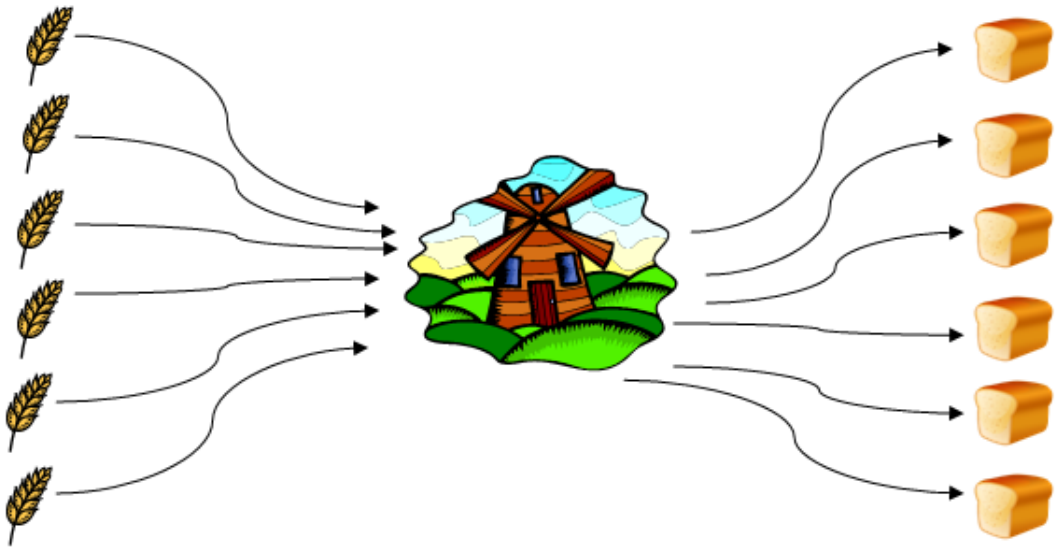
AGEC 321: Economics of Agricultural Marketing

Course Notes



Anton Bekkerman

Any errors in this document are the responsibility of the author. Corrections and comments regarding any material in this text are welcomed and appreciated. The material in this document is intended to be supplementary (not as a substitute) to attending lectures regularly.

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Contents

Class Syllabus

Course Information

Instructor:	Dr. Anton Bekkerman	**Class days:**	Tue, Thur
Office:	205 Linfield Hall	**Class times:**	3:05 p.m. – 4:20 p.m.
Phone:	406-994-3032	**Classroom:**	Linfield Hall 234

Email: anton.bekkerman@montana.edu
Office hours: Tue, Thur: 9 a.m. to 12 p.m. and by appointment
Course website: http://www.montana.edu/bekkerman/#3

Required readings: *Assigned in class*

Optional readings: *Agricultural Marketing and Price Analysis*
F.B. Norwood and J.L. Lusk
(Prentice Hall, 2008; ISBN: 9780132211215)

Prerequisites: ECNS 204 or ECNS 251

Course Description

This course is intended to introduce important concepts in agricultural marketing. We will examine links between producers and consumers and factors that may cause changes in those links. Because agricultural markets are often fluid and changes can occur rapidly, we will seek to study current events and examine their effects on agricultural markets. Additionally, this course will emphasize the effects of local, national, and international events on agricultural markets in Montana. Students who complete this course should be comfortable with using a theoretical economic framework to assess and interpret the functions of agricultural markets.

During this course, we will develop theoretical frameworks to examine and evaluate questions that relate to agricultural markets. Examples include:

- How does food become available to consumers?
- How are agricultural commodity prices unique?

- Commodity markets are risky. How can producers and consumers hedge risk?
- How can futures markets be used to predict local prices?
- What effects do transporting and storing a commodity have on the commodity's price?
- Why do changes in the exchange rate between the dollar and the peso cause Montana ranchers to gain wealth?

Is this class the same as a marketing class in the business school?

The business school at Montana State University describes its marketing management as "decision-making in the product, price, promotion, and distribution areas. Behavioral, legal, ethical, competitive, technological, and economic environments [and their effects on] decisions in the domestic and international organizations [are examined]."

In this course, the definition of marketing is *different.* You will not be learning techniques to better advertise hamburgers to 12–18 year olds. Nor will you perform market tests or surveys to determine how milk fat content affects the purchasing decisions of married couples with children. Rather, we will seek to understand *how and why agricultural producers, consumers, and firms make buying and selling decisions.* To do so, we will examine local, regional, national, and international agricultural markets. We will explore ways to analyze economic conditions and their effects on markets, understand and manage risks that exist when selling and acquiring commodities, and investigate how market shocks can change agricultural supply and demand.

Economic and Math Prerequisites

ECNS 204 (Microeconomics) or ECON 201 (Principles of Microeconomics) is a prerequisite for this course. It is a prerequisite for a reason. This course is taught with the assumption that you have the appropriate foundation of economic education to comfortably apply theoretical concepts to real-world analyses of agricultural markets. If I go over material typically taught in ECNS 204, it will be an overview that will help you review important concepts, *not* learn them. Thus, taking ECNS 204 in the same semester as AGEC 321 may only help you minimally. Remember: ECNS 204 is a prerequisite, not a corequisite. *Not having the necessary prerequisites will significantly limit your success in this course.* If you do not have the necessary prerequisites, you need to talk to me as soon as possible.

In addition, you are expected to have a basic algebra skill set. Applied economics requires that you know how to add, subtract, multiply, divide, and solve for unknown variables.

Class Expectations: how to get an A in this class

From the first day of class to the final exam, every topic that we explore has three characteristics:

1. *Challenging material* – you will be presented with a lot of information. Some will be new and some should be familiar to you. In both cases, the material will challenge you and will take effort to grasp.
2. *Intuitive thinking* – much of economics is intuition. Having a calculator and memorizing a formula will get you almost nowhere if you don't know when and how to use them. A large component of this class is developing skills that will allow you to *apply* your knowledge and tools to new situations and develop your intuition.
3. *Applied analysis* – we will use graphical and mathematical tools for understanding the economics of agricultural markets. I will provide you with many opportunities to practice your applied analytical skills, but it is your responsibility to supplement my examples as much as is necessary for you to become proficient.

Reward (why should you care): economics is convoluted, confusing, and absolutely fascinating! Learning how to ask important questions and appropriately analyze real-world situations are skills that will earn you a high grade in this class, help you be successful in other classes, have an upper hand when applying for jobs, learn how to fly, and make you famous (ok, maybe just the first three). But perhaps the most important long-run benefit is earning the big bucks.

My commitment as a professor is to present relevant information, help you with challenging topics, and do as much as I can for you to be successful in this class. I have office hours – this is time that is devoted to my students. Please use them. There are numerous ways that you can schedule a meeting with me: (1) email or call me; (2) talk to me after class; (3) use the Google Calendar on the class website to view available times and schedule appointments (if you have a Google account).

Your commitment as a student is to put in the effort to understand the presented information, be inquisitive, and provide feedback. Feedback is extremely important because it makes class more interactive, helps me understand whether you are understanding the material, and allows me to improve lectures and class materials. There are several ways that you can provide feedback:

1. Ask and answer questions in class. All of you have life experiences that relate to the topics we learn in this class. It will be beneficial to everyone if you share some of them.

2. Email me with questions and/or suggestions – some of the most interesting questions I've received from students were by email.

3. Leave anonymous comments – a link is provided on the class website. This is where you can tell me that I'm the greatest thing since Nutella or if today's class seemed like I brought lecture notes from another course and presented them in Russian. If I don't know that something is wrong, I can't change it.

Class Attendance

A large portion of the material is discussed during the designated class periods. Although it is your decision whether to attend class, it is highly recommended that if you miss a lecture you attain a copy of the class notes and announcements from a classmate.

Please make every effort to come to class and arrive to lectures promptly. To be fully prepared, you should have read the assigned material and complete all assignments prior to each class.

Behavior

It is my strong belief that if you attend a lecture, then your intent is to concentrate on the presented material. Engaging in activities such as reading newspapers/magazines, using your cell phone or laptop to surf the Internet or send messages/emails, sleeping, etc., is inappropriate and distracts your classmates. Please refrain from such activities. Thanks!

Academic Integrity

It is my expectation and that of the university that students follow guidelines described in the Montana State University Conduct Code.

Academic Misconduct

Includes cheating, plagiarism, forgery, falsification, facilitation or aiding academic dishonesty; multiple submissions; theft of instructional materials or tests; unauthorized access to, manipulation of, or tampering with laboratory equipment, experiments, computer programs, or animals without proper authorization; alteration of grades or files;

misuse of research data in reporting results; use of personal relationships to gain grades or favors; or otherwise attempting to obtain grades or credit through fraudulent means.

Disabled Student Services

If you have a documented disability for which you are or may be requesting an accommodation(s), you are encouraged to contact me and Disabled Student Services as soon as possible.

http://www.montana.edu/wwwres/disability/index.shtml

Graded Opportunities

You will be provided numerous opportunities to demonstrate your comprehension of the material. It is in your best interest to take advantage of all graded opportunities.

Homeworks provide you with an opportunity to practice concepts that we go over during lectures. Quizzes will give *you* an opportunity to evaluate how well you can apply your understanding of learned material to new situations. Exams will give *me* an opportunity to evaluate how well you can apply your understanding of learned material to new situations.

There will be three exams. Each exam will be cumulative because all new material uses past information as building blocks.

Policy for turning in homeworks

Homeworks are due one week from the day they are assigned, and must be turned in by 5 p.m. on the day they are due. If you wish, you can turn them in during class; otherwise there are several methods by which you can provide a copy of your work:

1. Drop it off at my office or in my mailbox.
2. Email a typed copy.
3. Scan and email a written copy.

On days when homeworks are due, I will be in my office until at least 5 p.m. If I don't get your copy by the due date and time, it will not be accepted – *no exceptions*. At the end of the semester, your lowest homework grade will be dropped.

Graded Opportunity	**Weight**
Homeworks	20%
Quizzes	20%
Exam 1	20%
Exam 2	20%
Exam 3	20%

Earned Percentage	**Associated Letter Grade**
93% - 100%	A
90% - 93%	A-
87% - 89%	B+
83% - 86%	B
79% - 82%	B-
75% - 78%	C+
70% - 74%	C
65% - 69%	D+
58% - 64%	D
$\leq$ 57%	F

Incomplete Grades

Assigning of an *Incomplete* grade is in accordance with the guidelines of Montana State University, as outlined in the Course Catalog. This is as follows:

"The University takes the position that when students register, they commit themselves to completing their academic obligations as their primary responsibility. Therefore, the instructor may assign an *I* grade only in cases when students have suffered extreme personal hardship or in unusual academic situations."

Class Schedule

The outline of topics, associated note packet chapters, and exam dates are provided below. The exam dates will not change – *it is your responsibility to avert scheduling conflicts that may prevent you from taking an exam.* Quizzes will be announced at least three lectures (week and a half) prior to the quiz. If you know that you have an academically relevant scheduling conflict (e.g., job interview), you must let me know *at least* one week in advance. If you fail to notify me, you will be required to provide an appropriate excuse *and* provide a written letter signed by your major adviser describing the reason you were unable to take a quiz or exam. I reserve the right to contact your major adviser and ultimately determine the validity of your absence.

Course Outline

Topic	**Readings and Assignments**
Class overview	Read syllabus; sign last sheet and return to class.
Begin supply and demand Supply curve Demand curve Surplus and costs	Read chapter 1
S & D topics in agriculture Shifters of S & D curves Math of S & D	Homework 1
More on S & D in agriculture Math and graphical examples	Read chapter 2
Introduction to elasticities Graphical representation Deriving elasticities Elasticities in agriculture	Homework 2
Continue with elasticities Graphical and math examples	
Quiz 1	
Introduction to EDM	Homework 3, re-read EDM in chapter 2

Course Outline – Continued

Topic	Readings and Assignments
Graphical representation EDM math Continue with EDM EDM in agriculture Examples	
Commodity price analysis Determinants of ag. prices Prices and S & D Cobweb model Continue price analysis Law of one price Price transmission	Read chapter 3
Exam 1 – October 2, 2012	
Food marketing channel Vertical price transmission Derived demand Graphical representation Derived demand Scenario analyses Solving derived demand Derived demand: graphs and math Putting everything together Examples	Read chapter 4 Homework 4
Inter-regional trade models Moving commodities 2D and 3D trade models Who trades with whom? International trade Trade makes magic Trade in U.S. Three-panel trade model	Reading: Schrimper, chapter 9 Read chapter 5
Quiz 2	

Course Outline – Continued

Topic	Readings and Assignments
Modeling trade Scenario analyses Trade policy and its effects Introducing exchange rates How to find and interpret? Illustrating exchange rate effects Calculating exchange rate effects	Homework 5
Exchange rates Graphical and math examples	
Exam 2 – November 8, 2012	
Futures markets Introduction and history How to read contracts? Finding prices Basics of using futures markets	Read chapter 6
Operating in futures markets Your first trade Speculating in futures Marking-to-market	Read Schrimper, chapters 14, 15
Hedging risk Why does hedging work? Scenario analyses More hedging More examples Hedge ratio Why is hedging not easy?	Homework 6
Quiz 3	
Basis What is basis? Basis risk	Homework 7

Course Outline – Continued

Topic	Readings and Assignments
Examples and scenarios	
Using basis	
More in basis risk	
What can basis tell us?	
More examples	
Advanced futures markets	Readings TBA
Cross-hedging	
Basis volatility	
Current research	
Final exam* – December 12, 2012 (12 p.m. - 2:00 p.m.)	

* The final exam will be held in the same room as our regular class, Linfield Hall 234.

Chapter 1

Introduction to Agricultural Marketing

1.1 Typical issues and where to find answers

In recent years, there have been significant discussion about the following issues that relate to agricultural marketing:

- Grain / cattle prices – volatility; cross-relationships
- Market volatility and convergence – inability to hedge risk using futures markets
- Biofuels – are they viable? Who wants them? Who doesn't?
- Issues in foreign nations – trade agreements, food safety issues
- Economic downturn and its effects on agricultural markets – lower food prices; drop in demand

To find the most current news about these and other issues in agricultural markets, you can visit the following websites:

- www.cattlenetwork.com

- www.agweb.com
- www.feedstuffs.com
- www.wsj.com
- www.farmpolicy.com
- www.cbot.com

1.2 What is "marketing?"

- Change of ownership of agricultural and food products.
- Link between agricultural production and food consumption.
- Three aspects of market transactions:
  - Spatial – transactions occur across space
  - Temporal – transactions occur across time
  - Form – transactions occur in a certain form

1.2.1 Facets of marketing

- Coordination and process of exchange.
  - How does the supply of food become available to those who demand it?
  - Both suppliers and consumers are part of markets and marketing.
- Geographical aspects.
  - Locations where buyers and sellers meet (Billings wheat market).
  - Broader context: U.S. wheat market; World wheat market.
- Value-adding activities.
  - Transformation
  - Transportation
  - Storage

1.2.2 Facilitating functions of a market

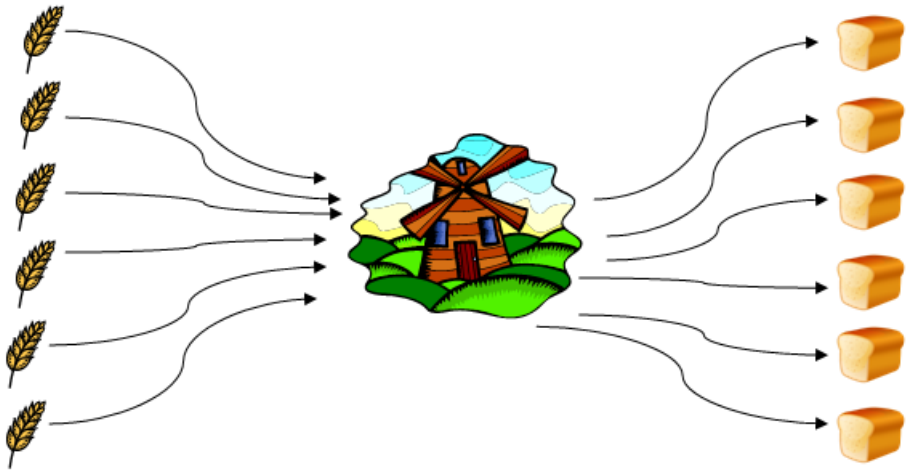
Unlike the ownership transfer and value-adding functions of marketing, facilitating functions help the marketing process operate.

- Business climate
  - Conducive business environment.
  - Clear understanding of ownership privileges and legal code.
- Standardization of measures
  - Inspection of merchandise quality.
- Economic information
  - Current and prospective market conditions (e.g., local and futures prices).
- Financial services
  - Provide liquidity for day-to-day operations.
  - Minimize costs of transferring goods.

1.3 What's special about agricultural markets?

- Biological characteristics
  - Fixed periods of production and seasonality – growing seasons are established; seasonality affects demand.
  - Risk of perishability – risk that good will become unusable.
  - Weather and other unpredictable events – frost, hail, drought.
  - Invasive species – karnal bunt; grasshoppers; wheat stem rust; BSE.
  - Potential for high price volatility.
- Product homogeneity – 13% protein wheat is the same in MT and KS.
  - Competitive markets (price taking environment) – supply and demand determine prices; producers accept these prices when they sell, and consumers accept these prices when they buy.

- Large involvement by government
  - Price augmentation – price augmentation; subsidized insurance.
  - Trade policies – tariffs; quotas.
- Bulkiness (low initial value-per-unit weight)
  - Transportation and processing are crucial.
  - Economies of scale (few processing facilities for large geographic areas).



1.3.1 Role of prices

The role of price is integral in agricultural markets.

- Price is a signal for production and consumption.
- Government can play a large role in affecting prices in agricultural markets.
- Knowing and predicting future prices is very important (but extremely hard to do).

1.4 Trends in U.S. Agricultural Markets

Agricultural and food markets are changing. Here are several reasons for these changes:

- Demographics
  - Population growth is slowing – baby boomers led to greater production; now, production doesn't need to be as fast. However, population and economic growth in other nations is outpacing slower U.S. growth.
  - Age distribution and preference – preferences of older and younger generations.
  - Ethnic diversity – influx of immigrants has increased diversity of foods.
  - Household size (3.33 in 1960; 2.59 in 2008)
- Higher incomes
  - Less food is cooked at home, more is purchased outside of home. Ratio of expenditure for food at home to outside:

    1970: 2:1 2007: 1:1
  - Opportunity cost of time.
  - Economies of scale (how often do you make your own salad?)
- International trade and domestic policies.
- Increasing female labor force.
- Production technologies – high-speed Internet in rural areas.
  - Genetically modified crops.
  - Longer shelf life.
  - Computerization in farming.
- Health, food safety, quality, and nutrition issues.

Chapter 2

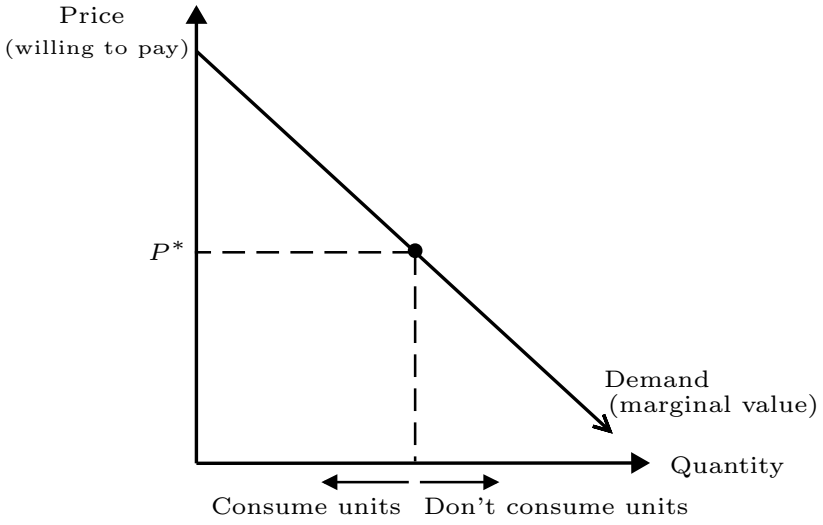
Basics of Supply and Demand

2.1 Demand

Terminology:

- Demand schedule
- Demand curve
  - Illustrates all quantities desired at every alternative price.
  - Describes the *marginal value* of the last consumed unit.
  - Downward sloping (Law of Demand)
    For a normal good, as price increases, the quantity demanded decreases.
- Marginal value (marginal benefit) – shown by the demand curve.
- Marginal cost
  Continue to consume/buy while MB > MC – continue to consume until the benefit from the next unit exceeds the costs of the next unit.

Figure 2.1: Demand curve plot



2.1.1 Properties of a demand curve

- Constrained by income (or wealth).
- Demand curve is steeper (less elastic, more inelastic) if:
  - There are no close substitutes.
  - Quantity demanded rises very little as income increases (would you buy 5 times as much food if your income increased five-fold?)
  - There is a short time considered.
  - If there is a price change, your consumption of the good will change very little.
- Movements along and shifts of the demand curve:
  - Change in price $\rightarrow$ movement along demand curve.
  - Change in external variable (e.g., income, price of other goods) $\rightarrow$ shift of the demand curve.

2.1.2 Numerically solving for quantity demanded and price

Suppose Sarah consumes beef according to the following consumption function:

$$Q_{Sarah} = 60 - 0.5P_{beef}$$

Perform the following:

1. Calculate the *inverse demand* function (i.e., solve for P).
2. Calculate Sarah's beef demand if the price of beef is \$10. What if it's \$18?
3. Calculate the price of beef if Sarah consumes 25 pounds of beef. What if she consumes 60 pounds?

Steps to solve:

1. Add P_{beef} to both sides; subtract Q_{sarah} from both sides; divide through by 0.5

$$P_{beef} = 120 - 2Q_{sarah}$$

2. Beef demand:

$$\text{If } P_{beef} = \$10 \;\rightarrow\; Q_{sarah} = 55$$
$$\text{If } P_{beef} = \$18 \;\rightarrow\; Q_{sarah} = 51$$

3. Price of beef:

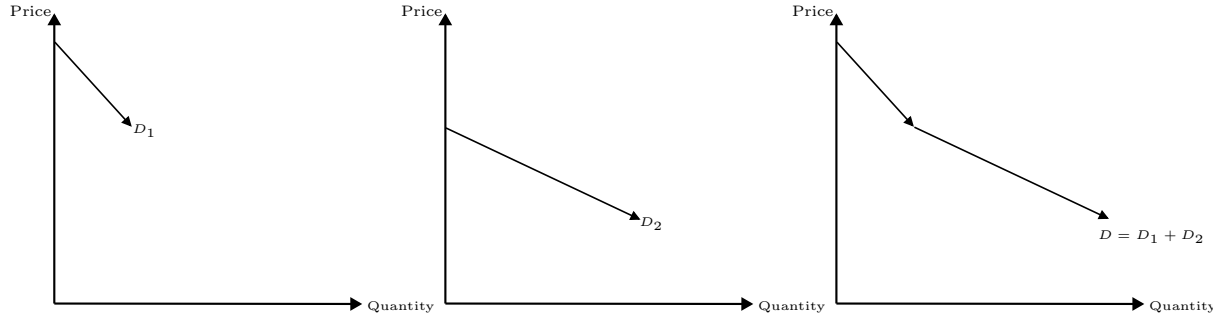
$$\text{If } Q_{sarah} = 25 \;\rightarrow\; P_{beef} = \$70$$
$$\text{If } Q_{sarah} = 60 \;\rightarrow\; P_{beef} = \$0$$

2.2 Aggregate Demand

There are millions of consumers who consume agricultural commodities. How do we determine the demand functions for the entire population?

We aggregate all individual demand functions – *horizontal aggregation.*

Figure 2.2: Market Demand Curve – Horizontal Aggregation of Individual Demand Curves



2.2.1 Numerically aggregating demand

Suppose there are four consumers with the following demand functions:

$$\begin{aligned} Q_{sarah} &= 60 - 0.5P_{beef} \\ Q_{rob} &= 30 - 0.2P_{beef} \\ Q_{jen} &= 45 - 0.35P_{beef} \\ Q_{greg} &= 50 - 0.45P_{beef} \end{aligned}$$

To find aggregate demand, you simply add the four equations: $Q^D_{beef} = Q^D_{sarah} + Q^D_{rob} + Q^D_{jen} + Q^D_{greg}$

$$\begin{aligned} Q^D_{sarah} &= 60 - 0.5P_{beef} \\ &+ \\ Q^D_{rob} &= 30 - 0.2P_{beef} \\ &+ \\ Q^D_{jen} &= 45 - 0.35P_{beef} \\ &+ \\ \underline{Q^D_{greg}} &\underline{= 50 - 0.45P_{beef}} \\ Q^D_{beef} &= 185 - 1.5 \cdot P_{beef} \end{aligned}$$

2.2.2 Properties of aggregate demand

- As more consumers are added to the aggregate demand curve, the more *elastic* the curve becomes (i.e., flatter).

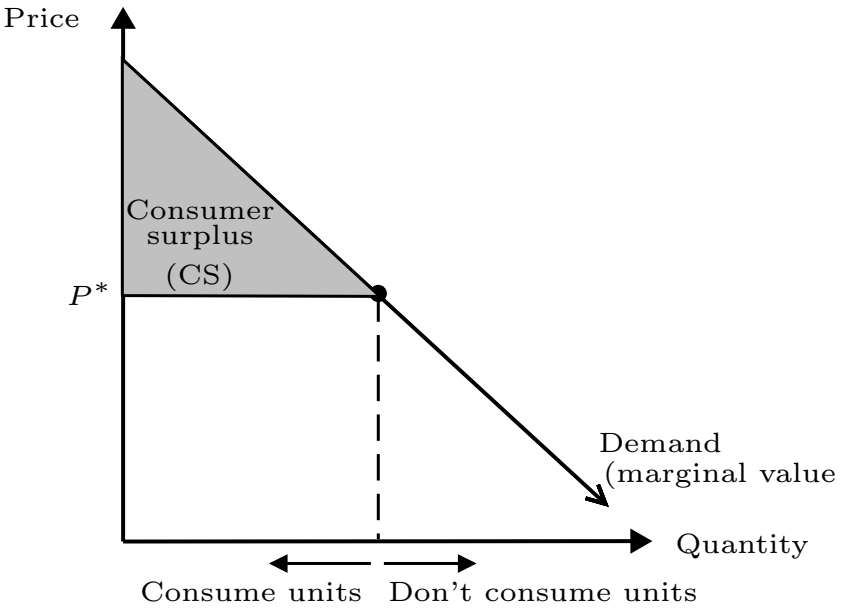
- What can shift/rotate the demand curve?
  - Structure and competition among packing and retail sectors.
  - Population in the U.S.
  - Demographics of the U.S. population.

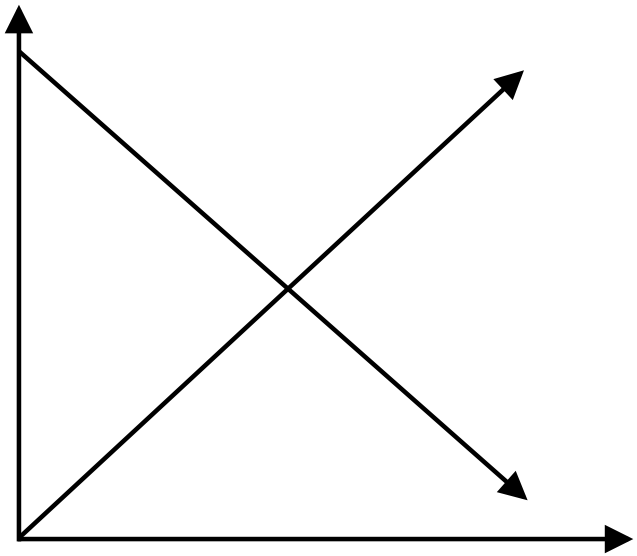
2.2.3 Consumer surplus

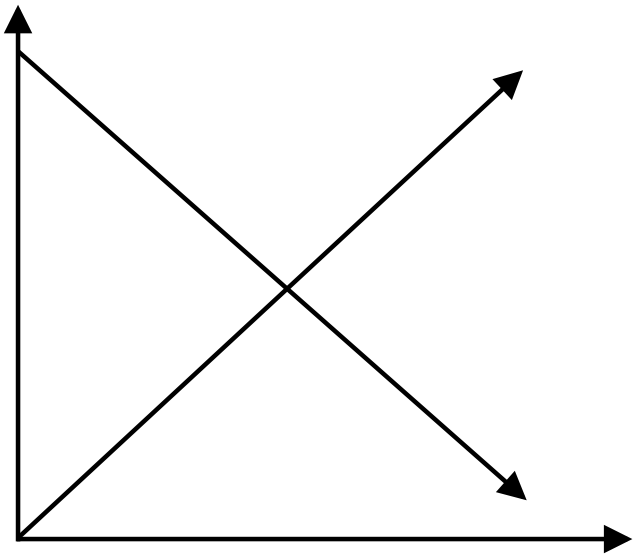
Consumer surplus (CS) is the amount of value that is derived by the consumer *above* the price that was paid for the good.

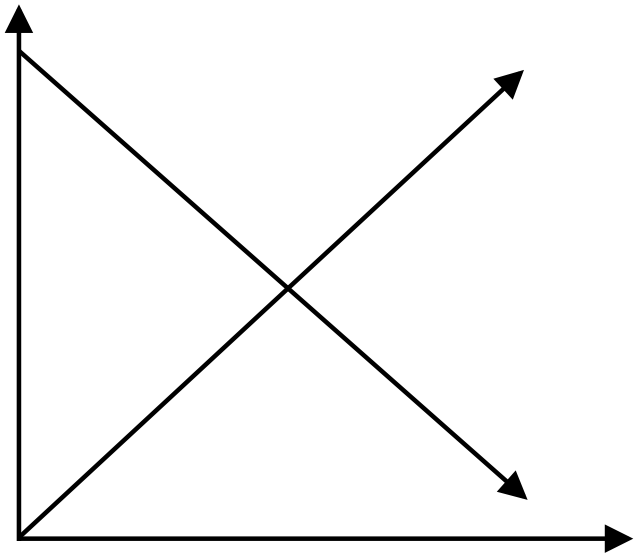
Typically, consumer surplus is the area *below* the demand curve and above the price (frequently, we will model CS is a triangle).

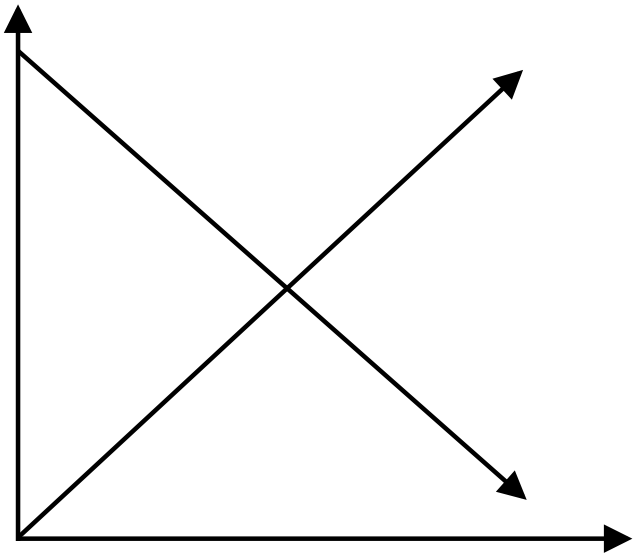
Figure 2.3: Consumer Surplus is the Area Below the Demand Curve and Above Price









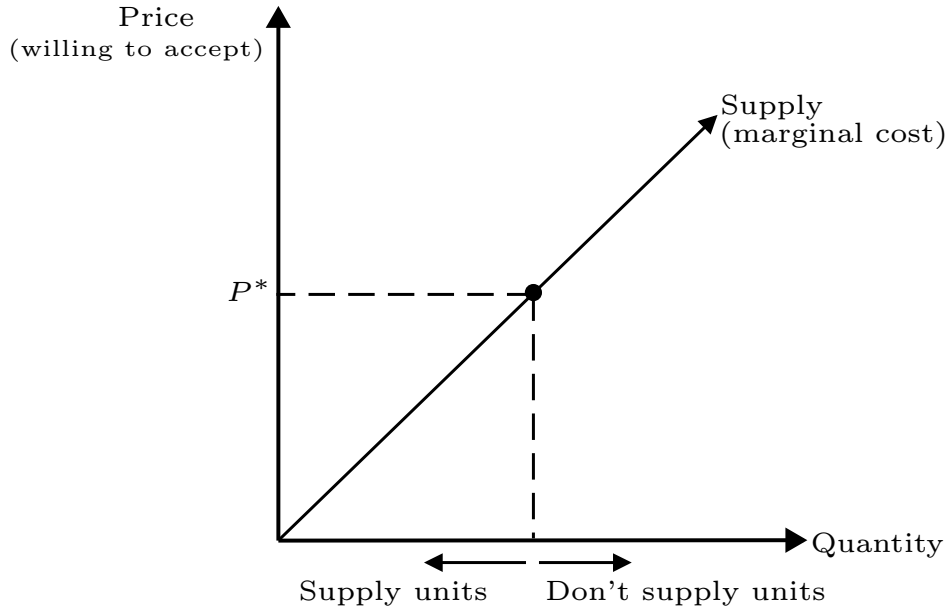


2.3 Supply

Terminology:

- Supply schedule
- Supply curve
  - Illustrates all quantities supplied at every alternative price.
  - Describes the *marginal cost* of the last produced unit.
  - Upward sloping (Law of Supply). For a normal good, as price increases, the quantity supplied increases.
- Firms produce at the point where MR = MC
  Continue to produce and sell while MR > MC
- In competitive markets, P = MR = MC

Figure 2.4: Producer's Marginal Cost (supply) Curve



2.3.1 Properties of supply

- Firms must be able to cover their long-run (average) variable costs
  If P < AVC, then firms no longer continues produce.
- Fixed costs exist only in the short run
  In the long run, any fixed cost can be eliminated.
- In general: AVC < ATC

Remember: All costs are *opportunity costs*. This is important when thinking about costs in the agricultural sector.

2.3.2 What changes supply?

- Change in price will result in a *movement along* the supply curve.
- Change to an external factor will *shift* the supply curve.
  - Relative price of inputs.
  - Creation and adoption of technology (e.g., GM crops, farming equipment).
  - Price of other related products (e.g., ethanol demand caused acreage to be turned over to corn at the expense of soybeans).
  - Risk levels and crop insurance policies.
  - Government acreage controls (CRP).
  - Weather.

2.4 Aggregate Supply

Just as with aggregate demand, *horizontal aggregation* is used to derive the market supply curve.

Consider: Three farms supplying wheat have these supply functions

$$Q_1^S = -45 + 2P_{wheat}^S$$
$$Q_2^S = -80 + 2.5P_{wheat}^S$$
$$Q_3^S = -35 + 3.5P_{wheat}^S$$

Market Supply

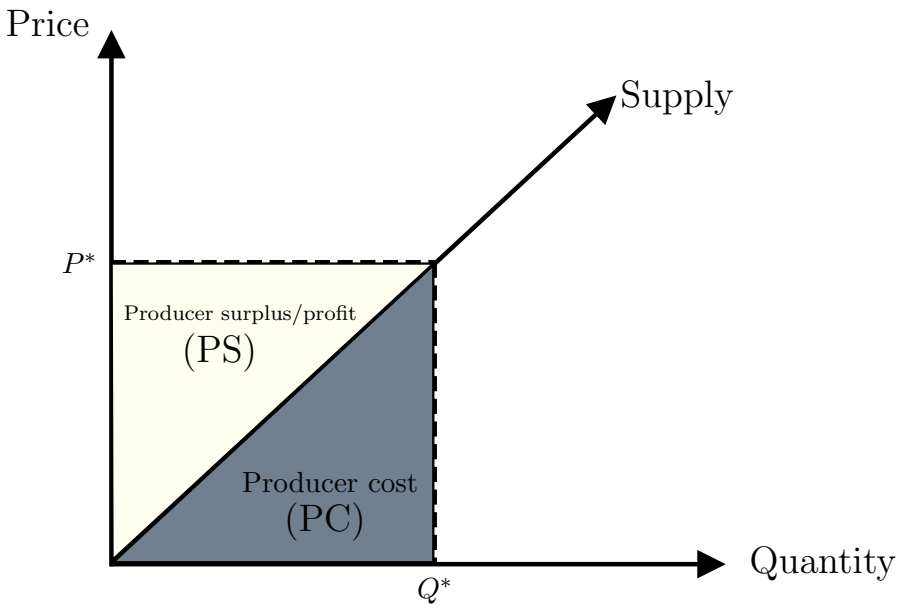
$$Q_{wheat}^S = -160 + 8P_{wheat}^S$$
$$P_{wheat}^S = 20 + 0.125Q_{wheat}^S$$

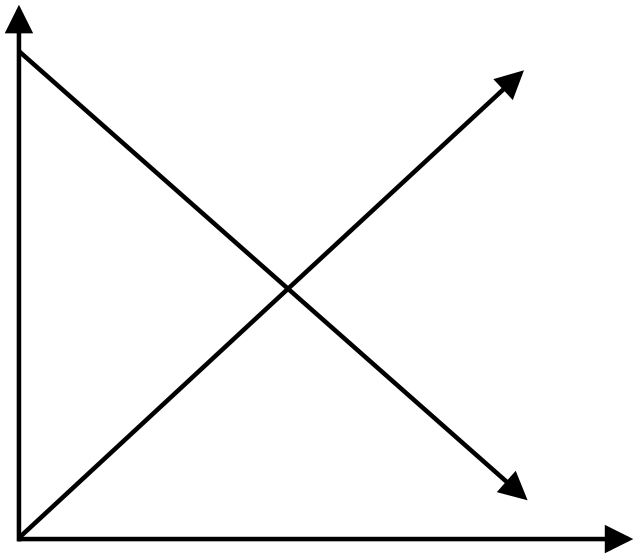
2.4.1 Producer surplus and Producer cost

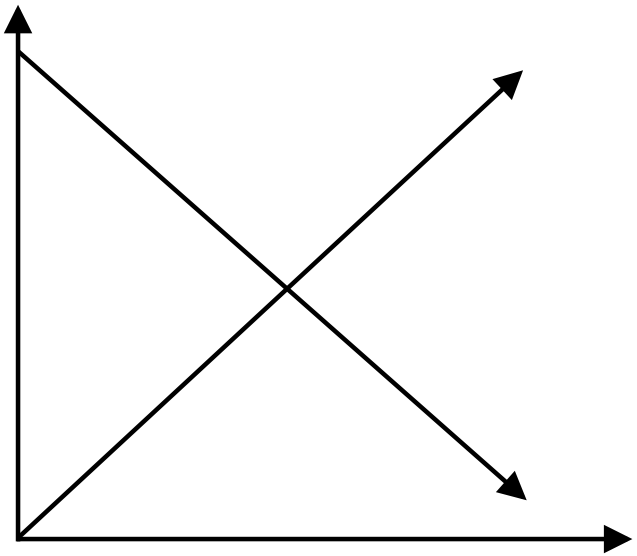
Producer cost (PC) is the total cost that is incurred by the supplier for making and selling a certain number of goods. It is measured as the area *below* the supply curve, bounded by the quantity supplied.

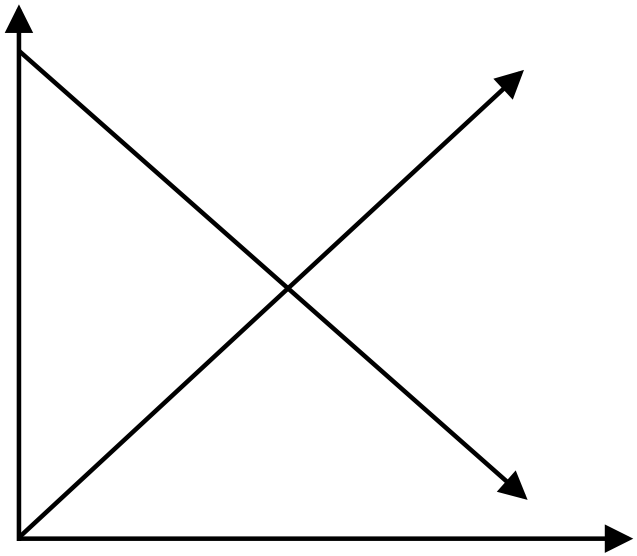
Producer surplus (PS) is the amount of value the firm receives *above* the marginal cost incurred to produce and sell the good. It is measured as the area *above* the supply curve, bounded by the sales price.

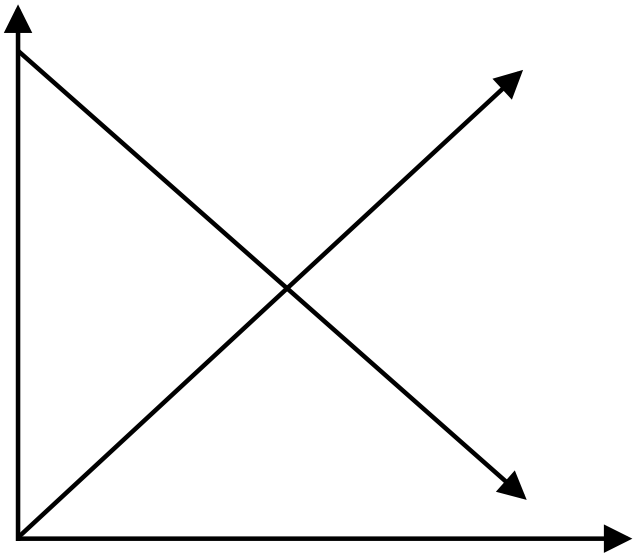
Figure 2.5: Producer Surplus and Costs







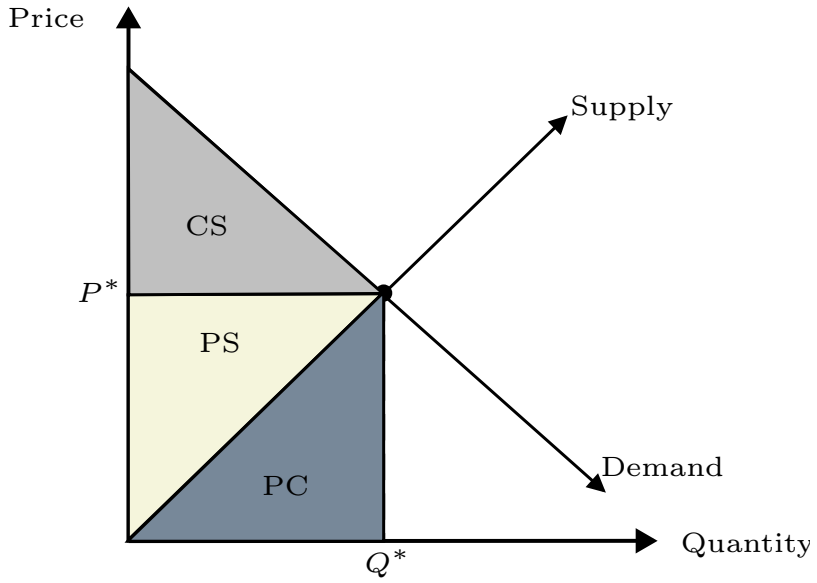




2.5 Equilibrium

Under perfect competition, rationing and resource allocation will cause prices to adjust until supply equals demand.

Figure 2.6: Market Equilibrium is Characterized by the Crossing of the Supply and Demand Curves



2.5.1 What do S and D models tell us?

Here are some examples of what supply and demand curves can be used to determine and analyze:

- Price and quantity sold increase / decrease.
- Price increases but quantity sold decreases.
- Price decreases but quantity sold increases.
- A new tax is imposed.
- A new policy is legislated.

2.5.2 What do prices indicate?

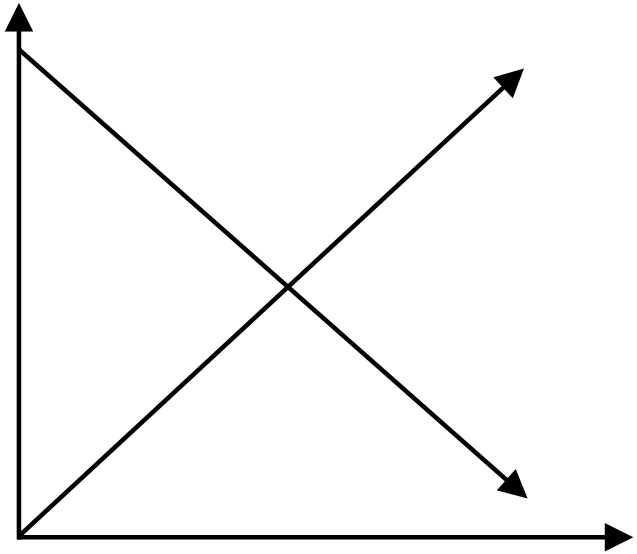
Prices convey an immense amount of information to consumers and producers:

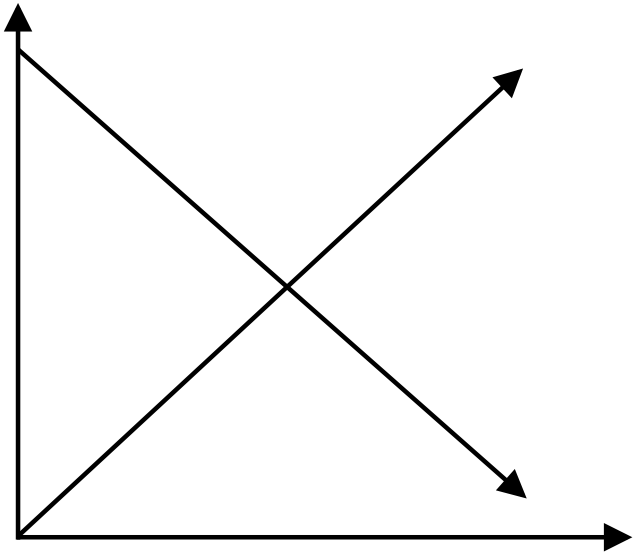
- Signal the demand for products.
- Signal the supply of goods.
- Allow for the coordination of demands for and supplies of goods.
- Provide an incentive to act on the available information.

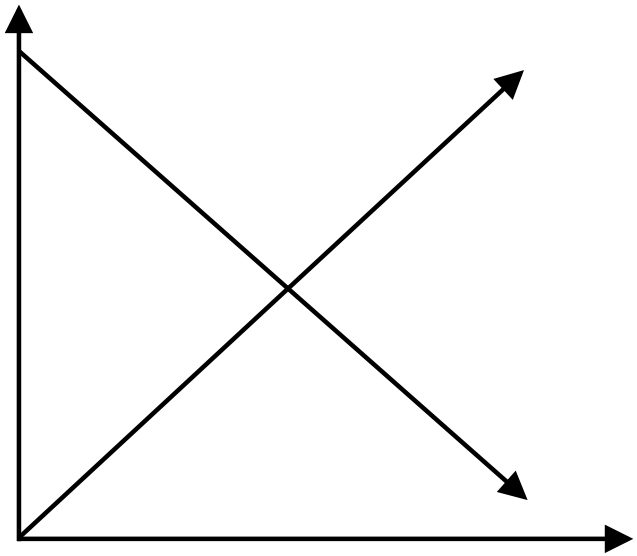
2.5.3 Practice problems

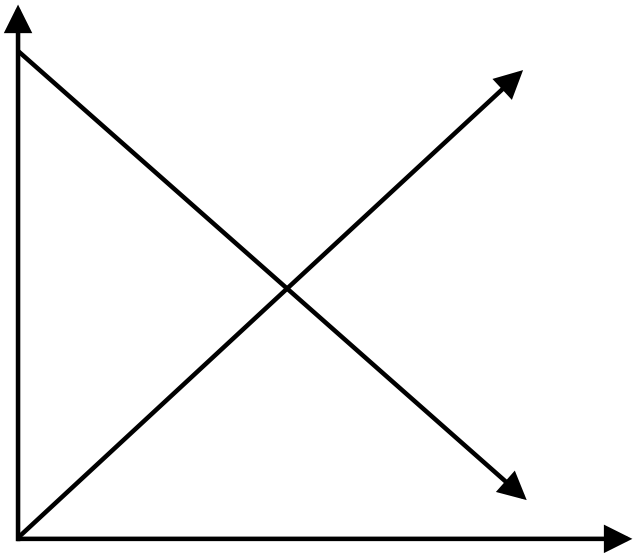
Indicate on a graph and with words how each of the following events would be expected to affect the U.S. market for strawberries:

1. A 15% increase in the price of strawberries because of increased costs of production.
2. A 10% decrease in the price of raspberries.
3. A drought during the strawberry growing season.









2.6 Solving for Equilibrium

Analyzing market scenarios involves understanding how to interpret market situations and mathematically derive important results. For example, suppose you are a producer and you have information about your production and the supply of labor. How can you determine how much of your commodity to produce and what price to charge?

Let's start with a simple example and work through the steps of solving for equilibrium:

Consider an isolated town in which wheat is grown and processed into flour. The following details are available:

- The demand for flour is: $Q_f = 250 - 25P_f$
- To process the wheat, a laborer is able to process one bushel of wheat into one vat of flour during one day. The production of flour requires only the work of laborers.
- Laborers require a minimum wage of \$4/day, but at any wage above \$4, labor is provided according to the following labor supply function: $Q_L = -200 + 50P_L$
- The market price of the input, wheat, is \$3/bushel.

As the wheat producer, you are interested in determining the following:

1. Supply curve for flour, equilibrium price of flour, and equilibrium quantity of flour.
2. Equilibrium price and supply of labor.
3. Profit (producer surplus) earned by laborers.

Follow these steps to solve:

1. Organize and label (very important):

   You know that you have a demand function for flour: $D: \ Q_f^D = 250 - 25P_f^D$

   You know that you have a supply function for labor: $S: \ Q_L^S = -200 + 50P_L^S$

   You know the input price of wheat: $P_{wheat} = \$3$

2. Convert all functions to inverse demand and inverse supply (in other words, solve for price):

$$ID: \ P_f^D = 10 - \tfrac{1}{25}Q_f^D$$

$$IS: \ P_L^S = 4 + \tfrac{1}{50}Q_L^S$$

3. Define the production function, and the price of production. To define the production function is the most intuitive step that you will have to make. In order to so, you have to read the problem carefully and think about what components are necessary to produce the final product. In this case, you are told that the production of flour takes only labor. However, what else is necessary to create flour? Of course, an input – wheat! So, you actually need labor AND wheat to produce flour. In other words:

$$F = L + W$$

   Now that you've got a production function, you need to determine how much it will cost to produce flour. If you know this cost, than you will be able to determine how much you can sell on the market. In a competitive market, a producer will set the price of the output (flour) equal to the price of the two inputs (labor and wheat, in this case). In other words:

$$IS: \ P_f^S = P_L^S + P_{wheat}$$

   Now, in step 1 you wrote out the price of wheat, and in step 2 you solved for the price of supplied labor. Plug these equations into the formula for $IS: \ P_f^S$:

$$IS: \ P_f^S = (4 + \tfrac{1}{50}Q) + (3)$$

$$P_f^S = 7 + \tfrac{1}{50}Q_f^S$$

The next step is to determine the supply function of flour. You already have the inverse supply function $IS: \ P_F^S$. To get the supply function, you solve for $S: \ Q_f^S$:

$$S: \ Q_f^S = -350 + 50P_f^S$$

Now, at equilibrium, you know that the supply and demand curves cross. At the intersection of this cross, there is only one price. In other words, the price at which flour will sell will be the **same** as the price at which flour will be purchased: $P_f^S = P_f^D$. Similarly, the quantity of flour sold will be the same as the quantity of flour purchased: $Q_f^S = Q_f^D$. To determine the equilibrium quantity, you set the equation for $IS: \ P_f^S$ equal to the equation $ID: \ P_f^D$, and then solve for Q_f. Remember, when you set these two equations equal to each other, you *should only have Q as the variable* to solve:

$$7 + \tfrac{1}{50}Q = 10 - \tfrac{1}{25}Q$$

$$\tfrac{3}{50}Q = 3$$

$$Q_f^* = 50$$

Now that you have the equilibrium quantity of flour, you need to determine the equilibrium price. To do so, you plug in Q_f^* into the inverse demand formula of flour, $ID: \ P_f^D$. Then, solve for the equilibrium price of flour:

$$P_F^* = 10 - \tfrac{1}{25}(50)$$

$$P_F^* = \$8.00$$

Next, you need to determine the amount of labor and the price that workers will be paid in order to produce the equilibrium quantity of flour. We will start by determining the price of labor (wage). But, we were only given the supply function of labor, $S: \ Q_L^S$.

Remember that in step 3, we solved for the price of flour: $P_f^S = P_L^S + P_{wheat}$. From this equation, we can also solve for the price of labor:

$$P_f^S = P_L^S + P_{wheat}$$

Solving for P_L^S:

$$P_L^* = P_f^S - P_{wheat}$$

It looks like we still don't have enough information to solve. But wait!! Recall that we already have the price of wheat, $P_{wheat} = \$3$, and we solved for the price of flour in step 6, $P_F^* = \$8.00$. All we need to do now is plug these values into the equation for P_L^* and solve:

$$P_L^* = \$8.00 - \$3.00$$

$$P_L^* = \$5.00$$

We now have the equilibrium price of labor. Next, we need to find how many workers you will need to produce the equilibrium quantity of flour. For this, we need a supply of function for labor. It so happens that we have it written out in step 1: $S: \ Q_L^S = -200 + 50P_L^S$. Since we already have the equilibrium price of labor, we simply plug it into the labor supply function, and solve for $S: \ Q_L^S$:

$$Q_L = -200 + 50 \cdot (\$5.00)$$

$$Q_L^* = 50$$

Finally, we can calculate laborer surplus (the amount of extra revenue is derived by workers above the minimum wage). Visually, it is the triangle above the labor supply curve up to the price that workers receive – in other words, it is the "producer surplus" of laborers:

$$Labor\ Surplus\ (LS) = \tfrac{1}{2} \cdot (Q_L^* \cdot (P_L^* - Minimum\ Wage))$$

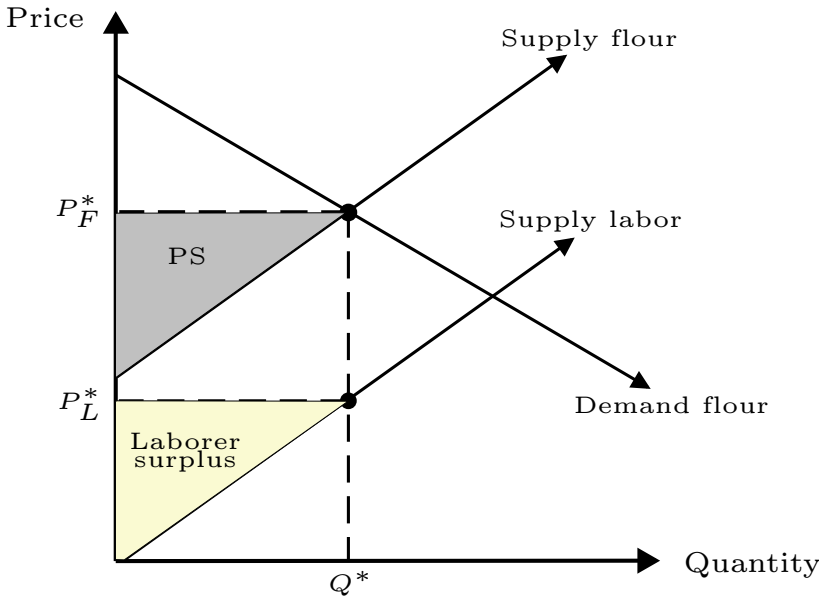
$$LS = \tfrac{1}{2} \cdot (50 \cdot (\$5.00 - \$4.00))$$

$$LS^* = \$25.00$$

2.6.1 Practice problems: solving for equilibrium

1. Consider the example above. Suppose that everything is exactly the same, but that now the Environmental Protection Agency (EPA) imposes a carbon price. This implies that for each unit of flour that you produce, you now have to pay an additional cost. Let the carbon price cost (CPC) be dependent on the quantity of flour you produce. That is, $CPC = 1 + \frac{3}{50}Q$. Follow the steps above and solve for the new equilibriums in the flour and labor markets. How does CPC impact the price and quantity that you sell, and the price and number of laborers that you hire?

Figure 2.7: Graphical Representation of the Flour and Labor Market Equilibriums



2. Consider a simple cattle operation in which feeder cattle are sent to feedlots to be brought up to weight (live cattle).

   Suppose that the demand function for live cattle is:

$$Q_{LC} = 5000 - 10P_{LC}$$

   Bringing a feeder cattle to weight requires labor and feed. This is as follows:

   - To raise one live cattle, the required feed is 100 lbs at \$1 per pound.
   - Feedlot operators are the required labor. Operators work for a fixed wage per each cattle. One operator is required to raise one cattle. The minimum wage is \$50. When the wage is above that, the supply of feedlot operators follows the labor supply function:

$$Q_L = -500 + 10P_L$$

   - A feeder cattle is priced at \$100 per head.

Complete the following:

(a) Calculate the supply function for live cattle.

(b) Determine the equilibrium price and quantity of live cattle.

(c) Determine the equilibrium number of feedlot operators and the wage paid to each feedlot operator.

3. Suppose a market for quaker oat cereal. The demand quaker oats is characterized as: $Q_Q = 800 - 5P_{LC}$

Producing one unite of quaker oats requires one unit of labor and one unit of electricity. Workers have the following conditions:

- The minimum wage for which laborers will work for is \$5.00.
- For any wage above \$5.00, workers follow the following labor supply function:

$$Q_L = -50 + 10P_L$$

- The price of raw oats is \$2.00/bu, and one bushel is required to produce one unit of quaker oats.
- One unit of electricity is required to produce one unit of quaker oats. Electricity costs \$1.00/unit.

(a) Calculate the supply function for quaker oats.

(b) Determine the equilibrium price and quantity of quaker oats.

(c) Determine the equilibrium number of workers and the wage paid to each worker.

(d) Plot the supply of quaker oats and workers, as well as the demand for quaker oats on a single graph. Mark and calculate laborer surplus.

Chapter 3

Elasticities and flexibilities

When measuring the demand, it is very useful to know the relationship between the change in quantity demanded after a change in price and vice versa.

But: Doing so using only the slope ($\frac{\Delta Q}{\Delta P}$) does not allow for comparisons across goods.

Elasticities and flexibilities provide a unit-less measures that describe the relationship between changes in the quantity demanded and price. In other words, you can *directly* compare how a change in price will affect quantity.

3.1 Definitions

Elasticity: indicates the percentage change in quantity demanded if price changes by 1%

$$\varepsilon = \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q}$$

This can also be thought of as the product of the slope of a demand curve and the ratio of price to quantity.

Flexibility: indicates the percentage change in price if quantity demanded changes by 1%

$$\phi = \frac{\Delta P}{\Delta Q} \cdot \frac{Q}{P}$$

This can also be thought of as the product of the slope of an inverse demand curve and the ratio of quantity to price.

3.1.1 Basic example

Sarah's demand and inverse demand functions are as follows.

$$Q_{sarah} = 60 - 0.5P_{beef}$$

$$P_{beef} = 120 - 2Q_{sarah}$$

Calculate the following:

1. Sarah's price elasticity of beef if:
   - $P = 60$ and $Q = 30$
   - $P = 80$ and $Q = 20$
   - $P = 20$ and $Q = 50$
2. Beef's flexibility:
   - $P = 60$ and $Q = 30$
   - $P = 80$ and $Q = 20$
   - $P = 20$ and $Q = 50$

Let's solve the price elasticity when $P = 60$ and $Q = 30$:

1. For the elasticity, we need the slope, $\frac{\Delta Q}{\Delta P}$. Recall that for a simple linear function, $y = a + mx$, a is the intercept and m is the slope. In the Sarah's demand function, Q_{sarah}, we see that $a = 60$ and $m = -0.5$. So, $m = \frac{\Delta Q}{\Delta P} = -0.5$.
2. Now that we have the slope, we can solve for the elasticity: $\varepsilon = \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q}$

$$\varepsilon = -0.5 \cdot \frac{60}{30}$$
$$\varepsilon = -1$$

3. What does this mean? Well, when price increases by 1%, Sarah will consume 1% *less* beef. This makes intuitive sense because the demand function is downward sloping. So, if price goes up, the demand for beef will go down.

Now, let's solve the beef flexibility when $P = 60$ and $Q = 30$:

1. For flexibilities, we again need a slope. But in this case, the slope we're looking for is $\frac{\Delta P}{\Delta Q}$. That is, how does price change when quantity of beef changes? To get this slope, we use the inverse demand function, $P_{beef} = 120 - 2Q_{sarah}$. As with the elasticity, the slope is $m = \frac{\Delta P}{\Delta Q} = -2$.

2. Now that we have the slope, we can solve for the elasticity: $\phi = \frac{\Delta P}{\Delta Q} \cdot \frac{Q}{P}$

$$\phi = -2 \cdot \tfrac{30}{60}$$
$$\phi = -1$$

3. What does this result mean? Well, when quantity demanded of beef increases by 1%, then the price of beef will decrease by 1%.

3.2 Properties of Demand Elasticities

- For normal goods, demand elasticity is *negative*.
- If $\varepsilon < -1$, then:
  - The good is *price elastic*.
  - A 1% change in price will cause a greater than 1% change in quantity demanded.
  - Total revenue changes in the direction of quantity (i.e., if price goes down, then quantity and total revenue go up).
- If $-1 < \varepsilon < 0$, then:
  - The good is *price inelastic*.
  - A 1% change in price will cause a less than 1% change in quantity demanded.
  - Total revenue changes in the direction of price (i.e., if price goes up, then total revenue go up).

3.3 Properties of Demand Flexibilities

- For normal goods, demand flexibility is *negative*.
- If $\phi < -1$, then:
  - The good is *price flexible*.
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- If $-1 < \phi < 0$, then:
  - The good is *price inflexible*.
  - A 1% change in quantity demanded will cause a less than 1% change in price.
  - Total revenue changes in the direction of quantity demanded (i.e., if quantity goes up, then total revenue go up).

3.4 Analyzing more complex relationships

Realistically, demand for a good must be able to take into account factors such as income and prices of other goods.

Let's reconsider Sarah's demand function for beef:

$$Q_{sarah,\ beef} = 60 - 0.5P_{beef} + 0.1P_{pork} - 0.2P_{bbq\ sauce} + 0.25I$$

P_{beef}	P_{pork}	$P_{bbq\ sauce}$	Income	$Q_{sarah,\ beef}$
30	20	5	60	61

From Sarah's demand function, we can see that three things can affect Sarah's consumption of beef:

1. Change in the price of beef.
2. Change in the price of another good.
3. Change in Sarah's income.

This implies that we can calculate three types of elasticity measures:

1. Own-price elasticity: the percentage change in quantity demanded if the price of the good changes by 1%.
2. Cross-price elasticity: the percentage change in quantity if the price of another good changes by 1%.
3. Income elasticity: the percentage change in quantity if income changes by 1%.

3.4.1 How do we find demand elasticities?

Remember that to calculate an elasticity, we need a slope $\frac{\Delta Q}{\Delta P}$, and the quantity and price at which we want to determine the elasticity. We already know the quantity and price, so we need to determine the slope.

In a more complex equation (such as above) there are numerous "slopes." For example, there is a slope for beef ($\frac{\Delta Q_{beef}}{\Delta P_{beef}}$), there is a slope for pork ($\frac{\Delta Q_{beef}}{\Delta P_{pork}}$), for BBQ sauce ($\frac{\Delta Q_{beef}}{\Delta P_{bbq\_sauce}}$), and income ($\frac{\Delta Q_{beef}}{\Delta I}$). This implies that we can calculate **four** elasticities.

How do we find each of the "slopes?" Well, if we use our intuitive thinking, we can see that a slope tells us the following: When everything else is the same, the quantity of beef demanded changes by a certain amount when a particular price changes. Another way to interpret "when everything else is the same" is to do the following:

1. Determine the elasticity that you want to calculate.
2. Based on this, determine the price that you're interested in.
3. Set all of the other prices to zero. Re-write the demand function.

For example, suppose that you're interested in determining the own-price elasticity of beef. That is, you'd like to know how much the quantity of beef demanded will increase when the price of beef decreases. So, you're interested in looking at P_{beef}. Thus, set all the other prices (and income) equal to zero:

$$Q_{sarah,\ beef} = 60 - 0.5P_{beef} + 0.1 \cdot (0) - 0.2 \cdot (0) + 0.25 \cdot (0)$$

$$Q_{sarah,\ beef} = 60 - 0.5P_{beef}$$

Now you have a very familiar demand function, which has the form $y = a + mx$. From here, you can directly get the slope, $m = \frac{\Delta Q}{\Delta P} = -0.5$. Then, simply use the formula for an elasticity to solve:

$$\varepsilon = -0.5 \cdot \tfrac{61}{30} = -1.02$$

In a similar fashion, we calculate the cross-price and income elasticities.

3.5 Properties of Cross-Price Elasticities of Demand

There are threes aspects that can cause an adjustment to quantity demanded. For good i:

1. Income: a change in income can increase or decrease purchasing power. For normal goods, an increase in income implies greater consumption of the good.
2. Substitutes: an increase in the price of another good will lead to a greater consumption of good i. $\varepsilon_{i,j} > 0$
3. Complements: an increase in the price of another good will lead to a lesser consumption of good i. $\varepsilon_{i,j} < 0$

3.6 Price Elasticities of Demand in Agricultural Markets

In general, food is relatively inelastic: -0.4% (own-price); 0.36% (income)

Other major commodities

	Beef	**Pork**	**Chicken**	**Fish**	**Income**
Beef	-1.17	0.081	-0.064	-0.32	2.72
Pork	0.115	-0.827	0.051	0.0059	1.083
Chicken	0.244	0.25	-0.842	-0.0027	-0.106
Fish	-0.087	0.034	0.071	-0.26	0.121

3.7 Elasticities of Supply

Price Elasticity of Supply: the percentage change in quantity supplied if there is a 1% change in price.

Price Flexibility of Supply: the percentage change in price if there is a 1% change in quantity supplied.

3.7.1 Properties of supply elasticities

- As quantity increases, supply elasticity nears unity.
- As price increases, the supply curve flattens (becomes more elastic).
  Higher price → higher incentive to plant → more acres
  → more supply curves included in aggregate supply

Important: in agriculture, elasticities of supply typically differ depending on the time period being examined.

- Short-run (day / week / month): price of supply is relatively elastic.
  Farmers can alter the amount of a commodity that they sell based on the current price

$$\text{Week 1: } P_{wheat} \text{ is high} \rightarrow \text{Sell more wheat}$$
$$\text{Week 2: } P_{wheat} \text{ is lower} \rightarrow \text{Sell less wheat}$$

- Intermediate-run (marketing period): price is least elastic.
  - The supply is fixed (can't grow extra corn in December).
  - Supply is not perfectly inelastic – if the price gets too low or high, there is possibility of import/export.
- Long-run (more than marketing period): price elasticity is greater than that during the marketing period.

3.7.2 Solving for elasticities of supply

Consider the following supply function for Montana wheat:

$$Q_{wheat} = 25 + 25P_{wheat} - 10P_{rye} - 15P_{barley} - 8W_{fuel} + 10Rain$$

$$P_{wheat} = \$5 \qquad P_{rye} = \$5.50 \qquad P_{barley} = \$5$$

$$W_{fuel} = \$2.50 \quad Rainfall = 10in.$$

Solve for the following:

1. Aggregate supply of wheat.
2. Own- and cross-price elasticities at the given values.

1. Total quantity of wheat supplied: 100

2. When solving supply elasticities, follow the same process as if you were solving demand price elasticities. Elasticities at given values:

	$\frac{\Delta Q}{\Delta P}$	$\varepsilon_{i,j}$
P_{wheat}	$\frac{\partial Q}{\partial P_{wheat}} = 25$	1.25
P_{rye}	$\frac{\partial Q}{\partial P_{rye}} = -10$	-0.55
P_{barley}	$\frac{\partial Q}{\partial P_{barley}} = -15$	-0.75
W_{fuel}	$\frac{\partial Q}{\partial W_{fuel}} = -8$	-0.2
$Rainfall$	$\frac{\partial Q}{\partial Rain} = 10$	1

Chapter 4

Equilibrium Displacement Models

We analyze economic scenarios using supply and demand diagrams. However, we often esoterically say that although we can show the market reaction on a graph, we need additional information to solve the math.

Well, the excuses are over: let's actually determine by how much shocks affect markets.

EDM calculations are excellent for analyzing events such as:

- Market shocks to the supply or demand.
- Government policies that affect prices.
- Effects of invasive species.
- Interaction of substitutes and complements.

4.1 Single Commodity EDM Analysis

Consider a basic scenario:

1. There is a negative shock to the supply of wheat, causing the supply curve to shift inward.

2. The resulting rise in price causes a decrease in both the quantity demanded until a new equilibrium is reached.

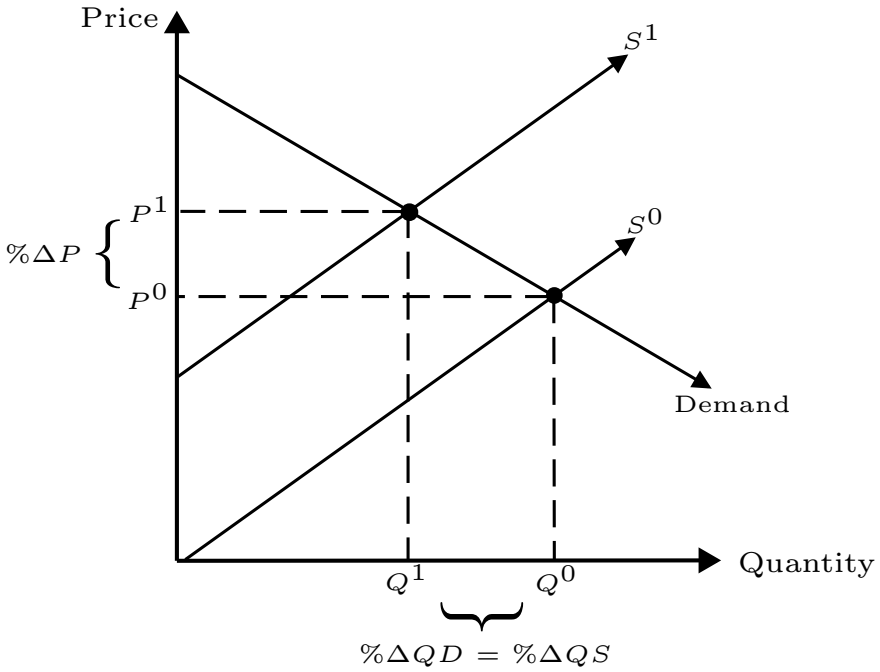
3. Question: how much did the price and quantity actually change due to the shock? That is:

   (a) What is the percentage change in quantity demanded ($\%\Delta QD$)?

   (b) What is the percentage change in quantity supplied ($\%\Delta QS$)?

   (c) What is the percentage change in price ($\%\Delta P$)?

Figure 4.1: Changes the Equilibrium Displacement Models Help Quantify



To answer these questions, we do need some information. Specifically we need:

- Elasticities of supply and demand curves (ε_D and ε_S).
- The amount of the shock (shift) to the supply curve (S_S).

Once we have these, we can solve for the changes in quantity demanded and supplied using the following formulas:

$$\%\Delta QD = \varepsilon_D \cdot \%\Delta P + S_D$$

$$\%\Delta QS = \varepsilon_S \cdot \%\Delta P + S_S$$

Here's the key to solving this problem: when the curves shift, what is the relationship of $\%\Delta QD$ to $\%\Delta QS$? In other words, how much does $\%\Delta QD$ change relative to $\%\Delta QS$?

The answer is easy: because after the shock the market returns to an equilibrium, the amount that quantity demanded changed by is the same as the amount that the quantity supplied changed. In other words, $\%\Delta QD = \%\Delta QS$!

This means that we can the two equations equal to each and then solve for $\%\Delta P$:

$$\varepsilon_D \cdot \%\Delta P + S_D = \%\Delta QD = \%\Delta QS = \varepsilon_S \cdot \%\Delta P + S_S$$

$$\varepsilon_D \cdot \%\Delta P + S_D = \varepsilon_S \cdot \%\Delta P + S_S$$

$$0 = \varepsilon_S \cdot \%\Delta P + S_S - \varepsilon_D \cdot \%\Delta P - S_D$$

$$0 = (S_S - S_D) + \%\Delta P(\varepsilon_S - \varepsilon_D)$$

$$\%\Delta P = \frac{(S_D - S_S)}{(\varepsilon_S - \varepsilon_D)}$$

Note: that the denominator $(\varepsilon_S - \varepsilon_D)$ is always positive.

So, if we know the elasticities and amount of shocks, we can solve for $\%\Delta P$. Then, we plug in $\%\Delta P$ into either $\%\Delta QD$ or $\%\Delta QS$ to determine the change in the quantity demanded / quantity supplied that occurred due to some market shock.

4.1.1 Example

Suppose that due to a failure of eradication, the wheat stem sawfly has caused a substantial reduction in Montana wheat supply. The resulting negative shift of the supply curve causes the quantity supplied to go down by 10%. Analyze the changes in price and quantity demanded/supplied in the wheat market, knowing that the following is true:

Elasticity of wheat supply (ε_S)	1.5
Own-price elasticity of wheat demand (ε_D)	-2

1. First, you need to analyze what is happening. A drop in quantity supplied is 10% – this is the *exogenous* shock ($S_S = -10\%$). We model this as following:

$$\%\Delta QS = \varepsilon_S \cdot \%\Delta P - 10\%$$

2. Now, the reduction in quantity supplied will increase the prices that producers charge for wheat and consumers pay for wheat. The change in price is the *endogenous* readjustment of the equilibrium in the wheat market. How do we determine this adjustment?

   We need to solve for the unknown $\%\Delta P$, which will tell us the true price adjustment due to the supply shock. In other words, $\%\Delta P$ reveals the true adjustment in price, after taking into account the elasticities of both the supply and demand curves. We solve this as we did above:

$$\begin{gathered}
\varepsilon_D \cdot \%\Delta P + S_D = \%\Delta QD = \%\Delta QS = \varepsilon_S \cdot \%\Delta P + S_S \\
\varepsilon_D \cdot \%\Delta P + S_D = \varepsilon_S \cdot \%\Delta P + S_S \\
-2 \cdot \%\Delta P + 0 = 1.5 \cdot \%\Delta P - 10\% \\
10\% = 3.5 \cdot \%\Delta P \\
\%\Delta P = 2.86\%
\end{gathered}$$

   This indicates that the effect of the wheat stem sawfly caused prices to rise by 2.86% as a result in the drop of quantity supplied. This result should make sense, because we know that a negative supply shock will cause prices to rise.

3. We know how much the price of wheat will increase, but we don't know how much quantity supplied/demanded changed. We can find out by simply plugging in $\%\Delta P$ into the equation for $\%\Delta QD$ or $\%\Delta QS$.

$$\%\Delta QD = \varepsilon_D \cdot \%\Delta P + S_D$$
$$\%\Delta QD = -2 \cdot 2.86\% + 0$$
$$\%\Delta QD = -5.72\%$$

   Because we are back in an equilibrium, we know that $\%\Delta QS$ was exactly the same.

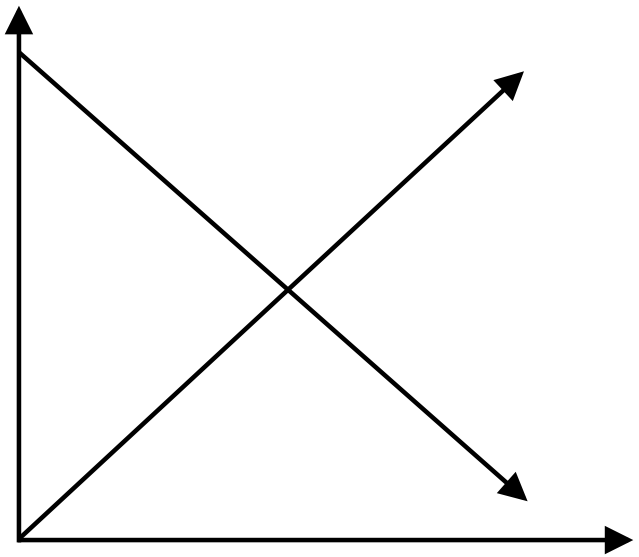
4.1.2 Additional practice

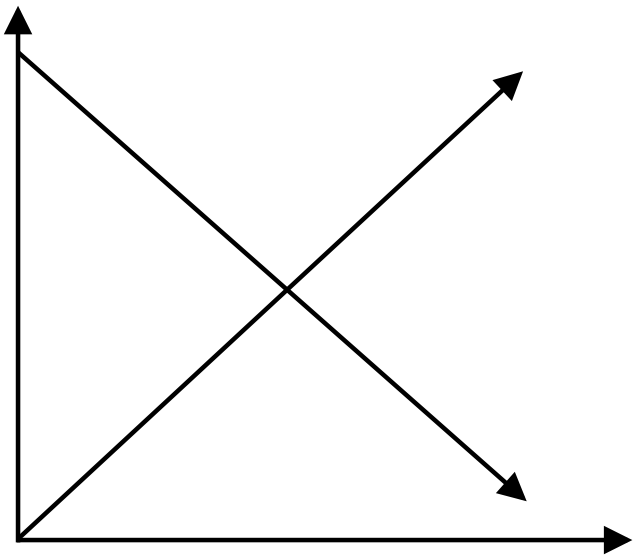
Consider the following information:

Elasticity of apple supply (ε_S)	3
Own-price elasticity of apple demand (ε_D)	-2.5
Elasticity of pear supply (ε_S)	5
Own-price elasticity of pear demand (ε_D)	-3

Analyze the percentage change in prices and quantities if the following scenarios occurred:

1. A rise in the price of oranges causes the demand for apples to increase by 15%.
2. A tax is imposed on pear producers, causing pear production costs to rise by \$5/bu, when the current price of pears received by producers is \$50/bu.
3. A drop in apple supplies and the resulting rise in apple prices causes the demand for pears to increase by 5%. Assume that apples and pears are substitute goods.





4.2 General Equilibrium Displacement Models – GEDM

In the simple EDM calculation, we consider only a "partial equilibrium." In other words, we only ask the question: How does a shock affect one market?

This is not very realistic! Shocks in one market can affect related markets (such as substitute or complementary goods), which can then cause feedback effects.

4.2.1 For example

Consider *Additional practice* problem 3. You are told that apple supplies decrease, causing apple prices to rise and the demand for pears to rise, because apples and pears are substitute goods.

However, the rise in the demand for pears will then cause a feedback effect on the apple market. That is, higher pear demand will increase pear prices and cause some consumers to demand more apples, in turn causing apple prices to rise further.

How do we analyze this particular scenario? Well, it seems intuitive that we will be analyzing both the apple and pear markets, and we also need some way to determine the interaction between these two markets. The interaction is the cross-price elasticity. Assume that:

Elasticity of apple supply (ε_S)	3
Own-price elasticity of apple demand (ε_D)	-2.5
Elasticity of pear supply (ε_S)	5
Own-price elasticity of pear demand (ε_D)	-3
Cross-price elasticity of apple demand with respect to pear prices ($\varepsilon_{apple,pear}$)	0.5
Cross-price elasticity of pear demand with respect to apple prices ($\varepsilon_{pear,apple}$)	0.25

4.2.2 Problem setup

Let's set up the four markets:

$$\%\Delta QS_{apples} = \varepsilon_{S,apples} \cdot \%\Delta P_{apples} + S_{S,apples}$$

$$\%\Delta QD_{apples} = \varepsilon_{D,apples} \cdot \%\Delta P_{apples} + \varepsilon_{apple,pear} \cdot \%\Delta P_{pear} + S_{D,apples}$$

$$\%\Delta QS_{pears} = \varepsilon_{S,pears} \cdot \%\Delta P_{pears} + S_{S,pears}$$

$$\%\Delta QD_{pears} = \varepsilon_{D,pears} \cdot \%\Delta P_{pears} + \varepsilon_{pear,apple} \cdot \%\Delta P_{apple} + S_{D,pears}$$

Note now that we directly account for the interaction of the two markets by including the terms $\varepsilon_{apple,pear}$ and $\varepsilon_{pear,apple}$.

Suppose that the supple of apples decreased by 10%. How do we solve for the changes in the price of apples ($\%\Delta P_{apples}$) and price of pears ($\%\Delta P_{pears}$)?

1. First, we know that in equilibrium, $\%\Delta QS_{apples} = \%\Delta QD_{apples}$ and $\%\Delta QS_{pears} = \%\Delta QD_{pears}$. For each relationship, solve for $\%\Delta P_{apples}$ and $\%\Delta P_{pears}$, respectively.

$$\varepsilon_{S,apples} \cdot \%\Delta P_{apples} + S_{S,apples} = \varepsilon_{D,apples} \cdot \%\Delta P_{apples} + \varepsilon_{apple,pear} \cdot \%\Delta P_{pear} + S_{D,apples}$$

$$3 \cdot \%\Delta P_{apples} - 10\% = -2.5 \cdot \%\Delta P_{apples} + 0.5 \cdot \%\Delta P_{pear} + 0$$

$$5.5 \cdot \%\Delta P_{apples} = 0.5 \cdot \%\Delta P_{pear} + 10\%$$

$$\boldsymbol{\%\Delta P_{apples} = 0.091 \cdot \%\Delta P_{pear} + 1.82\%} \quad (1)$$

$$\varepsilon_{S,pears} \cdot \%\Delta P_{pears} + S_{S,pears} = \varepsilon_{D,pears} \cdot \%\Delta P_{pears} + \varepsilon_{pear,apple} \cdot \%\Delta P_{apples} + S_{D,pears}$$

$$5 \cdot \%\Delta P_{pears} + 0 = -3 \cdot \%\Delta P_{pears} + 0.25 \cdot \%\Delta P_{apples} + 0$$

$$8 \cdot \%\Delta P_{pears} = 0.25 \cdot \%\Delta P_{apples}$$

$$\boldsymbol{\%\Delta P_{pears} = 0.031 \cdot \%\Delta P_{apples}} \quad (2)$$

2. Now, we have two equations (equations (1) and (2)) and two unknowns ($\%\Delta P_{apples}$ and $\%\Delta P_{pears}$). Two solve, plug in the equation for $\%\Delta P_{pears}$ into the equation for $\%\Delta P_{apples}$. Then solve for $\%\Delta P_{apples}$:

$$\%\Delta P_{apples} = 0.091 \cdot \%\Delta P_{pear} + 1.82\%$$

$$\%\Delta P_{apples} = 0.091 \cdot (0.031 \cdot \%\Delta P_{apples}) + 1.82\%$$

$$\%\Delta P_{apples} = 0.003 \cdot \%\Delta P_{apples} + 1.82\%$$

$$0.997 \cdot \%\Delta P_{apples} = 1.82\%$$

$$\%\boldsymbol{\Delta P_{apples} = 1.83}\%$$

Now that you have the percentage change in the price of apples, plug it into the equation for the price of pears to solve for $\%\Delta P_{pears}$:

$$\%\Delta P_{pears} = 0.031 \cdot \%\Delta P_{apples}$$

$$\%\Delta P_{pears} = 0.031 \cdot (1.83\%)$$

$$\%\boldsymbol{\Delta P_{pears} = 0.057}\%$$

3. Having both the $\%\Delta P_{apples}$ and $\%\Delta P_{pears}$, you can now solve for $\%\Delta QD_{apples}$ ($\%\Delta QS_{apples}$) and $\%\Delta QD_{pears}$ ($\%\Delta QS_{pears}$):

$$\%\Delta QD_{apples} = \varepsilon_{D,apples} \cdot \%\Delta P_{apples} + \varepsilon_{apple,pear} \cdot \%\Delta P_{pear} + S_{D,apples}$$

$$\%\Delta QD_{apples} = -2.5 \cdot \%\Delta P_{apples} + 0.5 \cdot \%\Delta P_{pear} + 0$$

$$\%\Delta QD_{apples} = -2.5 \cdot 1.83\% + 0.5 \cdot 0.057\%$$

$$\%\boldsymbol{\Delta QD_{apples} = -4.55}$$

$$\%\Delta QD_{pears} = \varepsilon_{D,pears} \cdot \%\Delta P_{pears} + \varepsilon_{pear,apple} \cdot \%\Delta P_{apple} + S_{D,pears}$$
$$\%\Delta QD_{pears} = -3 \cdot \%\Delta P_{pears} + 0.25 \cdot \%\Delta P_{apples} + 0$$

$$\%\Delta QD_{pears} = -3 \cdot 0.057\% + 0.25 \cdot 1.83\%$$

$$\%\Delta QD_{pears} = 0.287\%$$

4.2.3 Additional problems

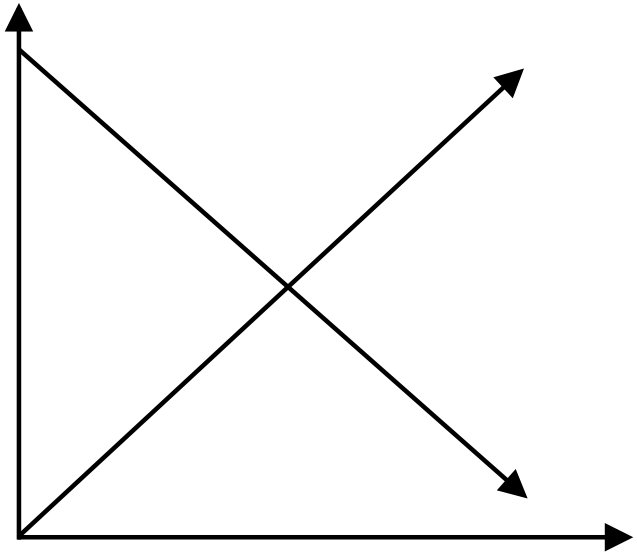
Sugar can be produced from sugar beets grown in Montana or sugar cane grown in Texas. These markets are linked, and so shocks to one market must be analyzed with respect to the other market.

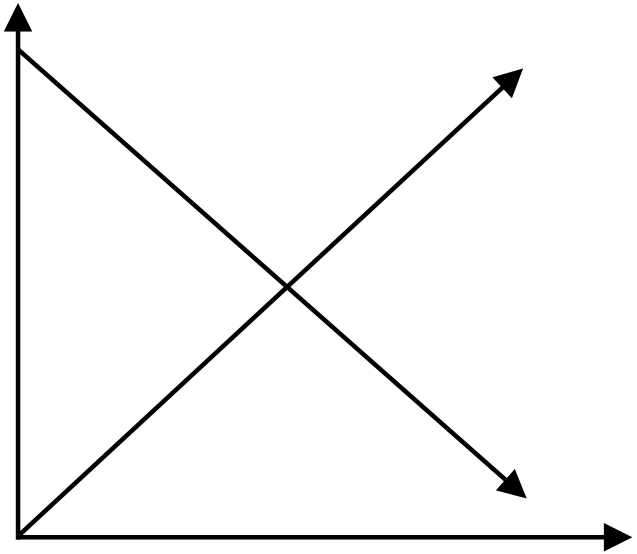
Consider the following information:

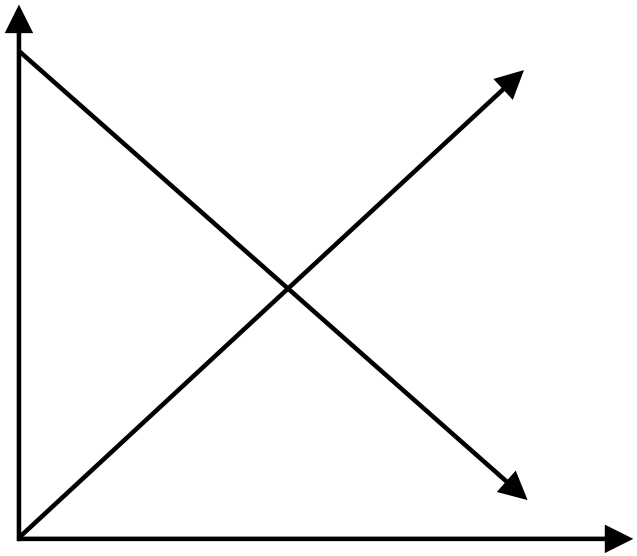
Elasticity of sugar beets supply (ε_S)	1.2
Own-price elasticity of sugar beets demand (ε_D)	-0.9
Elasticity of sugar cane supply (ε_S)	1.5
Own-price elasticity of sugar cane demand (ε_D)	-1
Cross-price elasticity of sugar beets demand with respect to sugar cane prices ($\varepsilon_{beet,cane}$)	1.2
Cross-price elasticity of sugar cane demand with respect to sugar beet prices ($\varepsilon_{cane,beet}$)	1.5

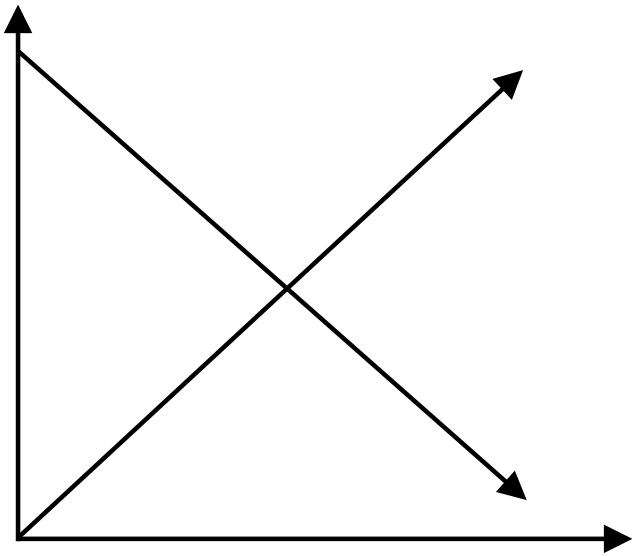
Analyze the following situations:

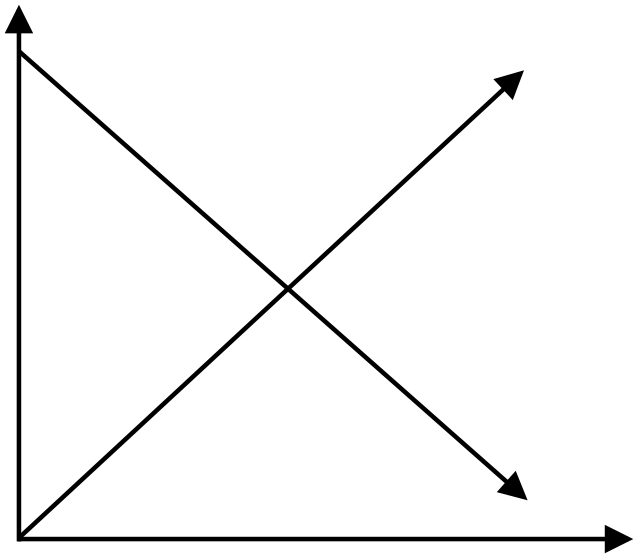
1. Sugar cane supply increases by 25%.
2. The FDA restricts only non Round-up Ready sugar beets to be planted, increasing the demand for beets by 5%.
3. Prices of sugar beets fall by \$5/ton from the original price of \$50/ton.

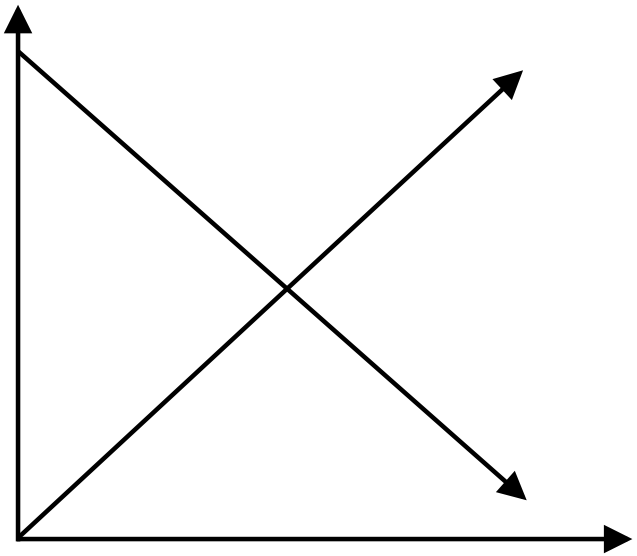


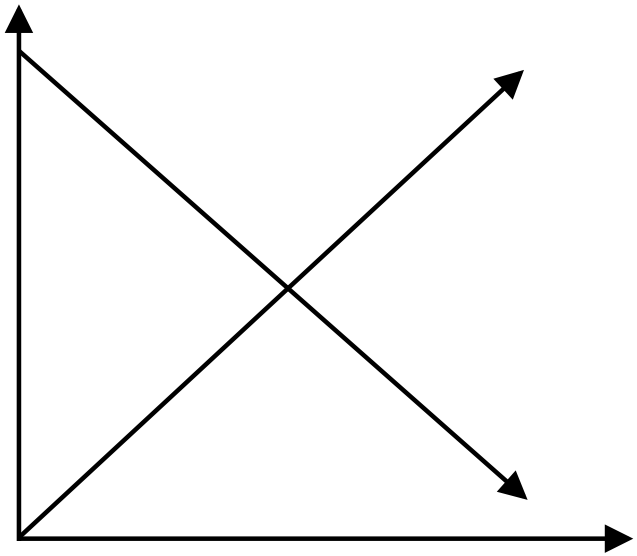


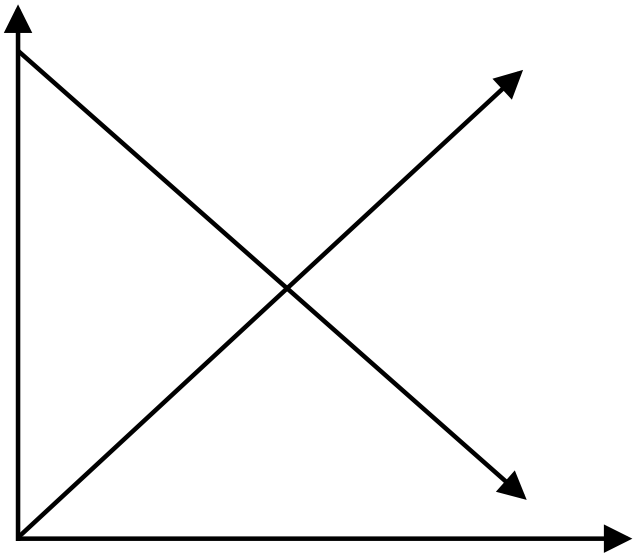












Chapter 5

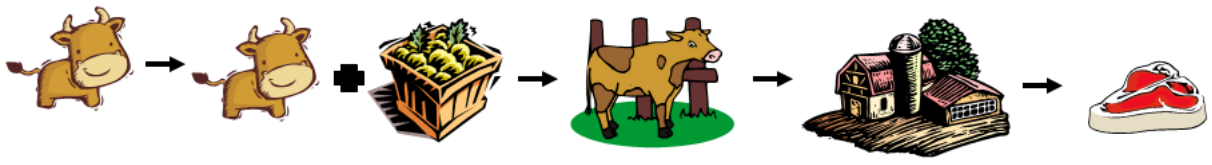
Food Marketing Channel

You go to Stacey's steakhouse, you order a nice, local 24 ounce steak (medium-rare, of course), and 15 minutes later you're enjoying the steak's delicious taste and smell. You then pay $30 for your dinner, and you're on your way.

If you've ever been to Stacey's, you probably know that they don't have any steak-trees or meat-bushes on which steaks grow. This makes you wonder: Where did the steak come from? How did it get there? And why was it so expensive?!?

Answering these questions is the goal of analyzing the food marketing channel.

Consider the following diagram describing the process of a Stacey's Steakhouse steak:



1. Calves are born and they are grass-fed until they can be sent off to feedlots.
2. At feedlots, cattle are brought up to weight.
3. Fed cattle are processed into meat products.
4. Meat products are transported to various locations (including Stacey's).

5. A medium-rare steak is provided to the customer.

Each one of these steps involves a cost, which is incorporated into the final price of the steak.

It should be intuitive that a shock at any one of these steps will have an impact on the others. For example, suppose that customers changed their tastes and started consuming pork. The demand for steak would decrease causing:

1. Decrease in the demand for meat by Stacey's.
2. Decrease in transportation of meat because less meat consumers need the product.
3. Decrease in how much meat is processed.
4. Decrease in the production (quantity supplied) of fed cattle.
5. Decrease in the production of feeder cattle.

And, because the demand at all of these steps has decreased, the following will happen to prices:

1. Decrease in the price that Stacey's is willing to pay for beef products.
2. Decrease in how much transporters of beef receive because consumers are less willing to pay.
3. Decrease in how much feedlot operators receive.
4. Decrease in how much feeder cattle producers receive.

As a producer, you may be very interested in understanding and modeling the effects of changes in the food marketing channel. For example, you may want to know how much less you will receive for your feeder cattle if there is a BSE outbreak that causes consumers to consume less beef.

5.1 Understanding the food marketing channel – Derived Demand

Agricultural production is unique! One of the ways that it is unique is that many agricultural commodities are produced in *equal proportions* from some raw input.

Cattle	→ Hamburger meat → Steaks
Chicken	→ Two legs → Two wings → Two breasts
Soybeans	→ Soybean meal → Soybean oil

As consumers, we demand the end product, such as chicken breasts or soybean meal (for feed). As producers, we supply the product and process it into consumables.

Questions of importance:

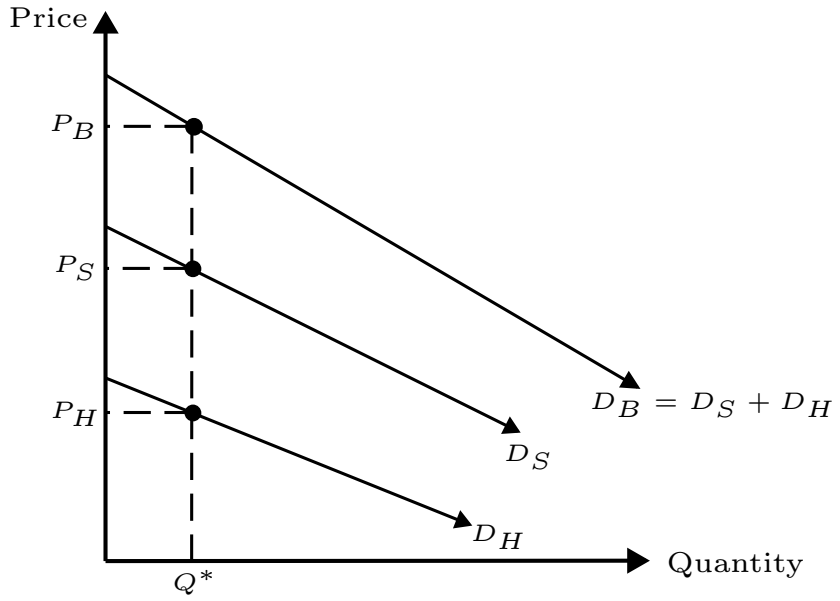
- How do we determine the demand for the agricultural raw input (farm level demand) product? In other words, what's the demand for chickens or soybeans?
- How do we determine the supply of the agricultural raw input product?
- What are the equilibrium prices of input and final goods?

Recall that in chapter 2, we solved for the supply functions and used provided demand equations to solve for equilibrium. The three questions above will allow us to solve for the demand functions. After completing this, we will be able to solve for *both* the demand and supply sides of the market equilibrium relationship.

To start answering these questions, we work backward. That is, we ask the question: *how much of the final, processed products do consumers demand?*

An intuitive way to answer this question is plotting the demands of all food products derived from an agricultural commodity on a single plane. For example, assume that from

Figure 5.1: Vertical Summation of Demand Curves for Derived Products



one fed cattle, you can produce steaks and hamburgers. At any quantity, consumers are willing to pay more for a steak than a hamburger. The sum of steaks and hamburgers makes up the total demand for beef. This is illustrated in figure 5.1.

You can see that the total demand for beef is the vertical sum of the demands for steaks (D_S) and hamburger (D_H), and for some quantity of meat ($Q*$), the price of steak is always higher than the price of hamburger.

Now that we know what the total demand for beef looks like, we are interested in understanding how this demand can be used to derive the demand for the agricultural commodity, fed cattle.

To understand this, we must consider that fed cattle becomes beef and is transported to its final destination through *processing and marketing* (P&M). So, amount of P&M will determine how much fed cattle will become meat. That is:

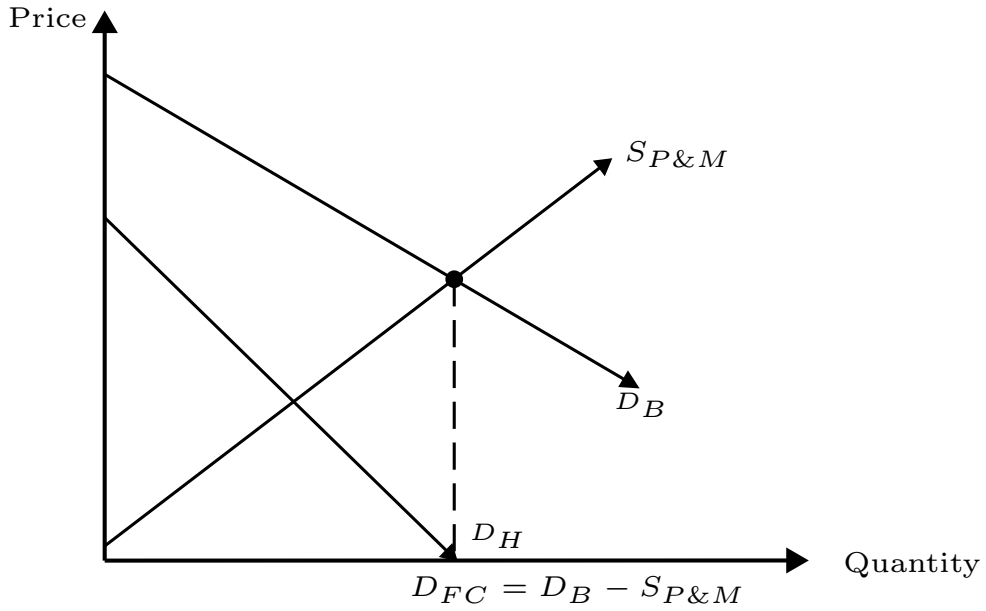
$$D_{beef} = D_{fed\ cattle} + S_{P\&M}$$

In other words, the amount of beef available for consumption is equal to the amount of fed cattle and the amount of processing. It is then easy to see that to derive the demand for fed cattle, we simply subtract $S_{P\&M}$ from both sides:

$$D_{fedcattle} = D_{beef} - S_{P\&M}$$

To interpret this relationship, consider that the demand for fed cattle will continue to be positive until the point at which the consumer market is satiated with enough processed beef. That is, until $D_{beef} - S_{P\&M} = 0$. If $D_{beef} > S_{P\&M}$, then there is excess demand for beef and processors will continue to supply their services. And because an input into processing is fed cattle, the demand for fed cattle will be positive. If $D_{beef} < S_{P\&M}$, then there is excess supply of beef, and processor will not need additional fed cattle to process into meat. This relationship is shown in figure 5.2.

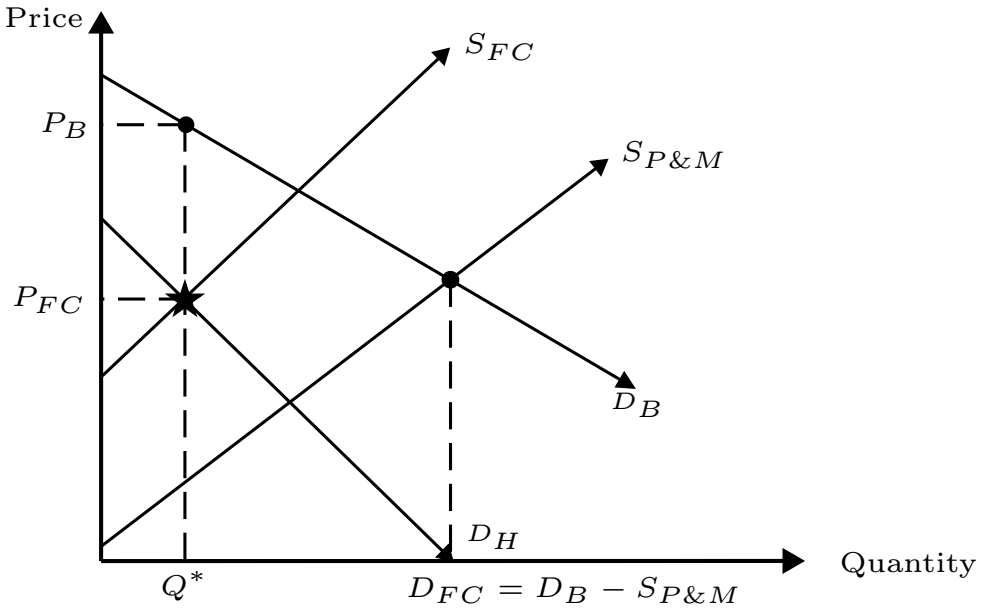
Figure 5.2: Vertical Summation of Demand Curves for Derived Products



The curve D_B comes directly from the previous diagram in which the sum of steaks and hamburgers determined the demand for beef. The supply of P&M is given, and the demand curve for fed cattle D_{FC} is determined by the vertical difference between the $S_{P\&M}$ and D_B curves. This figure clearly illustrates how the demand for the agricultural commodity is determined by the consumers of the final goods.

To find the equilibrium quantity and price of fed cattle (which as a feedlot operator, you're most interested in), we can simply look to the intersection of the supply and demand curves of fed cattle. Assuming that the supply curve of fed cattle is known, the equilibrium in the fed cattle market is shown in figure 5.3.

Figure 5.3: Equilibrium in the Fed Cattle Market



The intersection of D_{FC} and S_{FC} determines the equilibrium price and quantity of fed cattle. Also, because fed cattle are processed in fixed proportions, the quantity of fed cattle ($Q*$) is implicitly the quantity of beef that will be available. So, we simply project the quantity of beef onto the demand curve for beef (D_B) to retrieve the equilibrium price of beef. Lastly, we can also determine the price that processors receive by projecting the equilibrium quantity $Q*$ into the supply curve of processing and marketing $S_{P\&M}$.

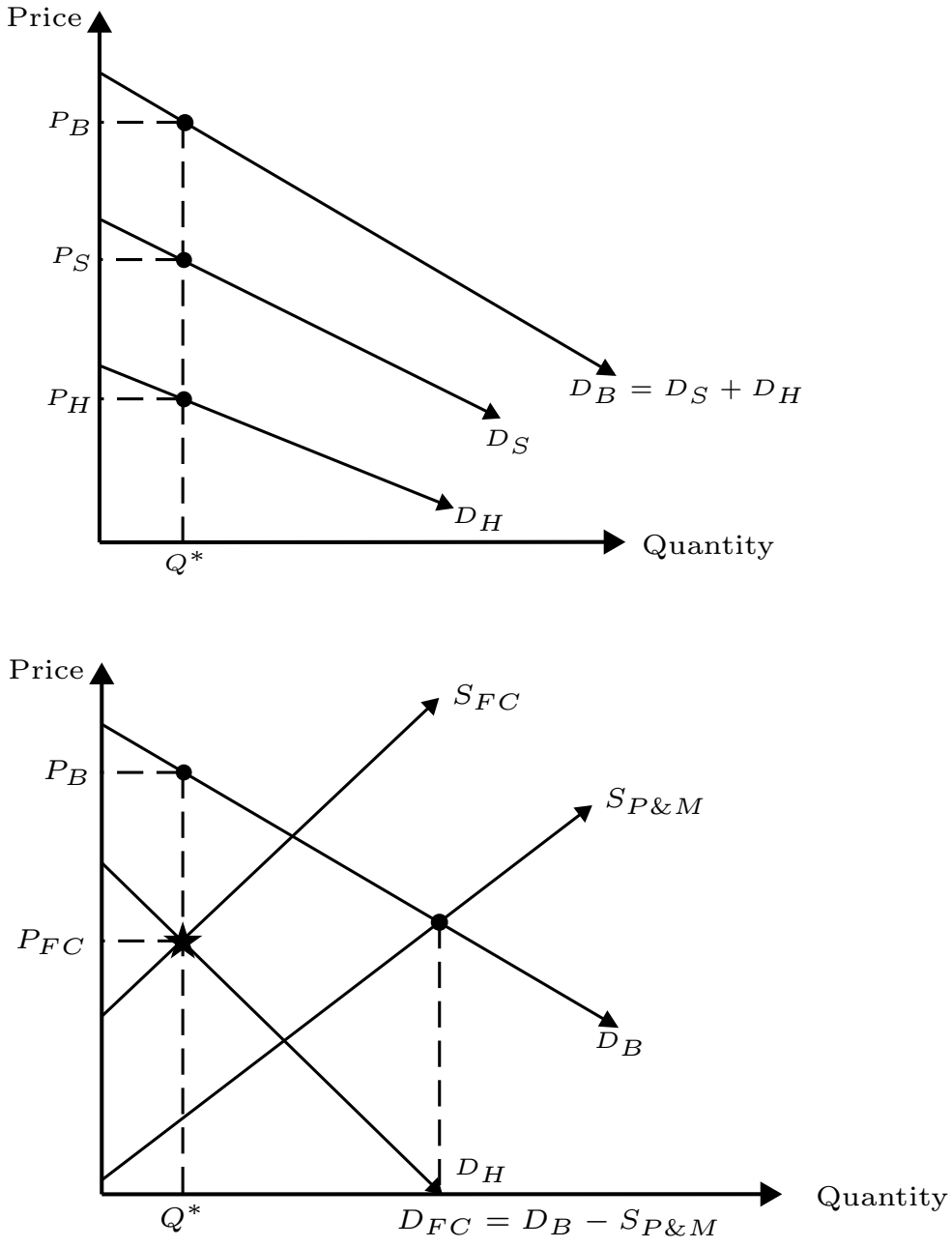
To determine the prices of steak and hamburgers, we simply project the equilibrium quantity onto the first graph. The overall analysis is shown in figure 5.4.

5.2 Scenario Analysis

The derived demand model we have derived is extremely powerful. You can use it to get intuition into the effects of market shocks. Consider the following scenario:

A case of BSE breaks out in the U.S. cattle market. This causes consumers to fear that the processed meat is inedible, and the demand for beef decreases. Analyze the following:

Figure 5.4: Equilibrium in the Fed Cattle and Processed Meat (Consumer) Markets



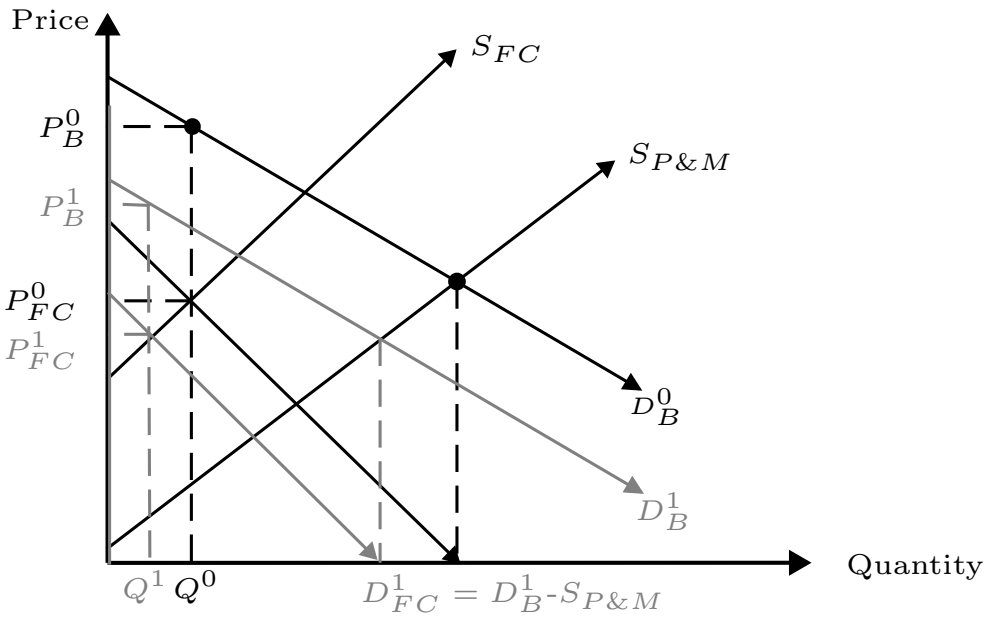
1. The effect on the quantity and price of fed cattle.
2. The effect on the quantity and price of beef.

3. The effect on the quantity and price of steaks and hamburgers.

5.2.1 Analysis

1. The demand for meat decreases and shifts inward.
2. Because the demand for fed cattle is derived from the from demand of beef, the demand for fed cattle will also decrease and shift inward.
3. This will change the point at which the demand and supply curves of fed cattle intersect. The result is a drop in quantity supplied and drop in price.
4. Projecting the new quantity onto the new demand curve of beef, we see that the price of beef has also decreased.
5. Projecting the new quantity onto the supply curve of P&M, we see that the price received by fed cattle processors has decreased.

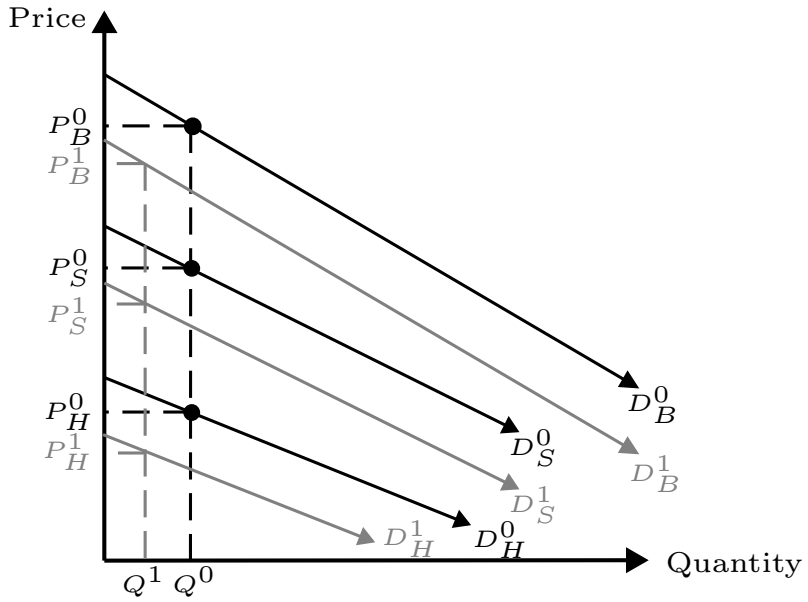
Figure 5.5: Effects in the Fed Cattle Market of a Negative Shock to Consumer Confidence



Because the demand for beef has decreased and the quantity of beef supplied has dropped, there we model the changes in the consumer market.

1. The drop in overall beef demand and quantity of beef supplied can be illustrated by the decrease in the demands of both steak and hamburger.
2. The demand for steak decreases. The price for steak drops.
3. The demand of hamburger decreases. The price for hamburger drops.

Figure 5.6: Effects in the Consumer Market of a Negative Shock to Consumer Confidence



5.2.2 Additional problems – DD Graphical Analysis

Set up diagrams for the consumer and farm-level markets, and analyze the following market scenarios:

1. The demand for steak increases.
2. The supply of processing and marketing is reduced.
3. The supply of fed cattle increases.

5.3 Derived Demand – Numerical Analysis

Although graphical derived demand analysis helps understand the intuition of markets, as a producer, you may find it useful to mathematically determine the demand function for the farm-level commodity. By knowing this demand, you will be able to determine the equilibrium quantity and price levels.

Suppose that you know the consumer-level demand functions for the final goods, as well as the supply functions for P&M and the farm-level good. To derive the demand and equilibrium price and quantity levels, use the following steps:

1. Determine the joint demand meat: vertical summation
2. Determine the equilibrium quantity of processing: Set $D_{consumer\ level} = S_{P\&M}$
3. We know that $D_{farm\ level} = (D_{consumer\ level} - S_{P\&M})$. So, plug in for $D_{consumer\ level}$ and $S_{P\&M}$ to solve for $D_{farm\ level}$.
4. Find the equilibrium quantity and price of cattle by setting demand (inverse demand) of cattle equal to the supply (inverse supply) of cattle: $D_{farm\ level} = S_{farm\ level}$
5. Solve for the equilibrium price and quantities.

5.3.1 DD Numerical Example

Consider: you know the demand for hamburger meat and steaks, as well as the supply of meat processing and supply of fed cattle. Derive the demand for fed cattle.

$D_{hamburger}: \ P_H = 10 - 0.5 \cdot Q_H^D$

$D_{steak}: \ P_S = 20 - Q_S^D$

$S_{P\&M}: \ P_{P\&M}^S = 5 + 0.5 \cdot Q_{PM}^S$

$S_{FC}: \ P_{FC}^S = -20 + 3 \cdot Q_{FC}^S$

1. Determine the joint demand for beef: $D_B = D_{hamb} + D_{steak}$
   $D_B : P_B^D = (10 - 0.5 \cdot Q_H^D) + (20 - Q_S^D)$
   $D_B : P_B^D = 30 - 1.5 \cdot Q_B^D$

2. Solve for the derived demand of fed cattle: $D_{FC} = (D_B - S_{P\&M})$

   $D_{FC} : P^D_{FC} = (30 - 1.5 \cdot Q^D_B) - (5 + 0.5 \cdot Q^S_{PM})$

   $D_{FC} : P^D_{FC} = 25 - 2 \cdot Q^D_{FC}$

3. We have the function for the supply of fed cattle, so we can solve for equilibrium quantity: $D_{FC} = S_{FC}$

   $D_{FC} : P^D_{FC} = P^S_{FC} : S_{FC}$

   $P^D_{FC} = 25 - 2 \cdot Q^D_{FC} = -20 + 3 \cdot Q^S_{FC} = P^S_{FC}$

   $45 = 5 \cdot Q_{FC}$

   $\boldsymbol{Q* = 9}$

4. Now that we know the equilibrium quantity of fed cattle we can solve for other equilibrium values:

   (a) Equilibrium price of fed cattle: $P^D_{FC} = 25 - 2 \cdot Q*$

   $P^D_{FC} = 25 - 2 \cdot 9$

   $\boldsymbol{P^D_{FC} = \$7}$

   (b) Equilibrium price of beef: $P^D_B = 30 - 1.5 \cdot Q*$

   $P^D_B = 30 - 1.5 \cdot 9$

   $\boldsymbol{P^D_B = \$16.5}$

   (c) Equilibrium price of steak: $P_S = 20 - Q * D$

   $P_S = 20 - 9$

   $\boldsymbol{P_S = \$11}$

   (d) Equilibrium price of hamburger: $P_H = 10 - 0.5 \cdot Q*$

   $P_H = 10 - 0.5 \cdot 9$

   $\boldsymbol{P_H = \$5.50}$

5.3.2 Additional problems – Deriving demand numerically

1. Now that you know the demand for fed cattle, $D_{FC} : P^D_{FC} = 25 - 2 \cdot Q^D_{FC}$, you can derive the demand for feeder cattle, as well as solve for the equilibrium price and quantity of feeder cattle.

   Suppose that "processing" of feeder cattle into fed cattle is simply feed. The supply functions for feed and feeder cattle are as follows:

   $S_{feed} : \ P_F = -25 + 3 \cdot Q$

   $S_{feeder\ cattle} : \ P_{FC} = -4 + Q$

2. Consider the market for chicken. Typically, consumers purchase chicken wings, breasts, and legs. These parts are processed in fixed proportions – each chicken yields 2 wings, 2 breasts, and 2 legs. As a poultry farmer, you are interested in determining the demand for the raw product – chicken.

   Complete the following:

   (a) Using graphs, illustrate how you would determine the demand for processed chicken.

   (b) Using the demand for processed chicken, illustrate how you would derive the demand for the raw product, chicken. Assume that the supply of processors and supply of raw chickens is known. Label the price of processed chickens, the price of raw chickens, the price of processing & marketing, and the quantity of raw chickens.

   (c) Now, consider an outbreak of avian flu, causing a decrease in the demand for processed legs, breasts, and wings. Illustrate the changes that will occur in the market for processed chickens and in the market for raw chickens.

   (d) Let's calculate the derived demand using numbers. Suppose the following:

$$
\begin{aligned}
&D_{legs}: \ P_L = 5 - 0.25Q \\
&D_{wings}: \ P_W = 10 - 0.75Q \\
&D_{breats}: \ P_B = 15 - Q \\
&S_{M\&P}: \ P_{MP} = 8 + 0.25Q \\
&S_{chicken}: \ P_C^S = -10 + 5Q
\end{aligned}
$$

      i. Calculate the demand for processed chicken.
      ii. Determine the equilibrium quantity of processing.
      iii. Solve for the demand function for raw chickens.
      iv. Determine the equilibrium price and quantity of raw chickens.
      v. Find the price of legs, wings, and breasts.

Chapter 6

Spatial Concepts in Agricultural Markets

Transportation is a crucial factor in agricultural marketing.

- Movement of agricultural products across geographical distances *adds value* to the product.
- A decrease in transportation costs will lead to more transport and trade.
- Location matters – placement of processing facilities is strongly influenced by transport costs.

What are the factors that determine whether or not a commodity should be transported?

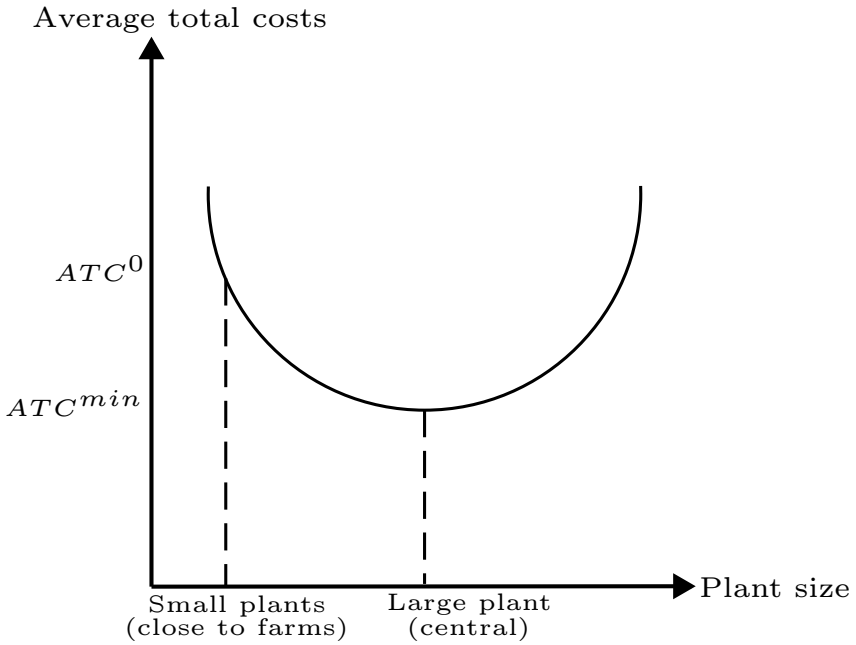
- If the initial processing *reduces* weight (and transportation costs), then processing facilities are more valuable *near production sites*.
  For example, flour is lighter than wheat. Beneficial to process nearby.
- If processing *adds* weight (and transportation costs), then processing facilities are more valuable *near end-users*.
  For example, reconstituted milk is heavier than dry milk powder.

6.0.3 Economies of Scale

So, why aren't there many small wheat processors in Montana?

By building a central processing plant, it may be possible to significantly reduce total average costs.

Figure 6.1: Average Total Costs of Processing Plants by Plant Size



It is about finding a balance between reducing transport costs and taking advantage of economies of scale by delivering to a central location.

What models can we use to determine how to strike this balance?

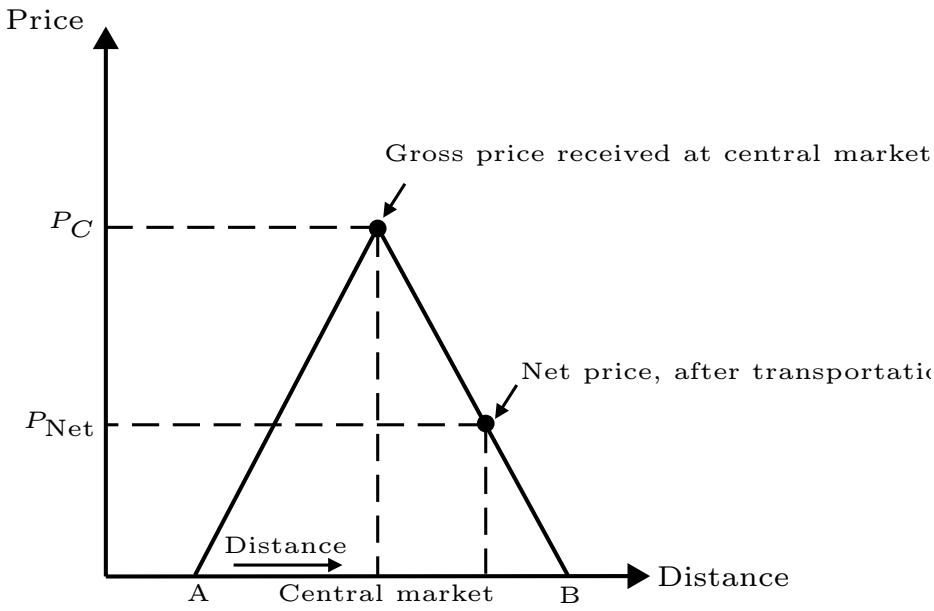
6.1 One-dimensional spatial model

Properties:

- Producers near central market will receive maximum price per unit (transportation distance is zero).

- The price received per unit from any other location is: (Distance $\times$ Cost of Transport).
- Profitable region: any location that can receive a net price per unit above zero.

Figure 6.2: Two-dimensional Net Price Diagram



In figure 6.2, suppose that a farmer at location A can sell a commodity at the central market. But, the commodity needs to transported to the central market. The price of transporting a commodity is constant, $\$c$ per mile. So, the farther away the farmer is from the central, the more expensive it is to transport the commodity. The total transport costs are $\delta \cdot \$c$, where δ is the distance to the central market.

At the central market, a farmer can receive price P^*. So, the farmer's net price is $P_{\text{Net}} = P^* - \delta \cdot \$c$. If this net price is greater than 0, then there is an incentive for the farmer to transport the commodity to the central market. The diagonal lines indicate the net price that a farmer will receive depending on the location of the farm. Obviously, the further a farmer is from the central market, the lower the net received price.

Profitability region: this is the region on the graph between Location A and Location B. Anywhere in that region, a farmer will have incentive to transport a commodity to the central market because the net received price is above or equal to zero.

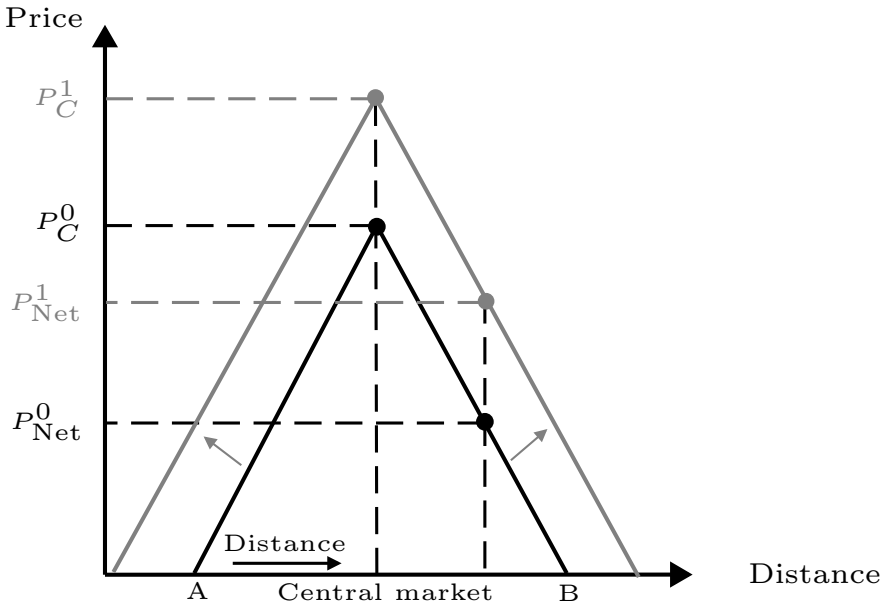
6.1.1 Scenario Analysis – One-dimensional transport models

1. There is an increase in the price paid for a commodity at the central market.

   Outcomes

   - Producers who were already in the profitable region will now receive higher profits.
   - Profitability region increases – it is now profitable for more producers to deliver (new producers deliver).

Figure 6.3: Scenario Analysis Using the Two-dimensional Net Price Diagram: Increase in Price at Central Market

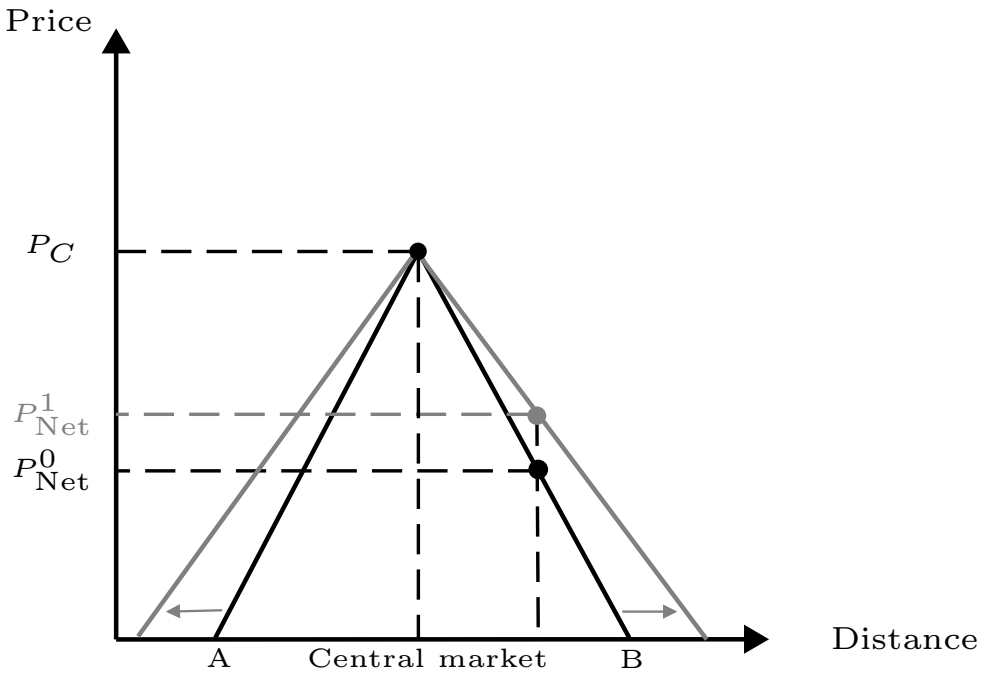


2. There is a decrease in the transportation costs of delivering a good to the central location.

   Outcomes

   - Producers close to the central location will not be affected.
   - The slope of the *net profit* lines *expands*.
   - The profitability region expands, increasing profit for current producers and creates profit for new producers.

Figure 6.4: Scenario Analysis Using the Two-dimensional Net Price Diagram: Decrease in Transportation Costs



6.1.2 Additional problems – 2D transport models

Consider that there is a new vector of delivering a good to the central location via a river. Producers that can ship downstream to the central market will have much lower transportation costs than producers who must ship upstream. Illustrate this scenario using a one-dimensional transport model.

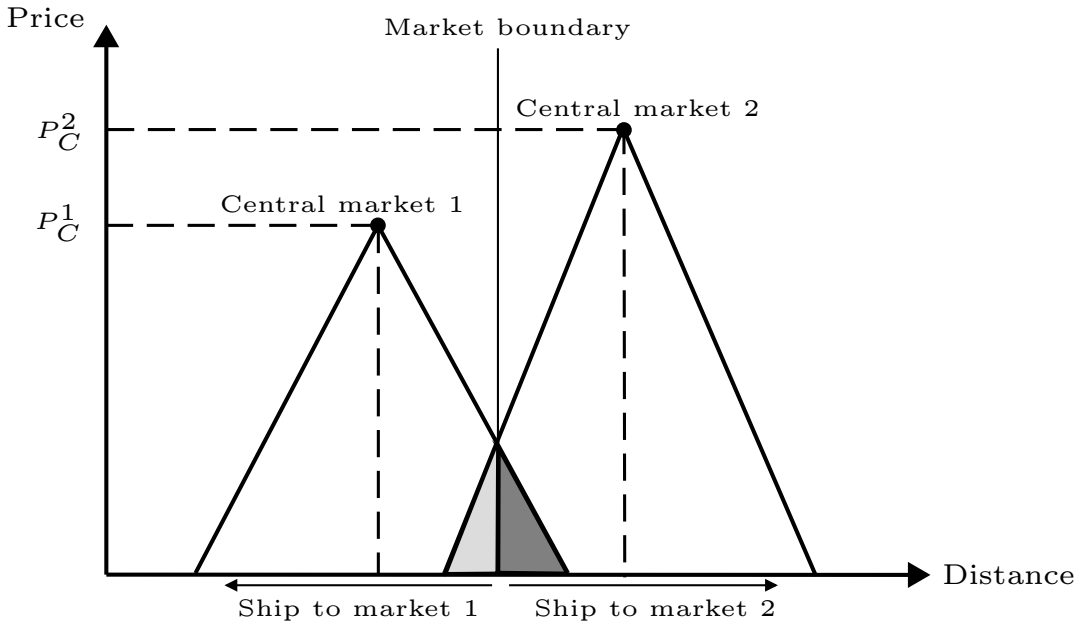
6.2 Overlapping production regions

What if there are two central markets to which delivery can occur? Which producers choose each market?

- For two delivery locations, there may be an *overlap region*. It is divided by the *market boundary*.

- Producers within the overlap region can deliver to *either* of the two delivery locations.
- For producers in the overlap region, it is more profitable to delivery location that corresponds to their side of the market boundary.

Figure 6.5: Two-dimensional Net Price Diagram to Illustrate Overlapping Profitability Regions



6.2.1 Addition problems – 2D overlapping transport models

Suppose that one central market exists, but it is relatively small and pays a low price to producers. A new processing plant is built in nearby market, and the price that this processing plant offers is substantially higher than offered in the smaller market. Suppose that the price offered in the new central market is so much higher that the profitability region overlaps the entire profitability region of the small market. What will happen to producers that delivered to the small market?

Chapter 7

Inter-regional Trade

An important aspect of agricultural production (especially for U.S. producers) is inter-regional trade. That is, moving commodities across space. To understand why and where commodities move, we need to develop a model of supply and demand that can appropriately capture relationships between regions.

Let's consider two regions in which there are production and consumption of barley. However, in region A, the resources for producing barley are low and the costs of production are high. Conversely, in region B, barley production is plentiful. Consequently, the price of barley in region A (P_A) is substantially higher than the price of barley in region B (P_B). Figure 7.1 shows a model of the two regions.

When the economy is closed (there is no trade), the prices determined in each market are known as *autarky prices*. Prices P_A^a and P_B^a are autarky prices.

Now, consider that it is possible to export from one market to another (assume that there are no transportation costs). What will be the direction of moving the commodities? That is, who will export and who will import?

To answer this question, you need to ask: In which market will it be profitable to buy a good, so that when you sell in the other market, you will make a profit?

In the scenario above, $P_B^a < P_A^a$. Thus, it is reasonable to purchase barley in market B and the resell the barley in market A for a higher price.

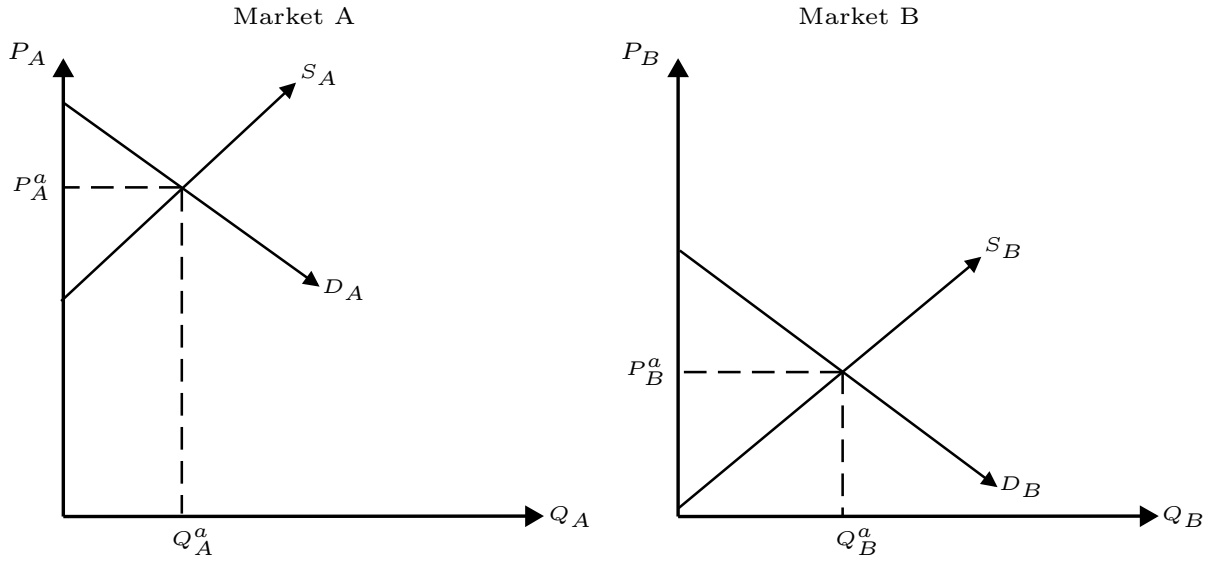
→ The market in which you buy is the *exporter*.

← The market in which you sell is the *importer*.

Why does trade occur?

The opportunity to profit provides incentives for producers in regions with comparative advantage to sell to regions that are willing to pay higher prices. In other words, if a producer can produce at a lower cost and sell in market that will pay a higher price than the domestic market, than trade will occur.

Figure 7.1: Two Markets with Closed Economies

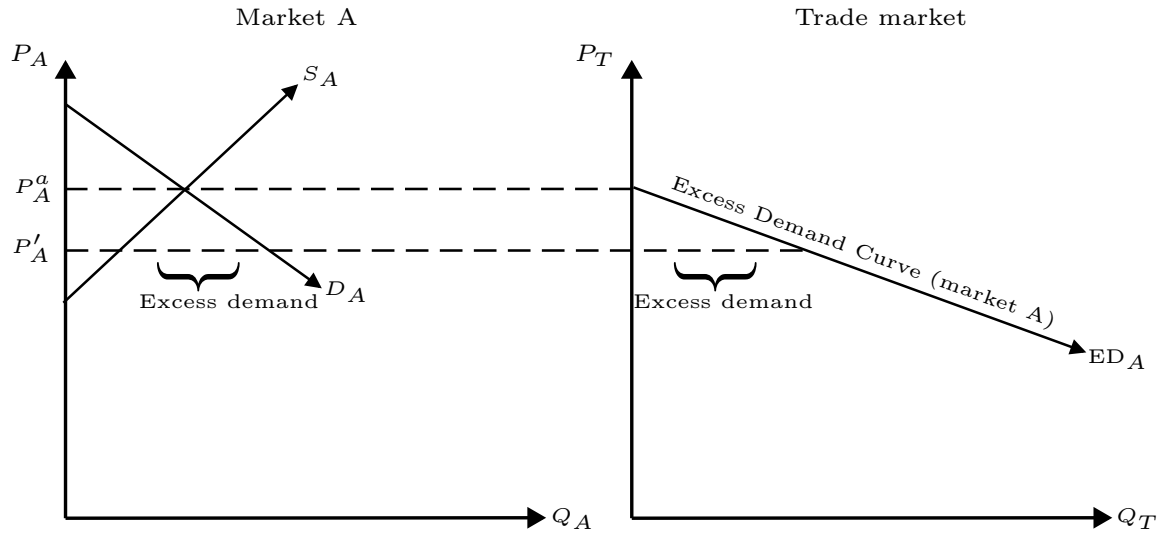


7.1 Deriving the excess demand curve

Properties of Deriving Excess Demand

- At autarky prices, no additional (excess) demand exists.
- When prices are *lower* than autarky prices, then:
  - Domestic producers are willing to produce less (they receive a lower price).
  - Domestic consumers want to consumer more (they can buy more for a lower price).

Figure 7.2: Excess Demand in Market A, if Price is Lowered



The difference between domestic quantity demanded and domestic quantity supplied is *excess demand*.

The *excess demand* curve is derived from the horizontal difference between the consumer's quantity demanded and the producer's quantity supplied. In other words:

$$ED_A = (Q_A^c - Q_A^p)$$

The amount of excess demand is the horizontal distance between the demand and supply curves at a particular price, P'_A. At this price, the quantity that producers in the domestic market (market A) are willing to sell for is Q_A^p; the quantity that consumers wish to purchase is Q_A^c.

7.2 Deriving the excess supply curve

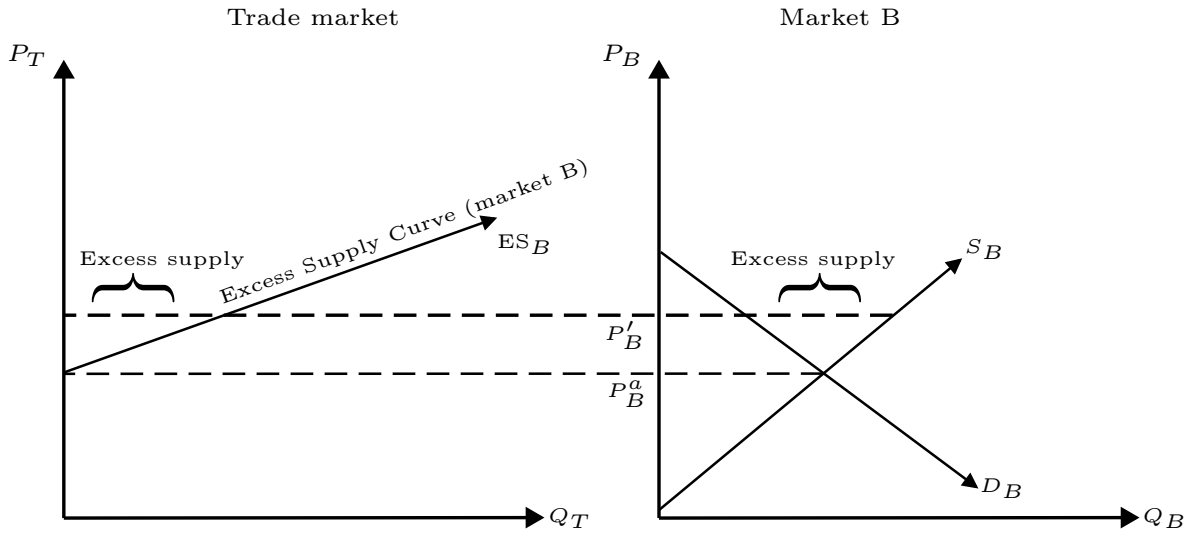
Properties of Deriving Excess Supply

- At autarky prices, no additional (excess) supply exists.

- When prices are *higher* than autarky prices, than:
  - Domestic producers are willing to produce more (they receive a higher price).
  - Domestic consumers want to consumer less (they can buy less for a higher price).

  The difference between domestic quantity supplied and domestic quantity demanded is *excess supply*.

Figure 7.3: Excess Supply in Market B, if Price is Raised



The *excess supply* curve is derived from the horizontal difference between the producer's quantity supplied and the consumer's quantity demanded. In other words:

$$ES_B = (Q^p_B - Q^c_B)$$

The amount of excess demand is the horizontal distance between the demand and supply curves at a particular price, P'_B. At this price, the quantity that producers in the domestic market (market B) are willing to sell for is Q^p_B; the quantity that consumers wish to purchase is Q^c_B.




7.3 Trade

Now that we have both the excess supply and excess demand curves, we need to determine the point at which trade occurs. Once we find this point, we are able to determine the price at which trade occurs and the quantity of agricultural commodities that are traded.

Treating excess supply and excess demand curves as we typically treat supply and demand curves, we find that the equilibrium occurs where the two curves intersect.

(See next page for illustration)

- P^T is the price at which two regions trade (price received by exporters, price paid by importers).

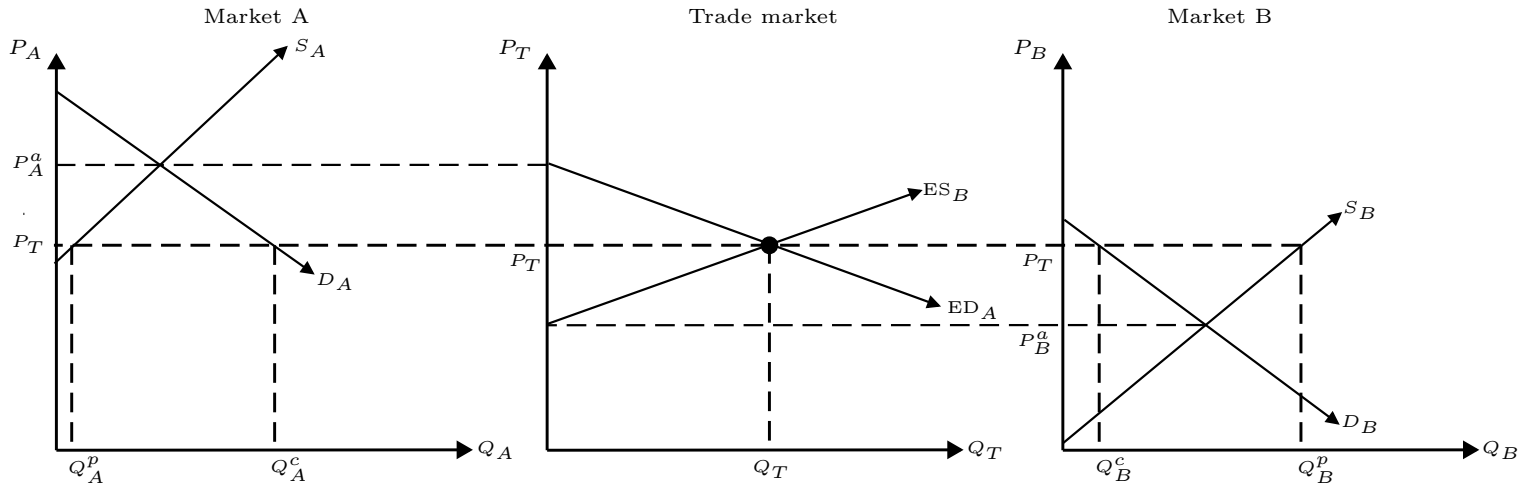
- Q^T is the quantity that is traded (quantity that is exported and quantity that is imported).

As regions trade, there will eventually emerge a single price for a good that is paid / received in all regions.

- If the price is higher in a particular region, then producers will sell there – increasing supply and decreasing price.
- If the price is lower in a particular region, then consumers will purchases there – increasing demand and increasing price.

In global trade, the Law of One Price results in a *world price*.

Figure 7.4: Equilibrium in Market A, Market B, and the Trade Market



7.4 Trade with transportation costs

It is reasonable to assume that trade is not costless. The producer bears costs for transporting a commodity from one market to another. The effect of transportation costs is that they make it less profitable to transfer commodities across space.

Assume that the exporting producer simply adds on the cost of transporting the good onto the price that the importing consumer must pay. In effect, this raises the price that the importing region must pay for the good they receive as an export. The effects of this are as follows (see the next page for an illustration of an inter-regional trade model with transportation costs):

- The price at which commodities are traded is higher.
- The quantity of traded commodities is lower.
- Consumers in importing market receive less of the commodity and pay a higher price.
- Producers in importing market sell more of the commodity and receive a higher price.
- Consumers in exporting market receive more of the commodity but pay a lower price.
- Producers in exporting market sell less of the commodity and receive a lower price.

When is profitable to trade if transportation costs exist?

- Without transportation costs, it makes sense to trade if $|P_A - P_B| > 0$. In other words, when the difference in prices between two regions exceeds zero, then it would be profitable to purchase a good in one region, transfer it and sell it in another, thus making a profit.
- With transportation costs, the profitability condition is now: $|P_A - P_B| > T_{AB}$, where T_{AB} are the transport costs to transfer a commodity from region A to region B. If the difference in prices is large enough so that you can purchase a good in one region, pay the transport costs, and sell it in another region, and *still* make a profit, then trade occurs.

7.4.1 Additional problems – Illustrating changes in inter-regional trade

Illustrate the effects of the following scenarios on the trade market and the individual export and import markets using the three-diagram model:

1. An increase in production technology in the exporting market.
2. A better than usual harvest in the importing market.
3. An increase in fuel costs, affecting the the barge and rail transport costs.

Discuss the changes in equilibrium trade price and quantity, and the changes in the prices and quantities consumed/supplied in the importing and exporting markets.

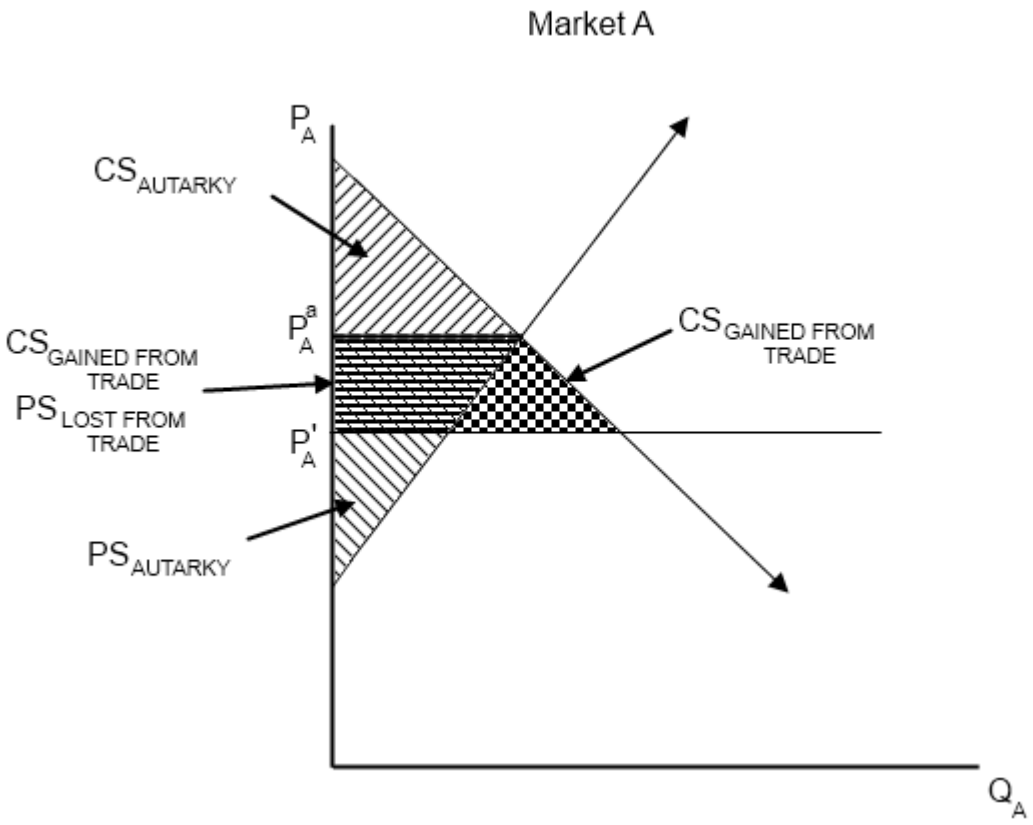
7.5 Welfare analysis of trade

Social Gain: total social gain is the *sum* of the producer and consumer surpluses.

7.5.1 Social Gains in the Import Market

1. Determine the consumer and producer surplus at autarky prices.
2. Once trade is allowed, the price in the import market will fall. This results in two outcomes:
   (a) The domestic producer loses some surplus, because they must sell at a lower world price.
   (b) The domestic consumer gains surplus from:
      - The domestic producer.
      - Trade.
3. The final outcome is that social welfare increases by the amount of consumer surplus gained from trade.

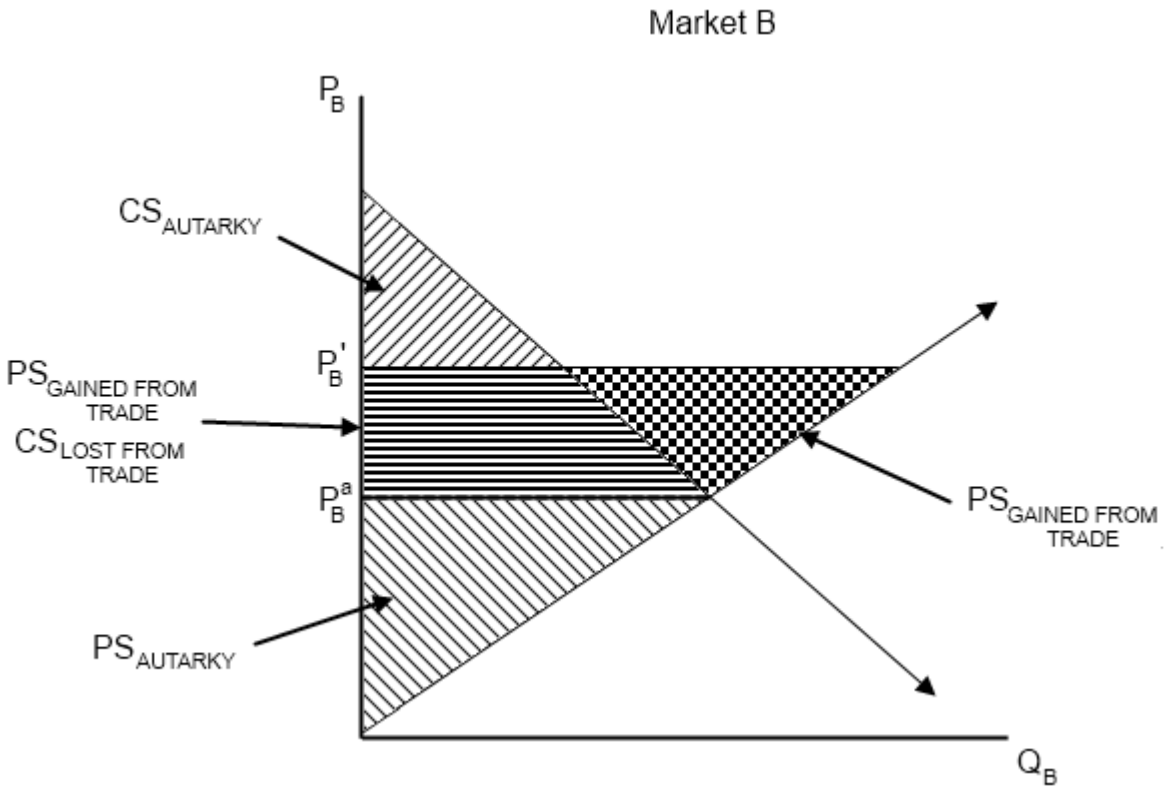
Figure 7.5: Welfare Analysis in Importing Market A



7.5.2 Social Gains in the Export Market

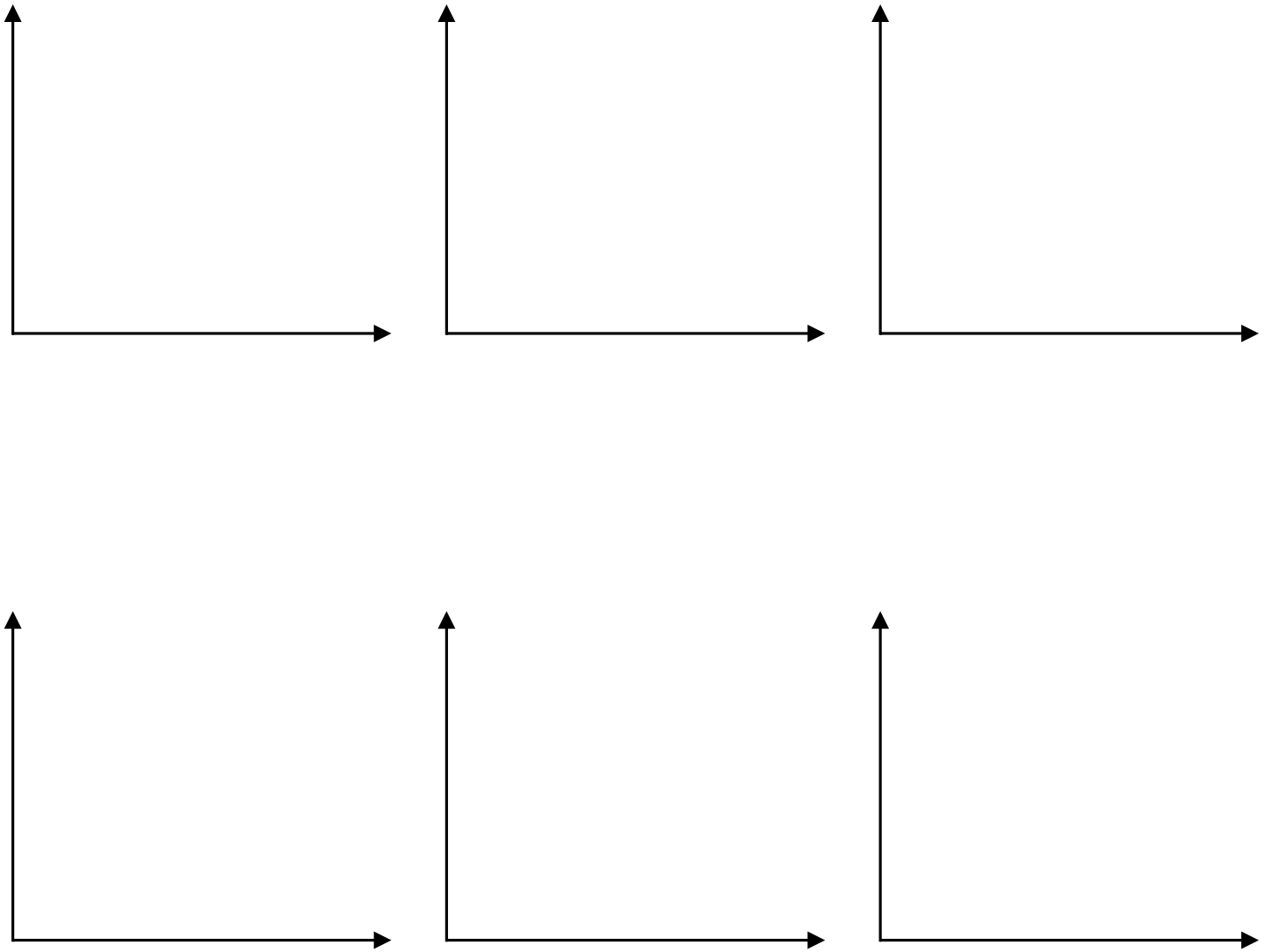
1. Determine the consumer and producer surplus at autarky prices.
2. Once trade is allowed, the price in the export market will rise. This results in two outcomes:
   (a) The domestic consumer loses some surplus, because they must incur a higher world price.
   (b) The producer gains surplus from:
   - The domestic consumer.
   - Trade.
3. The final outcome is that social welfare increases by the amount of producer surplus gained from trade.

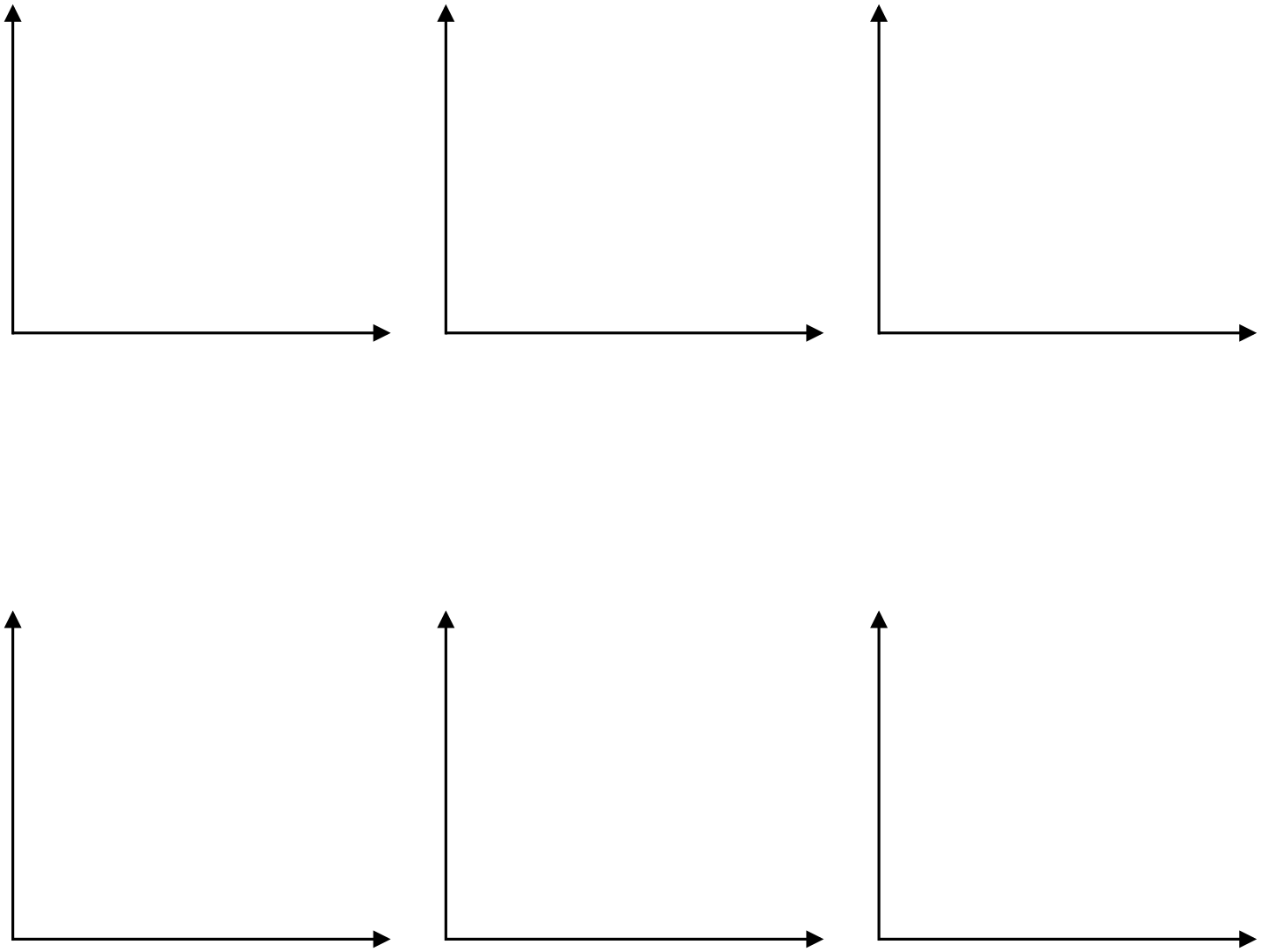
Figure 7.6: Welfare Analysis in Export Market B



Magic!!

Society gains from trade!!





Chapter 8

International Trade

International trade is an enormous part of U.S. agriculture. The U.S. is a major exporter of many commodities that are crucial the U.S. economy and the economies of other nations. For example, the U.S. is one of the largest exporters of corn, soybeans, beef, poultry, and pork. U.S. farmers depend heavily on exporting agricultural commodities to other nations, because they can receive higher prices and supply a larger quantity of the commodity. Thus, their total revenue is substantially increased with trade.

8.1 Politics of Trade

International trade is a delicate issue: there are strong proponents for free trade and against free trade. Producers and consumers are heavily invested in decisions that occur in Washington, D.C. and at the World Trade Organization (WTO). Below are several reasons and policies that deal with international trade:

8.1.1 Who wants free trade?

- Consumers in importing countries.
- Producers in exporting countries.
- Governments.
- Avenue for additional multinational and international corporations to expand. Foreign direct investment.

8.1.2 Who doesn't want free trade?

- Consumers in exporting countries.
- Producers in importing countries.
- Politicians in large agricultural states/provinces.
- Agricultural lobby groups.

8.1.3 Stumbling blocks to Trade

What might be some stumbling blocks that naturally / politically prevent trade?

- Language and cultural differences.
- Transportation difficulties (e.g., getting to a trade partner through unfriendly territory; pirates; etc.)
- Differences in government regulations – on both sides.
- Exchange rates.

8.1.4 Regional Trade Agreements

Currently, there are a number of regional trade agreements that exist. Along with those, there are trade agreements for commodities on a country-by-country basis. Here are some examples:

- NAFTA (North American Free Trade Agreement – U.S., Canada, Mexico)
- U.S. - Australia FTA
- CAFTA (Central America Free Trade Agreement – U.S., Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua)
- U.S. - Israel FTA

Other U.S. trade agreements
(http://www.fas.usda.gov/itp/agreements.asp)

8.2 Trade Restrictions

Politics plays a large role in determine the level of openness (freedom) in trade. There are two common restrictions that many governments can use to restrict free trade:

- Quotas: legal restriction on the *quantity* that can be imported.

- Tariff: a *tax* on an imported good. No quantity restrictions.

8.2.1 Quotas

Consequences of Quotas

- Raise prices in importing locations (who benefits? who loses?).
- Lower prices in exporting locations (who benefits? who loses?).
- Leads to a loss in total social welfare.

Examples of Quotas in U.S.

- Peanut Quota
- Milk / Dairy products
- Sugar
- Cotton

Who likes quotas?

- Domestic producers – receive higher price.
- Owners of quotas / those who are allowed to import – receive higher price than if quota did not exist.

- Foreign consumers – pay a lower price.
- Political groups who have a large incentive to maintain restricted trade.

Who dislikes quotas?

- Domestic consumers – pay higher price.
- Potential exporters who are unable to export because they do not own a quota.
- Social welfare is reduced.

8.2.2 Tariffs

Consequences of Tariffs

- Raise prices in importing locations (who benefits? who loses?).
- Lower prices in exporting locations (who benefits? who loses?).
- Leads to a loss in total social welfare.

Examples of Tariffs

- Argentinian honey – 50% - 60% tax.
- Tea (from selected locations) – 6.4%.
- Broccoli/cauliflower – 2.5% - 10%.
- Goats – \$0.68/head.
- Beef meat – 4%.
- Durum wheat – \$0.65/kg.

Chapter 9

Exchange Rates in International Trade

We have seen that international trade can increase social welfare. When discussing international trade, we assume that there is a simple transaction: the producer provides a commodity and the consumer pays some amount of money for the commodity. Implicitly, we also assume that there is only one currency exchanged between the consumer and the producer. Unfortunately, this simplification does not describe the real world.

To provide a more realistic description of trade, consider the following steps of a transaction:

1. Using local currency (money that is used in domestic market), *purchase* foreign currency at the going exchange rate.
2. Use the foreign currency to purchase goods in foreign market.
3. Import the goods to the domestic market, and sell them in exchange for local currency.

What is obvious from these steps is that consumers cannot simply use their domestic currency to purchase the commodity because (most of the time) the exporter cannot directly use another nation's currency. In addition, the burden of exchanging currency is placed on the consumer. This indicates that understanding exchanges rates and how they affect trade is a crucial aspect of international agricultural trade.

9.1 Exchange Rate Basics

Exchange rate: the ratio of the present values of two currencies.

$$XR = \frac{Currency_A}{Currency_B}$$

Another way to think about is to ask the following question:

If I have x amount of currency A, how much can I buy/receive of currency B?

9.1.1 Calculating Exchange Rates

To calculate an exchange rate, you take the ratio of prices of two perfect substitutes in different countries:

Using Prices of Wheat

$$XR = \frac{P_w^A}{P_w^B}$$

9.1.2 Using Exchange Rates

To determine the foreign price of a good with respect to local currency:

Price of Wheat in Country A

$$P_w^A = P_w^B \times XR$$

9.1.3 Examples – calculating and using exchange rates

Using the following information, calculate the exchange rates between the two countries:

1. $P^{US}_{cell\ phone} = \$100$; $P^{China}_{cell\ phone} = 150\ yuan$ – calculate the XR.
2. $P^{US}_{chicken} = \$10/broiler$ – calculate $P^{China}_{chicken}$ using XR in (1).

1. Using the formula for the ratio of prices, we can calculate the exchange rates for both exchange directions:

$$XR_{US,China} = \frac{\$100}{150yu} = \frac{2}{3}\ \ \$/yu$$

Interpretation: for every Chinese yuan, you would receive \$0.67.

$$XR_{China,US} = \frac{150}{\$100} = 1.5\ \ yu/\$$$

Interpretation: for every U.S. dollar, you would receive 1.5 yuan.

2. Using the exchange rate in (1), we can calculate the price that we would need to receive in China in order to have the equivalent revenue as if we were to sell the chicken in the U.S. for \$10/broiler.

$$P^{Yuan}_{broiler} = (XR_{China,US}) \cdot (P^{US}_{broiler})$$

$$P^{Yuan}_{broiler} = \left\{1.5\ \frac{yuan}{\$} \cdot 10\ \$\right\}$$

$$P^{Yuan}_{broiler} = (1.5 \cdot 10) \cdot \left\{\frac{yuan}{\$} \cdot \$\right\}$$

$$P^{Yuan}_{broiler} = 15\ yuan$$

9.1.4 Additional problems – calculating and using exchange rates

Using the following information, calculate the exchange rates between the two countries:

1. $P^{US}_{Wii} = \$200$; $P^{G.B.}_{Wii} = 125\ pounds$ – calculate the XR.
2. $P^{US}_{cocoa} = \$325/ton$ – calculate $P^{G.B.}_{cocoa}$ using XR in (1).
3. $P^{US}_{beef} = \$5/lb$; $P^{czech}_{beef} = 45krona$ – calculate the XR.
4. $P^{US}_{stapler} = \$3$ – calculate $P^{czech}_{stapler}$ using XR in (3).
5. $P^{US}_{bike} = \$100$; $P^{Mexico}_{bike} = 325peso$ – calculate the XR.
6. $P^{US}_{hog} = \$50/cwt$ – calculate P^{Mexico}_{hog} using XR in (5).

9.2 Trade with Exchange Rates

Suppose that a Chinese importer wishes to purchase and import U.S. wheat. We know the following:

$$P^{US}_{wheat} = \$5.50/bu$$

$$XR_{China,US} = 6.50\ \frac{yuan}{\$}$$

What are the steps that the importer must take to bring 1,000 bushels of wheat into China?

1. Determine how much they must pay for wheat in U.S. dollars: $1,000/bu \times \$5.50/bu = \$5,500$
2. Exchange local yuan for U.S. dollars: $\$5,500 \times 6.50\ \frac{yu}{\$} = 35,750\ yu$
3. Purchase the wheat in the U.S. and deliver it to China.

9.2.1 Arbitrage Condition 1

Suppose some wheat is grown in China, and that the actual local Chinese price for wheat is 30 yuan/bu. Is there opportunity to profit?

1. Using exchange rates, determine whether the difference in price per bushel is only due to the exchange rate:
   - Price per U.S. wheat bushel in yuan: $\$5.50/bu \times 6.50 \frac{yu}{\$} = 35.75\ yu/bu$
   - Price per Chinese wheat bushel in yuan: $30\ yu/bu$
2. Exchange U.S. dollars to purchase a bushel of wheat in China: $30yu \times \frac{1}{6.50\frac{yu}{\$}} = \$4.61$
3. Sell the wheat in the U.S. for \$5.50/bu.

Profit: (\$5.50/bu - \$4.61/bu) = \$0.89/bu

Do you think these conditions are sustainable in the long run? Consider what will happen:

1. U.S. importers will flood the Chinese market attempting to purchase wheat.
2. The increase demand for Chinese wheat will cause the price of wheat in China to rise.
3. The price will rise until it reaches 35.75 yu/bu, which is exactly the price of wheat in the U.S. (after accounting for the exchange rate conversion).

Arbitrage Condition 1

No arbitrage occurs when: $P^A_{good} = P^B_{good} \times XR$

If this condition does not hold, then profit maximizing individuals will continue to exploit the non-equilibrium exchange rates until convergence of the XR occurs such that Arbitrage Condition 1 holds.

9.2.2 Arbitrage Condition 2

The second arbitrage is derived from the knowledge that there is more to trade than a unidirectional flow of goods. Typically, countries produce commodities for which they have a comparative advantage, and exchange for goods for which other countries have a comparative advantage.

- U.S. is the world's leader in soybean production.
- China produces electronics, such as cell phones, with small costs.
- Opportunity for trade: U.S. exports soybeans to China and imports cell phones from China.

The first arbitrage condition states that: $P^A_{good} = P^B_{good} \times XR$

We can apply this to a two good scenario to determine the second arbitrage condition:

$$P^{US}_{soybeans} = P^{China}_{soybeans} \times XR_{US,China}$$

$$P^{US}_{phones} = P^{China}_{phones} \times XR_{US,China}$$

Solving for $XR_{US,China}$ in each of the equations and setting them equal to other yields:

$$\frac{P^{US}_{soybeans}}{P^{China}_{soybeans}} = \frac{P^{US}_{phones}}{P^{China}_{phones}}$$

We can divide both sides by P^{US}_{phones} and multiply both sides by $P^{China}_{soybeans}$ to retrieve the second arbitrage condition.

Arbitrage Condition 2

$$\frac{P^{US}_{soybeans}}{P^{US}_{phones}} = \frac{P^{China}_{soybeans}}{P^{China}_{phones}}$$

No arbitrage occurs when the ratio of exchange of any two goods is the same in *both* participating countries. This is known as *purchasing power parity.*

9.2.3 Example – purchasing power parity

Suppose:

$$P^{US}_{soybeans} = \$9.00/bu \qquad P^{US}_{phones} = \$100/phone$$

$$P^{China}_{soybeans} = 60.00\ yu/bu \qquad P^{China}_{phones} = 600\ yu/phone$$

1. Will arbitrage occur?
2. If the relationship between U.S. and Chinese soybean prices represents the correct exchange rate, what is the arbitrage opportunity in the cell phone market?

1. Using Arbitrage Condition 2, we know that arbitrage will not occur if:

$$\frac{P^{US}_{soybeans}}{P^{US}_{phones}} = \frac{P^{China}_{soybeans}}{P^{China}_{phones}}$$

   Thus, we have to check if:

$$\frac{\$9.00/bu\ soybeans}{\$100/phone} \ ?=? \ \frac{60\ yu/bu\ soybeans}{600\ yu/phone}$$

$$0.09 \neq 0.1$$

   This indicates that Arbitrage Condition 2 does not hold, suggesting that arbitrage will occur.

2. To determine the profit opportunity from selling cell phones, we first need to calculate the true exchange rate:

$$XR_{US,China} = \frac{P^{US}_{soybeans}}{P^{China}_{soybeans}} = \frac{\$9.00}{60\ yu} = \mathbf{0.15\ \$/yu}$$

   Now, let's determine how much U.S. dollars are necessary to purchase a Chinese cell phone:

$$P^{US}_{phone} = (600\ yuan/phone) \cdot (0.15\ \$/yuan)$$

$$P^{US}_{phone} = (600 \cdot 0.15) \cdot \left(\frac{yuan}{phone} \cdot \frac{\$}{yuan}\right)$$

$$P^{US}_{phone} = 90\ \$/phone$$

So, cell phones can be purchased in China for \$90/phone. This means that if cell phones are sold in the U.S. for \$100, there is a \$10/phone profit opportunity.

9.2.4 Additional problems – purchasing power parity

1. Suppose:

$$P^{US}_{soybeans} = \$9.00/bu \qquad P^{US}_{phones} = \$100/phone$$

$$P^{China}_{soybeans} = 60.00\ yu/bu \qquad P^{China}_{phones} = 600\ yu/phone$$

   (a) Will arbitrage occur?

   (b) If the relationship between U.S. and Chinese soybean prices represents the correct exchange rate, what is the arbitrage opportunity in the cell phone market? In other words, where should you buy cell phones, where should you resell cell phones, and how much profit can you earn per cell phone?

2. Suppose: a wheat storage operator in Montana has the ability to buy wheat in either the U.S. or Canada. The current exchange rate between U.S. and Canada is 0.95 $\frac{USD}{CAD}$.

   - In the U.S., the storage operator can purchase wheat at \$6.00/bu.
   - In Canada, the storage operator can purchase wheat at 6.75 CAD/bu.

   (a) Is there opportunity for arbitrage for buying wheat in Canada and reselling in the U.S., or vice versa?

   (b) If there is this opportunity, how much per bushel gain is there from arbitrage?

   (c) What will happen in the long-run?

9.3 Modeling Trade with Exchange Rates

Changes in the exchange rate can have substantial impacts on the equilibrium values of trade. Understanding how to appropriately model international trade that accommodates exchange rates can help us better grasp changes that occur in agricultural markets if exchange rates fluctuate.

9.3.1 Definitions

Currency appreciates (exchange rate *increases*): the event during which it becomes more expensive to purchase the particular currency.

Example: If the yuan appreciates relative to the dollar, then it will require more dollars to purchase one yuan ($\uparrow XR_{\$,yu}$ and $\downarrow XR_{yu,\$}$).

Currency depreciates (exchange rate *decreases*): the event during which it becomes cheaper to purchase the particular currency.

Example: If the yuan depreciates relative to the dollar, then it will require less dollars to purchase one yuan ($\downarrow XR_{\$,yu}$ and $\uparrow XR_{yu,\$}$).

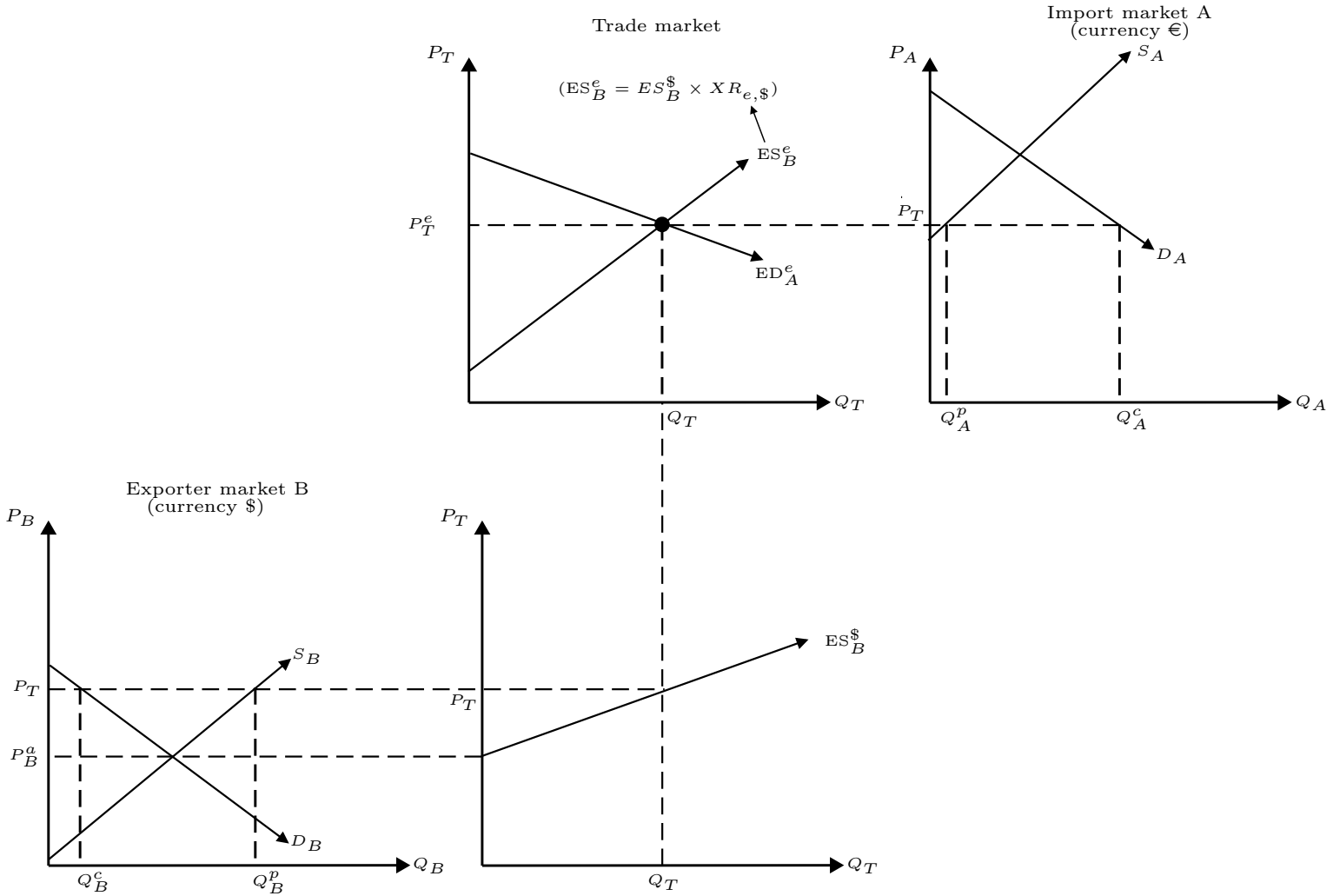
9.3.2 Graphing Trade with XR

To properly model trade with exchange rates using supply and demand diagrams, it is necessary to use a four-panel approach. That is, we need to explicitly account for the excess supply (or excess demand) curves being altered because of the exchange rate.

In figure 9.1, you can see that the slope of the excess supply is made more steep by the exchange rate. After converting the ES curve into the currency of the importer, we can appropriately plot the trade market and determine the equilibrium price and quantity of traded commodities.

Then, we can project the quantity traded onto the un-adjusted excess supply curve, and determine the price received by exporters using domestic currency.

Figure 9.1: Model of Trade Between Markets with Different Currencies



9.3.3 Scenario Analysis using Trade with XR Models

1. Model a change in exchange rates on B's exports? What if the dollar ($) appreciates?

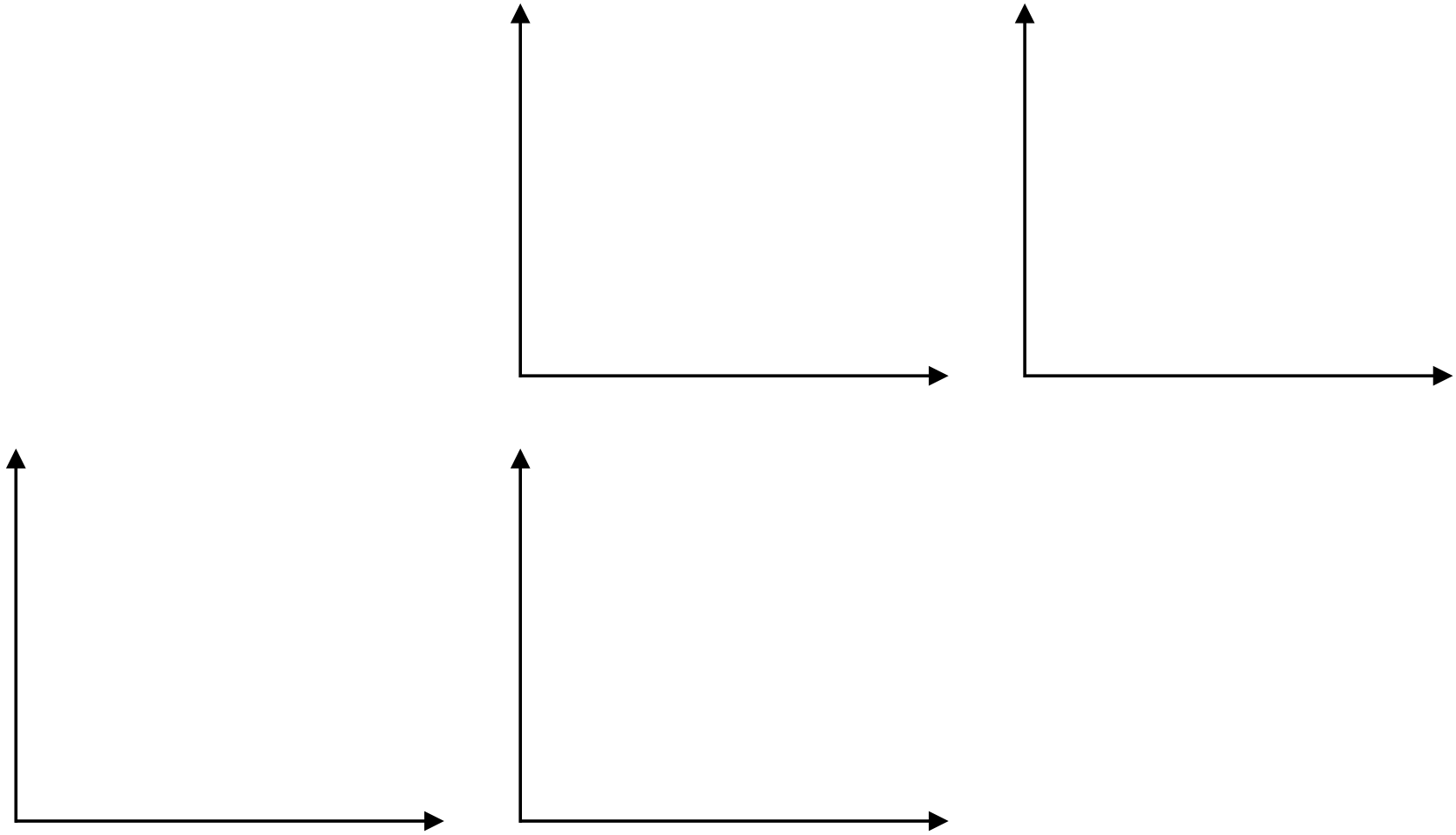
   Thinking logically:

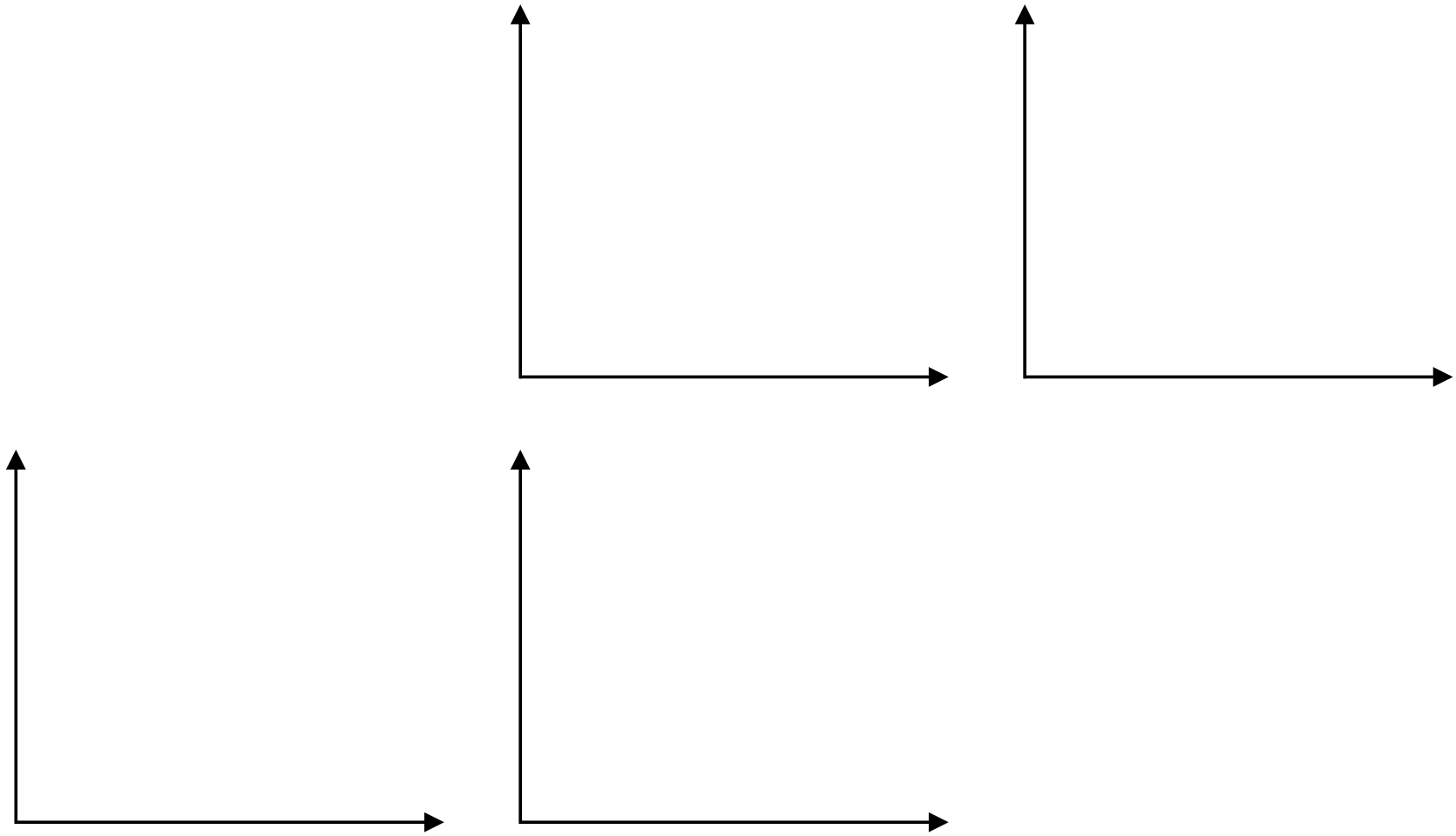
   - An appreciation of the dollar implies that A faces *higher* prices. (Why?)=
   - The slope of the U.S. excess supply curve (converted into yuan) is now *steeper* – a higher $XR_{yu,\$}$ (lower $XR_{\$,yu}$) implies that the slope increases.=
   - The rotation of B's excess supply curve implies a drop in the quantity of A's excess demand, a lower quantity traded, higher prices paid by consumers in A, and lower prices received by exporters in B.

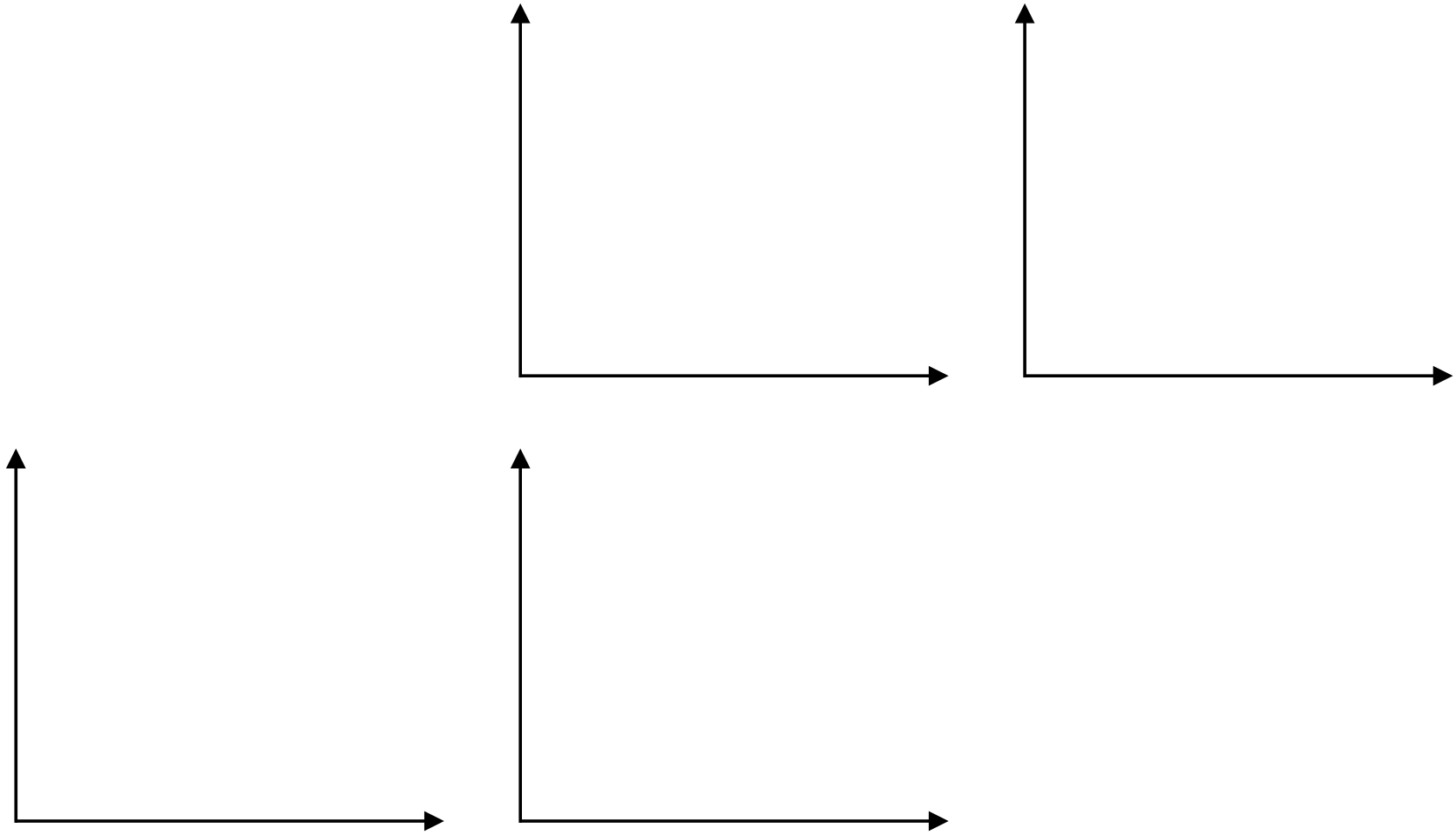
2. Model an improvement in productivity in the importing nation.

   Thinking logically:

   - An improvement in productivity implies an outward shift of the supply curve in A. This reduces prices and shifts the ED curve downward.
   - The downward shift of the ED curve results in lower quantity and price at which commodities are traded.
   - A lower quantity results in producers in the exporting nation B to receive lower prices for their exports.
   - Because prices for exports are now lower, consumers in B can now consume more of the commodity at lower prices.







Chapter 10

Introduction to Agricultural Futures Markets

Futures markets for commodities have been an important method for agricultural producers to hedge revenue risk, which can be very high. Not only do agricultural producers face the fluctuations of demands for their goods, but they also face significant risks of events that can substantially affect their output. Both of these can affect commodity prices. By allowing producers to "lock in" a price far in advance of actually selling a commodity, futures markets can be used to remove the risk of fluctuating and unknown sale prices.

10.1 Brief history of agricultural futures markets

A futures market is a designated location used to assist agribusiness and farmers discover prospective prices for a commodity.

- Agricultural markets appeared in mid 1800's
  - CBOT (1848)
  - Chicago Mercantile Exchange (1874) (formally known as Chicago Egg and Butter Board)
  - First corn futures contract written in 1851.

- Why did markets come about?
  - Transportation distances increased – higher price volatility followed.
  - No central information source.
  - No standardized trading rules and measures.

Futures markets are used to create and trade futures contracts between a buyer and seller of a commodity. Futures contract are a statement signifying a promise between a seller and a buyer (two sides are required to trade). A contract specifies the following:

- An obligation of the seller to deliver a commodity to a specified point-of-delivery at a future time.
- An obligation of the buyer to pay a fixed price and pick up the commodity at the pre-specified point-of-delivery.
- An expiration date (time of delivery).
- Other standardized measures and dates.

For any traded commodity, all contracts are perfect substitutes for each other (except for price).

10.1.1 Commodity futures markets – contract price information

- Chicago Board of Trade
  http://www.cmegroup.com/trading/commodities/
- Minneapolis Grain Exchange (dark northern spring wheat)
  http://www.mgex.com/
- Kansas City Board of Trade (hard red winter wheat)
  http://www.kcbt.com/
- Wall Street Journal - Market Data
  http://online.wsj.com/mdc/public/page/marketsdata.html

These can be found on the class website under the "Futures Markets" heading.

10.2 Introduction to Futures Contracts

Futures contract provide a very structured and standardized method for buyers and sellers to determine the terms of an exchange. Each futures contract is exactly the same *except* for the price of exchange established by the buyer and seller. The following describe the standardizations that exist in each futures contract:

- Measures
  - 5,000 bushels wheat, corn, soybeans, etc.
  - 40,000 lbs. live cattle.
  - 50,000 lbs. feeder cattle.
- Quality
  - #2 SRW (CBOT); #2 HRW (KCBT); #2 HRS (Minn Exch)
  - 55% Choice, 45% Select, Yield Grade 3 live steers
  - 650-849 pound steers, medium-large #1
- Delivery location
- Contract end date
  - 15th day in the contract month.
  - Last day of the contract month (live cattle)
  - Last Thursday of the contract month (feeder cattle)
- Pricing units
  - Cents per bushel (tick: 0.25 cents)
  - Cents per pound (tick: 0.00025 cents per pound)

10.2.1 Purchasing a Futures Contract

Every contract requires two parties – buyer and seller.

- Seller: a party that promises to deliver the designated quantity of a commodity. In exchange, they will receive a fixed price.

  - Selling a contract is known as taking a *short position*. If delivery date comes and the seller can't deliver, they are *short* of the commodity.

- Buyer: a party that promises to take delivery of a specified quantity of commodity. In exchange, they will pay a fixed price.

  - Buying a contract is known as taking a *long position*.
    If delivery date comes and the buyer has a commodity they may not want (or too much of it), they are *long* in the commodity.

10.2.2 Offsetting Contracts

Typically, only relatively few contracts have sellers and buyers who can actually deliver or take on a commodity. Instead of delivering or taking on a commodity, a party can offset a short or long position by purchasing an opposite contract.

- Short position → offset by buying a contract (long position).
- Long position → offset by selling a contract (short position).

By offsetting a futures contract with another opposite-position futures contract, an individual is released of the responsibility to either buy or sell the physical commodity. The only obligation that the individual is required to meet is any difference the price of the two contracts. For example, if one contract was bought at \$5.00/bu and another was sold at \$4.50/bu, the individual would be responsible to pay \$0.50/bu (more on this later).

10.3 Mechanics of a Futures Market

The day-to-day operations of a futures market are described below:

1. Times vary, but usually markets are open between 9 a.m. and 2 p.m.
   - Open outcry.
   - Electronic exchange.

2. Buying and selling occurs simultaneously.

   But: Each contract must have exactly one buyer and one seller.

3. Two types of participants:

   - Exchange members.
   - Nonmembers.
     Nonmembers can participate in the market either through members or through a broker.

4. Clearinghouse overlooks positions and obligations.

   - Notifies buyers and sellers of obligations.
   - Matches open positions (buyers with sellers).

Futures contracts are a *promise* to pay a fixed price at some future time. But, buying/selling a contract is not free. Any time a transaction takes place, a *margin requirement* is necessary. A margin requirement is an amount of money required as a payment in order to purchase or sell a contract.

- Typically, 5% - 20% of a contract's value.
- Margin payments differ for speculators and those that actually have the commodity.
- Along with assurance, provides coverage for potential losses if price fluctuations occur.
- At daily market closing, all participants are marked-to-market (more on this later).

10.4 Example of Futures Market Participation

Consider the following scenario:

- Current date (t_0): November 1
- July SRW wheat futures contract: \$5.50/bu
- You believe that the *actual* price in July will be \$4.00/bu.

10.4.1 Deciding what position to take

Knowing the information that you know, which position should you take?

Short – sell a contract
Long – buy a contract

Properties of Market Positions:

- A *short position* benefits when the price *drops*:

  Suppose you take a short position by selling a contract at $5.00/bu. This implies that at the delivery date, you have agreed to sell 5,000 bushels of a commodity at $5.00/bu. If in July the price of the commodity drops to $4.00/bu, you can buy that commodity at $4.00/bu and sell it at $5.00/bu because that is the price at which you established the original futures contract. Thus, a drop in price benefits you if you have a short position.

  Conversely, if you took a short position and the price rises, then you are worse off. Because you now have to buy a commodity at a higher price than you will receive by selling at the established contract price, you lose money.

- A *long position* benefits when the price *rises*:

  Suppose you take a long position by buying a contract at $5.00/bu. This implies that at the delivery date, you have agreed to buy 5,000 bushels of a commodity at $5.00/bu. If in July the price of the commodity rises to $6.00/bu, you can buy the commodity at $5.00/bu using your futures contract, and then sell at $6.00/bu. Thus, a rise in price benefits you if you have a long position.

  Conversely, if you took a long position and the price drops, then you are worse off. Because you now have to sell a commodity at a lower price than at which you have agreed to purchase the commodity, you lose money.

So, the best strategy is to take a short position because you believe that seven months (July) the price per bushel will be *lower* than it is today. Thus, you are counting on the fact that you will be able to buy the commodity at $4.00/bu in July, and then sell at $5.50/bu using your futures contract.

10.4.2 Entering the market

Now that you have decided which contract will be most beneficial, you need to enter the futures market. Suppose you want to sell ten (10) July contracts (i.e., agree to deliver 50,000 bushels in July). To do so, you would take the following steps:

1. Call a broker or exchange member and inform them of your intentions.
2. Pay a commission fee – typically 1 cent per bushel ($\$0.01 \cdot 50,000 = \$500$)
3. Put up a margin deposit – 10%
   Margin deposit: $10\% \times 10 \times 5,000 \times \$5.50 = \$27,500$

So the total funds needed to sell 10 contracts in November: **$28,000**.

10.4.3 Actions at Delivery Time

After seven months, you are near the delivery time in July. At this point, you have two options:

1. Deliver on the contract
   Find someone who is selling wheat, purchase the wheat and deliver the wheat to the delivery location.
2. Take a long position on an off-setting contract by buying a July contract at the going price.

Suppose that you don't actually have the wheat, so you are required to choose option 2. In July, you discover that a better than usual harvest leads to excess supply of wheat and a drop in the price of wheat. This is reflected in the price of the July futures contracts being offered in July at $4.00/bu. This outcome is exactly what you had anticipated!

You purchase (take an off-setting long position) July contract at $4.00/bu and realize the following profit:

$$(\$5.50 - \$4.00) \times 10 \times 5,000 = \mathbf{\$75,000}$$

10.4.4 Additional problems – market participation

Consider the following scenarios:

1. You believe that the price of corn will rise in September to \$4.50/bu. It is currently July and the price of futures contracts is \$4.25.
2. The USDA comes out with a report that the soybean harvest in September will be well below expectations. Using an EDM calculation, you find that prices will change by 25%. One soybean contract is 5,000 bushels and the current price is \$8.00/bu.
3. From a friend working in the U.S. Senate, you found out that there is a policy in the works that will place a tax on feedlot operators. This policy will go into effect in December. You know that this policy will change the price of fed cattle by 10\$. A fed cattle contract is 40,000 pounds, and the price in June is \$1.00/lb.

For each scenario, do the following:

- Decide which position you should take given that you know the information.
- Decide how much you will profit per unit (bushel or pound).
- Decide how many contracts you should buy/sell in order to profit by at least \$20,000.

10.5 Market Risks - price variability

In the example above, you predicted exactly what would happen to the price of corn in July. Unfortunately, doing so on a regular basis (or even once) can be extremely difficult because prices are established by thousands of people acting to maximize their own welfare. Thus, prices are subject to many unexpected fluctuations.

Suppose that instead of prices dropping to \$4.00/bu, prices actually rose to \$6.50/bu. As mentioned, you will lose money if you take a short position and prices rise. In the example above, your loss would be:

$$(\$5.50 - \$6.50) \times 10 \times 5,000 = \mathbf{-\$50,000}$$

So, small, unpredictable price movements can a substantial difference in whether you lose/win and how much you lose/win.

10.6 Market Risks – Placed out of the Market

When entering the futures market, you are required to pay a margin requirement – usually 5% – 20% of the futures contract value. The margin account provides assurance that there exists a line of credit that can be used to finance changes in the value of the futures contract. The margin account is recalculated at the end of each trading day to accurately reflect price changes.

What if price changes?

Each day, there is a very high probability that the closing price for a particular futures contract will be different than the opening price. How do the losses and profits get paid?

Marking-to-market: process of determining the financial positions of all market participants after the market closes. All remaining futures contracts are recalculated to reflect the closing price.

10.6.1 Example – Marking-to-Market

Let's consider an example of typical futures market day-to-day operations:

Day 1

You sell (take a short position) a July futures contract for 100,000 bushels of wheat at \$3.50/bu. You pay 10% into the margin account: \$35,000.

Day 2

July wheat futures prices fall to \$3.40/bu. Since you are short, a decrease in price implies that you profit by \$0.10/bu. In other words, your futures contract is now worth
(\$0.10/bu $\times$ 100,000) = \$10,000 more.

So, \$10,000 is deposited into your margin account at the end of Day 2. However, this implies that your contract has been *marked to market* – it is now a contract that would require you to sell at \$3.40/bu, not \$3.50/bu.

Day 3

July wheat futures prices rise to \$3.45/bu. Since you are short, an increase in prices implies that you lose
by \$0.05/bu. In other words, your futures contract is now worth
(\$0.05/bu $\times$ 100,000) = \$5,000 less.

So, \$5,000 is taken out of your margin account at the end of Day 3. However, this implies that your contract has been *marked to market* – it is now a contract that would require you to sell at \$3.45/bu, not \$3.40/bu.

10.6.2 Price Paths Matter

Suppose that in December you sell a July wheat contract at \$3.50/bu. Through extrasensory abilities, you know that the actual wheat price in July will be \$3.00/bu. This implies that you should profit by \$0.50/bu!

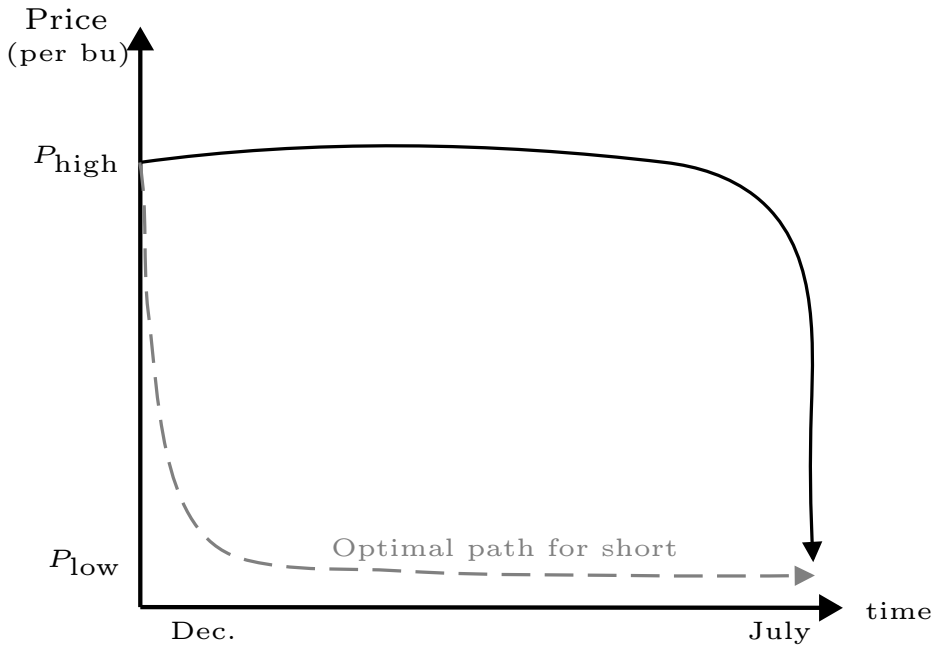
But: A lot will depend on what path the prices will take between December and July.

Two scenarios

- Prices will drop to \$3.00/bu immediately → money is placed in your margin account → price stays at \$3.00/bu until the contract expiration in July. (This is the desired path for a short position)

- Prices remain at \$3.50/bu until early July → prices drop to \$3.00/bu near the expiration date → money is placed into your margin account.

Figure 10.1: Possible Futures Price Paths Over Time

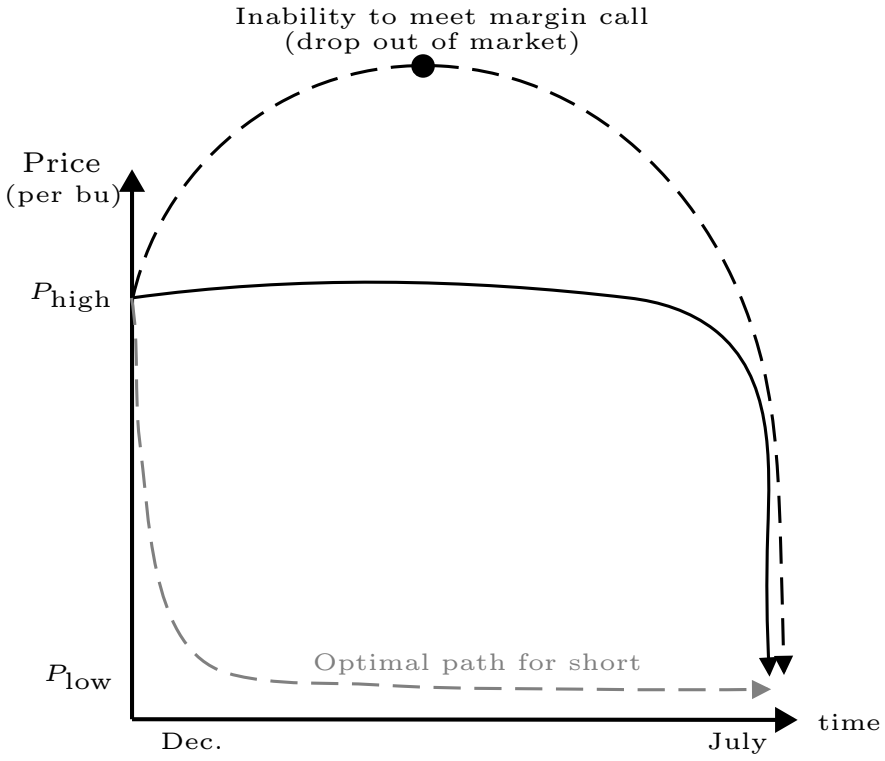


What if the following happens?

Short position in Dec. on a 100,000 bushel July wheat contract.

	Open Price	**Close Price**	**Margin account**
Week 1	\$3.50	\$3.55	- \$5,000
Week 2	\$3.55	\$3.65	- \$10,000
Week 3	\$3.65	\$4.05	- \$40,000
Week 4	\$4.05	\$4.20	- \$15,000
Week 5	\$4.20	\$4.50	- \$30,000
.			
.			
.			
Week 26	\$3.45	\$3.20	\$25,000
Week 27	\$3.20	\$3.05	\$15,000
Week 28	\$3.05	\$3.00	\$5,000

Figure 10.2: Futures Price Path That Can Force Short Position Out of Market



Liquidity for farmers is extremely important – if farmers are unable to pay into the margin, then they are forced out of the market and are unable to use futures to hedge risk.

Chapter 11

Hedging Risk using Futures Markets

Markets can be very risky. So why use them?

For many agricultural producers, futures markets can be important *tools* for reducing risk. It is important, however, to understand *how* futures markets can reduce risk! this process is known as hedging: taking opposite positions in commodity markets (typically, local cash and futures markets) in order to guarantee a certain profit.

11.1 Local vs. Futures Markets

In the basic example of participating in futures markets, we assumed that the participant was a *speculator*. Typically, speculators do not have the actual commodity and participate in futures markets for one reason: profit.

When we discuss the use of futures markets as a hedging tool, we are typically talking about agricultural producers who are either involved in producing the commodity (e.g., growing wheat; raising cattle) or purchasing the commodity (e.g., grain elevators; feedlot operators). For these producers, there are two markets in which participation can occur:

- Local market (e.g., Billings, Great Falls)
- Futures market (e.g., MGEX, KSBT, CBOT)

There is an important distinction between these markets:

• Local market – used primarily to sell or buy the physical commodity. Most farmers deliver their commodities to the local market and *sell at the price offered in that local market*. For agricultural producers, it is the fluctuation of prices in the local market that are source of risk.

• Futures market – used to hedge the risk that can exist due to the fluctuation of prices in local markets. Typically used to offset the position that the agricultural producer has in the local market.

The price that you observe in a local market is the price at which an agricultural producer can sell a commodity. The price observed in a futures market is the price at which the "market" expects the commodity to be sold at the time that the futures contract expires. Typically, the local price and the futures contract price are *not the same*.

One exception to this is at the expiration date of a futures contract. We will assume that *at delivery time* (i.e., the date that a futures contract expires), the price of a commodity in the local market and the futures market is exactly the same.

11.1.1 Positions in the local market

When you want to figure out what position you are in your local market, ask yourself this question:

If the price in the local market drops, do I benefit or do I lose?

- If you *own* (or are producing) the commodity, then a drop in price is *not* beneficial, because you will not be able to sell it for as much as you could before the price drop.

  So, if you don't benefit when the local market price drops, then you are naturally long. Conversely, you benefit if price rises.

- If you *consume* the commodity, then a drop in price *is* beneficial, because you will be able to purchase it for a lesser price and reduce your costs.

  So, if you do benefit when the local market price drops, then you are naturally short. Conversely, you lose if price rises.

11.2 Hedging Local Market Price Risk

Suppose that in November, an operator of a grain storage facility buys 100,000 bushels of wheat from a farmer at $4.00/bu. You now own the wheat and will sell it to processors at the local market price in July. You worry that by the time July comes around, the price of wheat might drop below $4.00/bu, meaning that you will lose money. How do you hedge this price risk?

Well, if there is a July wheat futures contract that has a price above $4.00/bu, you can lock in a profit!

Because you own the commodity and wish to sell it at the highest price possible, you *do not* benefit if the price drops. So, you are naturally long. To hedge the risk of a price drop, you will need to take an off-setting short position (short hedge) in the futures market.

Remember that if you are a short position in the futures market, every drop in the price of the commodity is a gain for you. So, if the price drops in the local market, it will also drop in the futures market. Thus, even though you lose in the local market, you exactly offset those losses by gaining in the futures market. Let's see how this works.

11.2.1 Offsetting Price Risk

Suppose that the price of a July wheat futures contract in November is $4.50/bu. To hedge the risk of price drops, the operator sells (goes short) 20 July contracts at $4.50/bu. In July, the operator will sell the wheat on the local market at the July price and buy back (goes long) the 20 contracts at the July futures contract price.

Let's analyze the operator's equity under various July price scenarios. Here are a few tips on calculating revenues in the local and futures markets:

- Local market – the per unit equity is the difference between the price at which a commodity was sold on the local market and the cost.

$$Equity_{local} = Local\ Cash\ Price - Cost$$

- Futures market – the per unit equity calculation depends on which position was taken in the futures market:

- *Short position* – the difference between the price at which a futures contract was sold and the price at the time that the futures contract was offset.

  For example, if a July futures contract was sold in November, it has a price of F_{July}^{Nov}. An offsetting July contract was bought in July and has a price of F_{July}^{July}.

  The per unit equity is: $(F_{July}^{Nov} - F_{July}^{July})$

- *Long position* – the difference between the price at which a futures contract was offset and the price at which a contract was bought.

  For example, if a July futures contract was bought in November, it has a price of F_{July}^{Nov}. An offsetting July contract was sold in July and has a price of F_{July}^{July}.

  The per unit equity is: $(F_{July}^{July} - F_{July}^{Nov})$

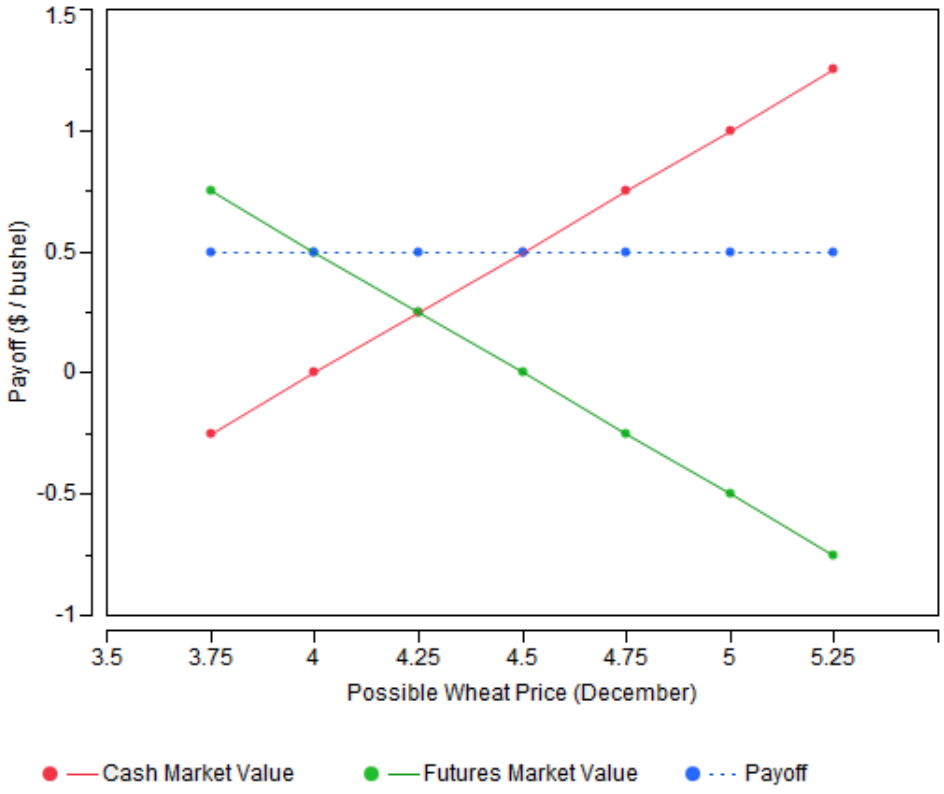
Consider that there are five possible prices in July: \$4.00, \$4.25, \$4.50, \$4.75, \$5.00 (each price is per bushel). A way to analyze possible outcomes from hedging is to set up a table as follows:

Price in July	\$4.00/bu	\$4.25/bu	\$4.50/bu	\$4.75/bu	\$5.00/bu
Local Equity $(P - Cost)$	(\$4.00 - \$4.00) 0	(\$4.25 - \$4.00) \$0.25	(\$4.50 - \$4.00) \$0.50	(\$4.75 - \$4.00) \$0.75	(\$5.00 - \$4.00) \$1.00
Short Futures Position $(F_{July}^{Nov} - F_{July}^{July})$	(\$4.50 - \$4.00) \$0.50	(\$4.50 - \$4.25) \$0.25	(\$4.50 - \$4.50) \$0.00	(\$4.50 - \$4.75) -\$0.25	(\$4.50 - \$5.00) -\$0.50
Total per Unit	\$0.50	\$0.50	\$0.50	\$0.50	\$0.50

You can see that in each case, the operator gets a \$0.50/bu payoff. This is regardless of the price fluctuating in the local and futures markets. Thus, by hedging the local price risk with a futures contract, the operator guarantees a positive net equity.

An illustration of this is presented below. The red line indicates what happens to equity if the price of wheat rises. The green line indicates what happens to equity when the price of the futures contract rises. The blue line indicates the equity when futures contracts are used to offset local markets – your equity is constant. Risk is minimized!

Figure 11.1: Returns to Hedged and Unhedged Market Strategies



11.2.2 Additional problems – Futures Market Hedging

Consider the following scenarios and analyze your per unit equity:

1. Assume that you are employed by the Grains Galore Exporting Company, and you have just negotiated to sell 10 million bushels of corn to India at a price of $4.25/bu. However, the delivery will not occur until September, six months from now. You will sell the grain to a transporter at a local port at the September local market price.

   How can you guarantee a profit for GGEC if the September corn futures contract is currently trading at $4.00/bu? Describe how you can use the futures market, your position in the futures market, and the number of contracts you would need to sell or buy. In September, describe how you would fulfill your obligations in the futures market and regarding your negotiated deal with India. What would be your per unit equity? How much will you earn in total?

2. You are feedlot operator. You will need to purchase feeder cattle in June and you will do so on the local market at the going price. Suppose you know that you can sell the fed cattle at \$1.50/lb, but you want to offset any price risks. To do so, you use the futures market. Answer the following:

   (a) What position are you in the local market?

   (b) What position should you take in the futures market to offset the price risk?

   (c) Suppose the current futures contract price for feeder cattle is \$1.25/lb. Construct a table that illustrates your per pound equity if the June contract price is one of the following: \$1.05/lb., \$1.15/lb., \$1.25/lb., \$1.35/lb., \$1.50/lb.

Chapter 12

Basis

In analyzing how to hedge price risk, we assumed that at the time that a futures contract expires, the price in the local and futures markets is exactly the same. This is known as *perfect convergence* of prices.

In reality, perfect convergence is rare, because there are always factors that can contribute to differences between local and futures contract prices. Some of these factors include:

- Locational differentials.
- Delivery point locations.
- Storage costs.
- Unforced load out provisions.
- Speculators in the market.

We need to analyze how imperfect price convergence affects an agricultural producer's ability to hedge risk. To do so, we introduce the concept of basis.

12.1 Introduction to Basis

Basis is the uninsurable changes in price that may prevent creating a perfect risk hedge using a futures market.

$$Basis = Local\ Cash\ Price - Nearby\ Contract\ Price$$
$$B = P - F$$

Basis can be to determine several important pieces of information that are useful to agricultural producers:

- Forecasting local prices

$$E[P_{t+1}] = F + (Historical\ Basis)_{t+1}$$

- Forecasting expected equity per unit

$$E[Equity] = E[B_2] - B_1$$

In addition, basis can be used to determine whether it is profitable to store a commodity or sell it today. In other words, is it profitable to store until some future selling date, or is it profitable to sell at the current local price?

Market price for storage

$$Market\ price\ for\ storage = Futures\ Price_{month} - Local\ Price$$

Expected local price in a particular month

$$E[Local\ Price]_{month} = Futures\ Price_{month} + E[Basis]_{month}$$

Profitable to store

$$E[Local\ Price]_{month} - Current\ Local\ Price > Market\ price\ for\ storage$$

Profitable to sell

$$E[Local\ Price]_{month} - Current\ Local\ Price \leq Market\ price\ for\ storage$$

12.1.1 Properties of Basis

Many locations in the U.S. that do not have the capacity produce and/or store commodities for the entire year. This implies that there is a large seasonality component to basis:

- Periods when **positive** basis are observed imply that the location is a **net importer**.

  Local prices exceed futures prices → higher value is placed on commodities that are imported.

- Periods when **negative** basis are observed imply that the location is a **net exporter**.

  Local prices are lower than futures prices → higher value is placed on the commodities elsewhere.

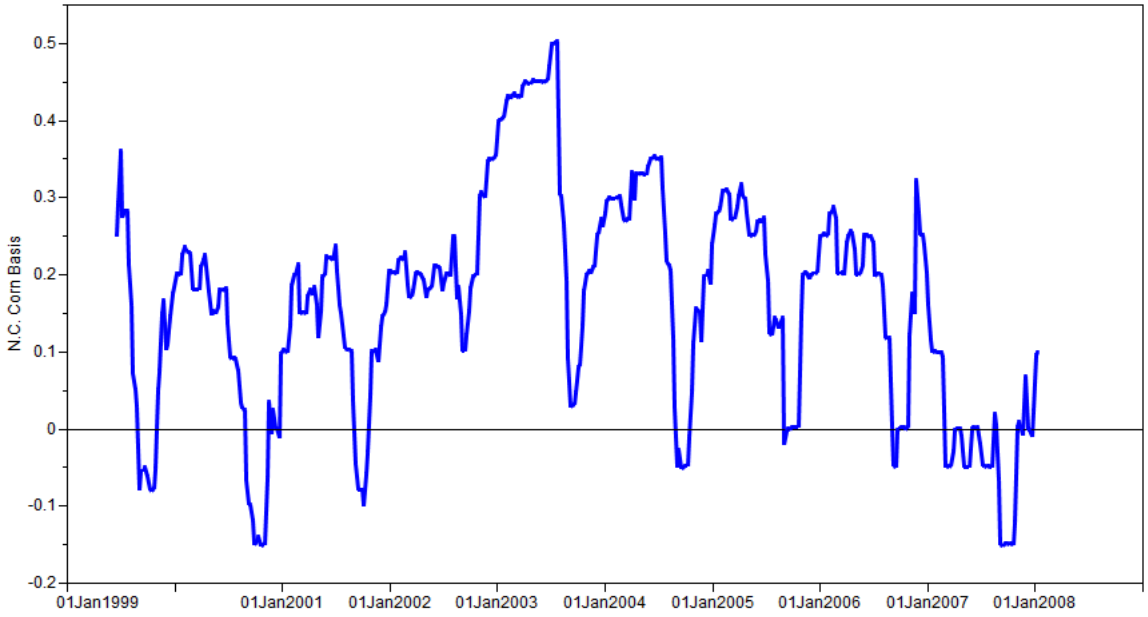


Figure: North Carolina Corn Basis, 1999-2008

12.2 Example of Hedging with Basis

Typically, basis incorporates transaction costs that have to do with transporting a commodity from a contractual delivery location to the final destination.

Suppose that you are an operator of a milling company in St. Louis, MO. The grain that you purchase on the local market is SRW wheat, which is sold on the CBOT, and barged from Toledo, OH at a price of \$0.50/bu. You receive the wheat in July.

$$Spot\ Price = CBOT\ July\ Futures\ Price + Basis$$

$$(P_{july} = F + B)$$

If the July contract price of wheat is \$5.00/bu, then you can guarantee paying \$5.50/bu for the wheat in July by establishing a long hedge.

12.2.1 What happens in July?

The futures price in July rose to \$5.30/bu.

Local cash market

You pay: $\$5.30 + \$0.50 = \$5.80$/bu

Futures market

Long hedge: $Equity = \$5.30 - \$5.00 = \$0.30$/bu

Total Paid for Wheat
$\$5.80 - \$0.30 = \$5.50$/bu

12.3 Basis risk

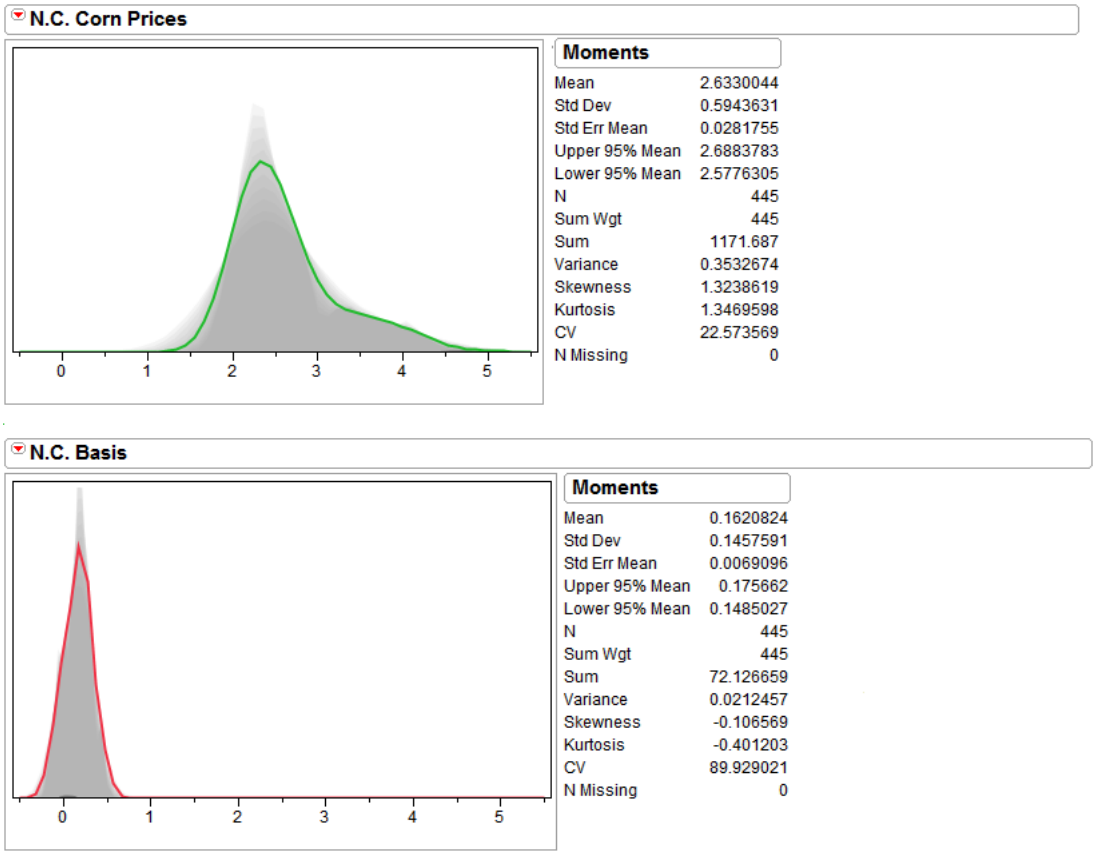
Basis still has variability:

- Increase in basis → increase local price → increase net costs.
- Decrease in basis → decrease local price → decrease net costs.

Good news!

Basis variability is less than price variability! Which is why you should still futures market to hedge price risk!

- Basis risk is less than price risk.
- The expected value of future basis is better known than the expected value of future prices.
- Assuming basis risk over price risk greatly reduces the chances of losses due to price movements.



N.C. Corn: Price Risk vs Basis Risk

Chapter 13

Futures Market Practice

13.1 Speculator Approach

As a speculator, you can either make or lose quite a bit in the commodity futures market. Consider the scenario:

It is currently November. The July wheat futures contract is trading at $3.50/bu. Answer following:

1. You believe that the price of wheat will fall. What position should you take? Ignoring commission, calculate your rate-of-return on investment for 10 contracts if the margin requirement is 10% and the July prices are:
   - $3.25
   - $2.00
   - $4.50
2. What if on Nov. 1 you decide to go short for 10 contracts. But, on Nov. 2, prices rise to $3.55/bu. Realizing this, you decide to partial hedge your risk by taking a long position for 7 contracts. Calculate the market equity (ignoring commission and margin requirements) for the following July price scenarios:
   - $3.50
   - $3.00
   - $4.00

13.2 Hedger Approach

You are a hog farmer in Iowa that plans on selling 1,000 hogs at 200 lbs. each to the local processor in October. Currently, it is March and lean hog futures contracts (40,000 lbs per contract) on the CBOT are trading at $0.50 per pound. Your cost of raising hogs to weight is $95 per hog. You are not a speculator and you just want to guarantee yourself a profit. Answer the following:

1. Suppose that you don't know how to use futures markets – you simply take the local October price. In other words, you are *taking on* ***price risk***. Calculate your local market equity using these three October price scenarios (prices per pound):
   - $0.45
   - $0.75
   - $0.30
2. Now, suppose that you know how to use the futures markets. At the current futures price, would using the futures market guarantee you a profit?
3. What position are you in the local market? (Hint: If prices increase, do you better or worse off?) What position should take in the futures market to hedge the local price risk?
4. How many futures contracts would you sell in March? In October, explain your actions in the futures and local cash markets. How much market equity would you earn in each of these markets? What is your total market equity? Calculate equity using these three October price scenarios (assume perfect convergence of futures and local prices):
   - $0.45
   - $0.75
   - $0.30

13.3 Basis

Basis is a great tool to forecast an agricultural producer's potential profits/losses. Consider that in Billings, the basis for wheat is currently -$0.30/bu. The current price of a nearby wheat futures contract is $5.50/bu. Answer the following:

1. What is the current local price?
2. If basis changed by -$0.10/bu and the local price changed by $0.20/bu, by how much did the futures price change?

3. It is currently February and the September HRS wheat futures contract is trading at \$5.25/bu. If the historical September basis for your location is -\$0.25, what is your expected local September price?

4. How much is the market willing to pay for you to store wheat from February to September? (Use the price you calculated in 1).

5. Is it profitable for you to store the wheat until September or sell in February?

13.4 Basis Risk vs. Price Risk

We saw that if you take on pure price risk (decide to sell at the local price without a futures hedge), you can lose quite a bit of money if the price moves against you. So, it is better to hedge by taking an opposite the position in the futures market.

But, when you take hedge using the futures market, you know that the price in the month of the contract expiration will almost never be the same as your local cash price. The difference is the *basis*. If you knew what the basis will be with 100% certainty, you could still fully hedge and avoid all risk. However, there is *basis risk* that occurs because basis in the month of the contract expiration will not always be equal to the historical basis in that month. Economic factors that affect storage and transportation prices, for example, will affect the movement of basis. This is called *basis risk*, and when you use the futures markets to offset your local position, you *exchange price risk for basis risk*.

Nevertheless, basis risk is **much less than** price risk. That is why it is still a much better idea to take on basis risk in exchange for price risk.

Consider the following

You are a grower of oats. Currently, it is March, and you will want to sell your 100,000 bushel harvest in December. The cost of growing oats is \$2.00/bu. The current December futures price is \$2.50/bu and the historical December basis is -\$0.35/bu. Answer the following:

1. *Price risk*: calculate your market equity if you decide not to hedge your risk in futures market, and simply sell on the local market. Consider these three scenarios of prices in December:
   - \$1.85
   - \$2.00
   - \$2.20

2. *Hedging*: now, you decide to use the futures market to hedge the price risk. What position are you in the local market? What position should take in the futures market? How many contracts should you exchange (5,000 bushels per contract)? What is the expected price that you will receive for the oats on your local market in December?

3. Calculate how much you will receive in December for your oats if the actual basis in December is equal to the expected December basis, and the December price of a December futures contract is as follows: (Hint: Don't forget to include the basis when calculating local prices)

   - \$1.85
   - \$2.00
   - \$2.20

4. *Basis risk*: a lot of the times, the expected basis will not equal the actual basis. However, the variation will be quite small. When you use the futures market, you exchange the high variability in prices for the small variability in basis. Calculate how much you will receive for your oats in December if the December futures contract price in December is \$2.10 and the actual basis is one of these three:

   - -\$0.30
   - -\$0.32
   - -\$0.40