. The marginal product eventually decreases with successive additions of workers.
 - This is called Law of Diminishing Returns.
- 3. Adding too many workers can actually decrease overall production.

Outline

Sellers in a Perfectly Competitive Market

The Seller's Problem

From the Sell's Problem to the Supply Curve

Producer Surplus

From the Short Run to the Lon_i Run

From the Firn to the Market: Long-Run Competitive Equilibrium



Exhibit 6.2 The Short-Run Production Function for The Cheeseman

Outline

Sellers in a Perfectly Competitive Market

The Seller's Problem

From the Sell's Problem to the Supply Curve

Producer Surplus

From the Short Run to the Long Run

From the Firm to the Market: Long-Run Competitive Equilibrium

The Cost of Doing Business: Introducing Cost Curves

Total Cost = Variable Cost + Fixed Cost

- Variable costs are those costs associated with the variable factors of production. Variable costs change as the level of output changes.
- Fixed costs are costs associated with the fixed factors of production. Fixed costs do not change as output changes.

Outline

Sellers in a Perfectly Competitive Market

The Seller's Problem

From the Sell's Problem to the Supply Curve

Producer Surplus

From the Short Run to the Long Run

From the Firm to the Market: Long-Run Competitive Equilibrium

$\frac{\text{Total Cost}}{Q} = \frac{\text{Variable Cost}}{Q} + \frac{\text{Fixed Cost}}{Q}$ Average Total Cost = Average Variable Cost + Average Fixed Cost ATC = AVC + AFC

Marginal Cost = $\frac{\text{Change in total cost}}{\text{Change in output}}$

Outline

Sellers in a Perfectly Competitive Market

The Seller's Problem

From the Sell's Problem to the Supply Curve

Producer Surplus

From the Short Run to the Long Run

From the Firm to the Market: Long-Run Competitive Equilibrium

| | Cost of Production | | | | | | | | |
|------------------------------------|--------------------|--|--|------------------------------|--|---|--|---|--|
| (1) Output Per Day (Q) | (2) # Employed | (3) Marginal Product = change in (1) | (4) Variable Cost (VC) = \$72 × (2) | (5) Fixed Cost (FC) | (6) Total Cost (<i>TC</i>) = (4) + (5) | (7) Average Total Cost (ATC) = (6)/(1) | (8) Average Variable Cost (AVC) = (4)/(1) | (9) Average Fixed Cost (AFC) = (5)/(1) | (10) Marginal Cost (<i>MC</i>) = change in (6)/ change in (1) |
| 0 | 0 | | \$ 0 | \$200 | \$ 200 | | | | |
| 100 | 1 | 100 | \$ 72 | \$200 | \$ 272 | \$2.72 | \$0.72 | \$2.00 | \$0.72 |
| 207 | 2 | 107 | \$ 144 | \$200 | \$ 344 | \$1.66 | \$0.70 | \$0.97 | \$0.67 |
| 321 | 3 | 114 | \$ 216 | \$200 | \$ 416 | \$1.29 | \$0.67 | \$0.62 | \$0.63 |
| 444 | 4 | 123 | \$ 288 | \$200 | \$ 488 | \$1.10 | \$0.65 | \$0.45 | \$0.59 |
| 558 | 5 | 114 | \$ 360 | \$200 | \$ 560 | \$1.00 | \$0.65 | \$0.36 | \$0.63 |
| 664 | 6 | 106 | \$ 432 | \$200 | \$ 632 | \$0.95 | \$0.65 | \$0.30 | \$0.68 |
| 762 | 7 | 99 | \$ 504 | \$200 | \$ 704 | \$0.92 | \$0.66 | \$0.26 | \$0.73 |
| 854 | 8 | 92 | \$ 576 | \$200 | \$ 776 | \$0.91 | \$0.67 | \$0.23 | \$0.78 |
| 939 | 9 | 85 | \$ 648 | \$200 | \$ 848 | \$0.90 | \$0.69 | \$0.21 | \$0.85 |
| 1019 | 10 | 80 | \$ 720 | \$200 | \$ 920 | \$0.90 | \$0.71 | \$0.20 | \$0.90 |
| 1092 | 11 | 73 | \$ 792 | \$200 | \$ 992 | \$0.91 | \$0.73 | \$0.18 | \$0.99 |
| 1161 | 12 | 69 | \$ 864 | \$200 | \$1,064 | \$0.92 | \$0.74 | \$0.17 | \$1.04 |
| 1225 | 13 | 64 | \$ 936 | \$200 | \$1,136 | \$0.93 | \$0.76 | \$0.16 | \$1.13 |
| 1284 | 14 | 59 | \$1,008 | \$200 | \$1,208 | \$0.94 | \$0.79 | \$0.16 | \$1.22 |
| 1339 | 15 | 55 | \$1,080 | \$200 | \$1,280 | \$0.96 | \$0.81 | \$0.15 | \$1.31 |
| 1390 | 16 | 51 | \$1,152 | \$200 | \$1,352 | \$0.97 | \$0.83 | \$0.14 | \$1.41 |
| 1438 | 17 | 48 | \$1,224 | \$200 | \$1,424 | \$0.99 | \$0.85 | \$0.14 | \$1.50 |

Exhibit 6.3 Costs of Production with Additional Cost Concepts for Wisconsin Cheeseman

• Marginal cost and marginal product are inversely related to one another.

Outline

Sellers in a Perfectly Competitive Market

The Seller's Problem

From the Sell's Problem to the Supply Curve

Producer Surplus

From the Short Run to the Long Run

From the Firm to the Market: Long-Run Competitive Equilibrium



Exhibit 6.4 Marginal Cost, Average Total Cost, and Average Variable Cost Curves for The Wisconsin Cheeseman

- When the marginal cost curve is below the average cost curves, average cost curves must be falling.
- When the marginal cost curve is above the average cost curves, average cost curves must be rising.
- MC intersects AVC and ATC at their minimums

Outline

Sellers in a Perfectly Competitive Market

The Seller's Problem

From the Sell's Problem to the Supply Curve

Producer Surplus

From the Short Run to the Long Run

From the Firm to the Market: Long-Run Competitive Equilibrium

The Rewards of Doing Business: Introducing Revenue Curves

- Total revenue = Price × Quantity sold
- Marginal revenue is the change in total revenue associated with producing one more unit of output.
- In a perfectly competitive market, marginal revenue is equal to the market price.



Exhibit 6.5 Supply and Demand: The Market Versus The Wisconsin Cheeseman

Outline

Sellers in a Perfectly Competitive Market

The Seller's Problem

From the Sell's Problem to the Supply Curve

Producer Surplus

From the Short Run to the Long Run

From the Firm to the Market: Long-Run Competitive Equilibrium

Putting It All Together:

Using the Three Components to Do the Best You Can

Profits=Total revenues- Total costs



Exhibit 6.6 Movement of Production toward Equilibrium

• Profits are maximized when

Marginal revenue = Marginal cost

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Chapter 6 Sellers and

Incentives

Sellers in a Perfectly Competitive Market

The Seller's Problem

From the Sell's Problem to the Supply Curve

Producer Surplus

From the Short Run to the Long Run

From the Firm to the Market: Long-Run Competitive Equilibrium



Exhibit 6.7 Visualizing Cheeseman's Profits with MC, MR and ATC

• We can rewrite total profits as:

 $\operatorname{Price} \times Q - ATC \times Q = (\operatorname{Price} - ATC) \times Q$

- Outline
- Sellers in a Perfectly Competitive Market
- The Seller's Problem
- From the Sell's Problem to the Supply Curve
- Producer Surplus
- From the Short Run to the Long Run
- From the Firm to the Market: Long-Run Competitive Equilibrium

- Accounting profits are equal to revenues minus explicit costs.
- Explicit costs are the sorts of line-item expenditures that accountants carefully tally and report.
- Economic profits are equal to total revenues minus both explicit and implicit costs.
- For example, the owner of The Wisconsin Cheeseman may have a high opportunity cost that he is sacrificing in order to run the company.

Outline

Sellers in a Perfectly Competitive Market

The Seller's Problem

From the Sell's Problem to the Supply Curve

Producer Surplus

From the Short Run to the Long Run

From the Firm to the Market: Long-Run Competitive Equilibrium

6.3 From Seller's Problem to Supply Curve

The firm's supply curve relates output to prices.



Exhibit 6.8 Impact of Price Changes on the Wisconsin Cheeseman

From the Sell's Problem to the Supply Curve

Price Elasticity of Supply

Percentage change in quantity supplied $\varepsilon_s =$ Percentage change in price



Exhibit 6.9 Various Supply Curves

If the firm has excessive inventories, the time horizon is longer, and workers are readily available, then the supply will be more elastic.

Outline

Sellers in a Perfectly Competitive Market

The Seller's Problem

From the Sell's Problem to the Supply Curve

Producer Surplus

From the Short Run to the Long Run

From the Firm to the Market: Long-Run Competitive Equilibrium

Shutdown

- A **shutdown** is a short-run decision to **not** produce anything during a specific time period.
- There is no variable cost when the firm is shutdown.
- The firm should shutdown if price is less than AVC.





Outline

- Sellers in a Perfectly Competitive Market
- The Seller's Problem
- From the Sell's Problem to the Supply Curve
- Producer Surplus
- From the Short Run to the Long Run
- From the Firm to the Market: Long-Run Competitive Equilibrium

- At point C in Exhibit 6.10, the average total cost is higher than the price. The firm is loosing money.
- But, it will not shutdown because the fixed costs in the short run are sunk costs.
 - Loss at point C is $(ATC P) \times Q$.
 - Loss if shutdown is $AFC \times Q$.
 - ATC P = AFC + AVC P < AFC since AVC < P at point C.
 - i.e. decision to shutdown: P < AVC.
- Once sunk costs are committed, they should not affect current or future production decisions.

Outline

Sellers in a Perfectly Competitive Market

The Seller's Problem

From the Sell's Problem to the Supply Curve

Producer Surplus

From the Short Run to the Lon Run

From the Firm to the Market: Long-Run Competitive Equilibrium



Exhibit 6.11 Short-Run Supply Curve: Portion of the MC above AVC

Outline

Sellers in a Perfectly Competitive Market

The Seller's Problem

From the Sell's Problem to the Supply Curve

Producer Surplus

From the Short Run to the Long Run

From the Firm to the Market: Long-Run Competitive Equilibrium

• **Producer surplus** is the difference between

Producer Surplus

market price and marginal cost.



Exhibit 6.12 Measuring Producer Surplus



Outline

- Sellers in a Perfectly Competitive Market
- The Seller's Problem
- From the Sell's Problem to the Supply Curve

Producer Surplus

- From the Short Run to the Long Run
- From the Firm to the Market: Long-Run Competitive Equilibrium



Exhibit 6.13 Producer Surplus for Trucking Services

- Supply curve for daily shipping trucking services to ship cheese from Madison, Wisconsin to Milwaukee, Wisconsin.
- Producer surplus is $\frac{(100-20)\times 4}{2} =$ \$160 when price is \$100.

Outline

- Sellers in a Perfectly Competitive Market
- The Seller's Problem
- From the Sell's Problem to the Supply Curve
- Producer Surplus

From the Short Run to the Long Run

From the Firm to the Market: Long-Run Competitive Equilibrium

From the Short Run to the Long Run

- In the long run, The Cheeseman can combine any quantity of labor and physical capital to maximize profits.
- In the long run, The Cheeseman is able to combine workers and physical capital to achieve the minimal *ATC* for each output level.
- This causes the short-run cost curves to be above the long-run cost curves.

Outline

Sellers in a Perfectly Competitive Market

The Seller's Problem

From the Sell's Problem to the Supply Curve

Producer Surplus

From the Short Run to the Long Run

From the Firn to the Market: Long-Run Competitive Equilibrium



Exhibit 6.14 Short-Run and Long-Run Supply Curve

- When *ATC* decreases as output increases, economies of scale exists.
- When *ATC* does not change with the level of output, the plant experiences **constant returns to scale**.
- Diseconomies of scale occurs when ATC increases as output rises.

Outline

- Sellers in a Perfectly Competitive Market
- The Seller's Problem
- From the Sell's Problem to the Supply Curve
- Producer Surplus

From the Short Run to the Long Run

From the Firm to the Market: Long-Run Competitive Equilibrium

Long-Run Supply Curve

- At point A in Exhibit 6.14, total revenue is less than total cost, leading to a negative economic profit.
- Long-run decision rule:
 Exit if: Price is less than ATC or if total revenue is less than total cost.
- The long-run supply curve is the portion of its marginal cost curve that lies above average total cost.

Outline

- Sellers in a Perfectly Competitive Market
- The Seller's Problem
- From the Sell's Problem to the Supply Curve
- Producer Surplus
- From the Short Run to the Long Run
- From the Firm to the Market: Long-Run Competitive Equilibrium

Long-Run Competitive Equilibrium

- Even though the number of firms in the industry is fixed in the short run, in the long run firms can enter or exit the industry in response to changes in profitability.
- In the long run firms have the ability to change both labor and physical capital.

- Outline
- Sellers in a Perfectly Competitive Market
- The Seller's Problem
- From the Sell's Problem to the Supply Curve
- Producer Surplus
- From the Short Run to the Long Run
- From the Firm to the Market: Long-Run Competitive Equilibrium

Firm Entry



Exhibit 6.15 Steve's Wholesale Cheese Entry Decision

- Steve's Wholesale Cheess is considering entering the industry, which has 10,000 identical firms.
- Suppose Steve's Wholesale is identical to The Cheeseman and to other firms.
- Since currently P > ATC, it is profitable to enter.



Outline

- Sellers in a Perfectly Competitive Market
- The Seller's Problem
- From the Sell's Problem to the Supply Curve
- Producer Surplus
- From the Short Run to the Long Run
- From the Firm to the Market: Long-Run Competitive Equilibrium



Exhibit 6.16 Firm Entry in the Long Run

- *Many* firms would realize they can be profitable in the industry and decide to enter.
- Adding new firms shifts the market supply to the right.
- This shift will cause the market price to fall.
- This will continue until the market price was driven to the minimum *ATC*, resulting in zero economic profit.

Outline

- Sellers in a Perfectly Competitive Market
- The Seller's Problem
- From the Sell's Problem to the Supply Curve
- Producer Surplus
- From the Short Run to the Long Run
- From the Firm to the Market: Long-Run Competitive Equilibrium

Firm Exit

- Suppose a group of researchers issues a report claiming that touching cheese can give skin irritations to toddlers.
- This causes the market demand curve for cheese boxes to shift leftward.
- The equilibrium price drops, and is below the minimum average total cost of the firms.
- This causes firms in the industry to make negative profits.
- If there is free exit from the market, in the long firms will leave the industry.

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Outline

Sellers in a Perfectly Competitive Market

The Seller's Problem

From the Sell's Problem to the Supply Curve

Producer Surplus

From the Short Run to the Long Run

From the Firm to the Market: Long-Run Competitive Equilibrium



Exhibit 6.17 Firm Exit After Demand Shifts Leftward

- The supply curve will shift leftward, raising the market price to point C.
- Exit continues until the market price rises to the minimum *ATC*. This is the long-run equilibrium.

Outline

Sellers in a Perfectly Competitive Market

- The Seller's Problem
- From the Sell's Problem to the Supply Curve
- Producer Surplus
- From the Short Run to the Long Run

From the Firm to the Market: Long-Run Competitive Equilibrium

Zero Profits in the Long Run



Exhibit 6.18 Why the Long-Run Supply Curve Is Horizontal

- The industry's *long-run* supply curve is horizontal at the long-run minimum average total cost level.
- Firms in a perfectly competitive market earn zero economic profit in equilibrium due to free entry and exit.

Outline

Sellers in a Perfectly Competitive Market

The Seller's Problem

From the Sell's Problem to the Supply Curve

Producer Surplus

From the Short Run to the Long Run

From the Firm to the Market: Long-Run Competitive Equilibrium

Evidence-Based Economics



Q: How would an ethanol subsidy affect ethanol producers?

Outline

Sellers in a Perfectly Competitive Market

The Seller's Problem

From the Sell's Problem to the Supply Curve

Producer Surplus

From the Short Run to the Long Run

From the Firm to the Market: Long-Run Competitive Equilibrium



Exhibit 6.19 Number of Ethanol Plants and the Number of Plants under Construction

- The ethanol production industry is approximately perfectly competitive.
- In 2006, every gallon of ethanol-based fuel was effectively subsidized by \$0.51.
- In 2009, the subsidy dropped to \$0.45 per gallon.

Outline

- Sellers in a Perfectly Competitive Market
- The Seller's Problem
- From the Sell's Problem to the Supply Curve
- Producer Surplus
- From the Short Run to the Long Run
- From the Firm to the Market: Long-Run Competitive Equilibrium

An experiment:

- Each of 12 producers received the same cost curves and each made the entry decision in each of 6 rounds.
 - If they enter, their plant capacity is to produce 2 million gallons and are paid the difference between their revenues and costs (\$1.25 or \$1.00 with \$0.25 subsidy).



Exhibit 6.20 Individual Cost Curves for Ethanol Producers (quantity in millions)

Outline

- Sellers in a Perfectly Competitive Market
- The Seller's Problem
- From the Sell's Problem to the Supply Curve
- Producer Surplus
- From the Short Run to the Long Run
- From the Firm to the Market: Long-Run Competitive Equilibrium

| Price per Gallon | Total Number of Gallons on the Market (in millions) |
|------------------|--|
| \$1.40 | 2 |
| \$1.35 | 4 |
| \$1.30 | 6 |
| \$1.25 | 8 |
| \$1.20 | 10 |
| \$1.15 | 12 |
| \$1.10 | 14 |
| \$1.05 | 16 |
| \$1.00 | 18 |
| \$0.95 | 20 |
| \$0.90 | 22 |
| \$0.85 | 24 |

Exhibit 6.21 Price and Quantities in Lab Experiment



Exhibit 6.22 Results from Experimental Study

Converge to zero profit at the end of the experiment.