Basic Economic Analysis: The Role of Time Paths

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Abstract

This material covers time paths. It uses basic microeconomic models to generate time paths of variables of interest and discusses how to interpret time paths of variables in terms of the models. I use this material in most intermediate and higher economics courses I teach. I also find it helps students connects the models to the real world in a simple, applied way.

The outline is as follows:

1. Review of supply and demand analysis
2. From supply and demand analysis to basic time paths
3. Going Backwards: From time paths back to the models
4. Assumptions about the speed of adjustment

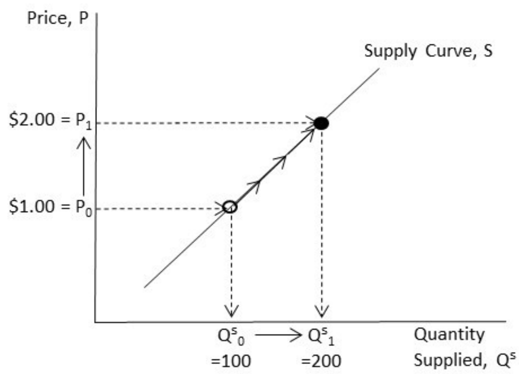
Interspersed are also recommended practice problems to do so you can try your hand at this. I included a short verbal description of the answers to the practice problems, but I didn't include all the diagrams, etc.

1 Review of supply and demand analysis

The core model in all applies economics is really the supply and demand model. Assuming that you've learned this model at some point, I'll just review it briefly rather than "teach it" from beginning. I'll also lay out how I like to conduct supply and demand analysis in my classes because it keeps it clean and simple.

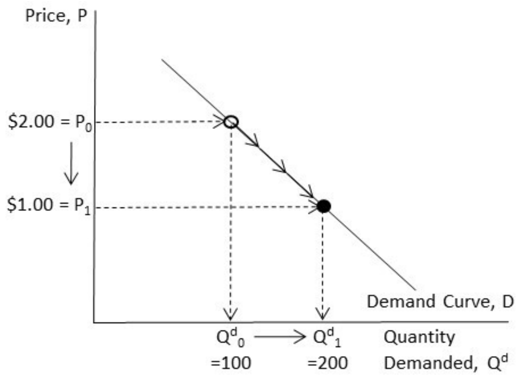
1.1 The supply side

The supply side of the market is made up of people trying to sell goods or services. The higher the price at which they can sell their goods or services, the more they would like to sell. This is called the **"Law of Supply"** and it says that the price of a good/service is positively related to the quantity supplied (i.e., higher price, higher quantity supplied). Intuitively, if you are selling something, if you learn you can sell it at double the normal price, then obviously you'd love to sell more and more at that higher price. If instead you learn that the price just got cut in half, your interest in selling in this market is lessened. That's basically it. Graphically, we capture that with a supply curve that is upward sloping when "price" (P) is on the y-axis and "quantity supplied" (q) is on the x-axis.

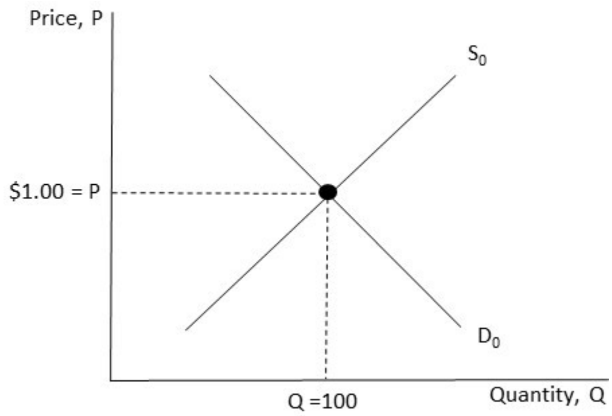


1.2 The demand side

The demand side of the market is made up of people trying to buy goods or services. For them, the higher the price in the market, the less they'd like to buy. This is called the **"Law of Demand"** and it says that the price and quantity demanded are inversely related (i.e., the higher the price, the less is demanded). Intuitively, if you walk into a store to buy groceries and see the price of something you like is half off, most people will buy extra. If you see instead that the price has doubled for some reason, you'll likely buy less. That's all. Graphically, we capture that with a demand curve that is downward sloping when "price" (P) is on the y-axis and "quantity supplied" (q) is on the x-axis.



1.3 Equilibrium or market clearing price



The point where the supply and demand curve cross is called "equilibrium". Technically the price adjusts up and down until it arrives at the price where the exact amount demanded is exactly equal to the amount supplied.

1.4 Basic analysis

It's important to understand how we typically use the supply and demand diagram as a tool. The general process is as follows:

1. Draw your diagram in equilibrium and designate what market you are analyzing.
2. Translate the shock...Take a shock to this market and determine whether it shifts the supply curve, demand curve, or both.
3. Move the appropriate curves in your diagram. Where the new curve(s) cross is the new equilibrium.
4. Write your prediction

This is how we generally teach students in a principles class to use this tool.

1.4.1 Shifting The Supply Curve

We call all the things that can shift the supply curve left or right the "factors of supply". They are

1. **The costs of production.** An increase in the costs of production shifts the supply curve left. A decrease shifts it rightward.
2. **Change in technology.** An improvement in production technology is essentially a decrease in the cost of production and hence shifts the supply curve to the right. A worsening of technology shifts it leftward.
3. **Expected sales price.** An increase in the (future) expected sales price will shift the supply curve to the left because sellers would like to wait for the higher market price at which to sell their goods. A decrease in the (future) expect sales price will shift the curve rightward.

1.4.2 Shifting The Demand Curve

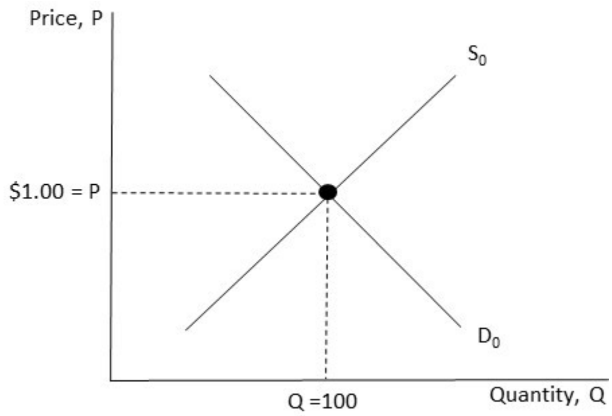
We call all the things that can shift the demand curve left or right the "factors of demand". They are

1. **Income/wealth of consumers.** An increase in consumer income/wealth will shift demand to the right. A decrease shifts it to the left.
2. **Price of complementary goods.** An increase in the price of a good that is a complement will shift the demand curve left. A decrease will increase demand (shift the curve rightward).
3. **Price of substitute goods.** An increase in the price of a substitute good will increase demand (shift the curve rightward).
4. **Expected purchase price.** An increase in the (future) expected purchase price will increase demand (shift the curve rightward) because consumers will want to buy now before the price rises. A decrease in the (future) expected purchase price will decrease demand (shift the curve leftward).

1.5 An Example

Consider an example of the market for orange juice in the United States. Suppose there is a cold snap in Florida, freezing lot of orange trees.

STEP 1: Start with the market in equilibrium.

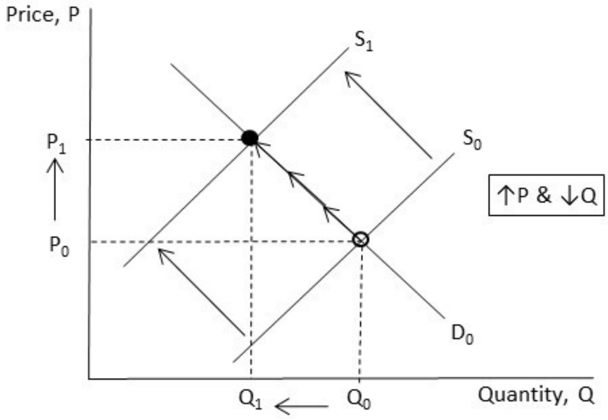


STEP 2: Translate the shock. A cold snap will destroy the orange trees. This lowers the supply of oranges, hence raising their price. Oranges are a factor of production in making orange juice so this is essentially an increase in the cost of producing orange juice. Hence it shifts the supply curve leftward. Nothing about the shock looks like it affects the demand-side of the model, so it is just a "supply shock".

STEP 3: Move the appropriate curves in your diagram. Where the new curve(s) cross is the new equilibrium.

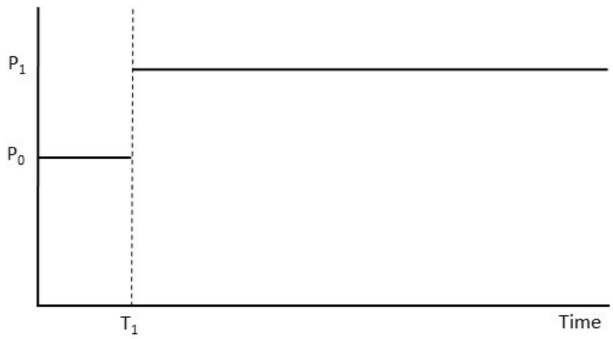
STEP 4: Write your prediction (i.e., what happens to P and Q)

The end result should look like the following:



2 From supply and demand analysis to basic time paths

The time paths one would draw for this analysis are just how P and Q behave over time. If we were to take our diagram 100% literally, then our time paths would just jump at the time of the shock when the supply curve shifts left. They would look like this:



Technically there's nothing more to time paths than this: trace out the path of a variable over time. Since we start in equilibrium, both start at their initial value. If nothing changed, they would just continue at these values forever. But, at time T_1 the shock hits, shifting the supply curve to the left, raising the equilibrium price and lowering the equilibrium quantity.

2.0.1 Practice Problems

To practice basic supply and demand analysis and time paths, go through the following problems. Imagine whatever market you like. In each case put the "shock" into your model, shift your curves and write the prediction and then also draw the prediction in time paths. Teach each problem as a separate problem (i.e., start from scratch with a new diagram in equilibrium):

1. Suppose consumer incomes rise.
2. Suppose costs of production fall.
3. Suppose both consumer incomes fall and the costs of production rise.
4. Suppose suppliers expect the price to rise in the near future (but consumers don't suspect anything)
5. Suppose both suppliers and consumers expect the price to rise in the near future.

Without drawing everything and giving it all away, here are the basic answers. **In case 1** the demand curve shifts right, pushing up the price and quantity. **In case 2** the supply curve shifts right, pushing down the price and increasing the quantity. **In case 3** the demand curve shifts leftward and the supply curve also shifts leftward, lowering quantity significantly, but leaving price mostly unchanged (note: it depends on how you drew your diagram whether prices when up or down in your diagram). **In case 4** the supply curve shifts left, pushing up the price and down the quantity. **In case 5** the supply curve shifts left and demand shifts right, pushing the price up dramatically and leaving the quantity mostly unchanged (again, it depends on how exactly you drew it whether quantity moves a little up or down).

3 Going Backwards: From time paths back to the models

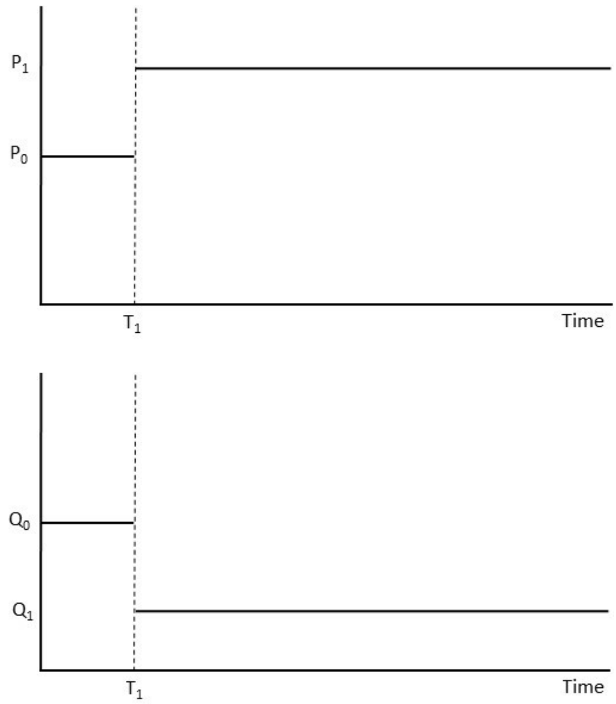
In the above example(s), we went in one direction. We started with a model in mind (supply and demand). We took a real-world shock (a cold freeze in Florida) and processed it in terms of the model (i.e., shifted curves) in order to make a prediction of which way price and quantity would move as a result. That alone is enough. But since we often look at data and data doesn't come in terms of little diagrams, it is helpful to translate our prediction into time paths. Data over time is often plotted like this. This is the first step in "taking our model to data". We made the model's output conform to the way data looks. And doing this makes it easier for us to interpret data in terms of our model.

The other common way we, as economists, interact with data is by looking at data and interpreting it in terms of our model. Once you've practiced a few times, the time paths become more obvious and you realize you can do everything in reverse. And, actually, it's a pretty common way to do things.

Start by looking at the practice problems. Noting that when just the demand curve shifts, both price and quantity move in the same direction. If demand increases (shifts right), then both price and quantity rise. When it falls (shifts left), both price and quantity decline.

When just the supply curve shifts, then price and quantity move in opposite directions. When the supply curve increases (shifts rightward), then price falls and quantity increases. When the supply curve decreases (shifts leftward), price rises and quantity falls.

This alone gives us our first hint. If all you saw were the following time paths, you would know that supply shifted, not demand:



When both curves shift, then one variable either doesn't change or changes very little (depending on how your drew your graph) but the other changes a lot.

So, you can tell from the data whether supply must have shifted or demand or both. This is all that's meant by "going backward".

4 Assumptions about the speed of adjustment

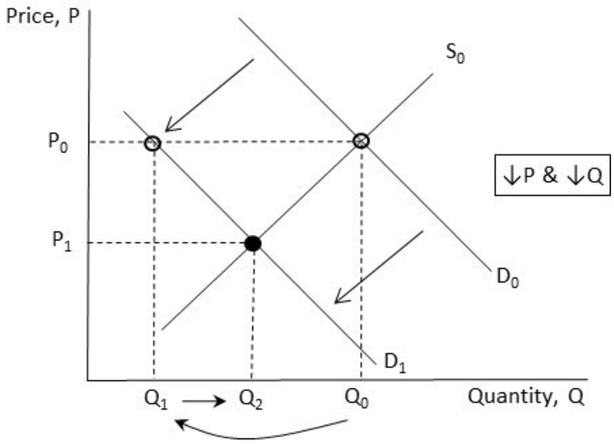
The last piece we need to consider when is whether one or both variables can adjust quickly or slowly. In general, you need at least one variable to be able to adjust quickly or jump if the other variable can only adjust slowly. In the language of dynamic systems we often call the quickly adjusting variable the "jump" or "control" variable and the other, slowly adjusting one, a "state" variable.

4.1 Slowly adjusting prices

Imagine a market where the price is slow to adjust but the quantity can reach more quickly. A good example is a labor market for salaried labor in normal conditions. Most salaried people have at least one year contracts. So, even if something changes today in the market, the salaries don't just jump around. But, a firm may fire people or hire new people. So, the quantity of labor tends to be more responsive.

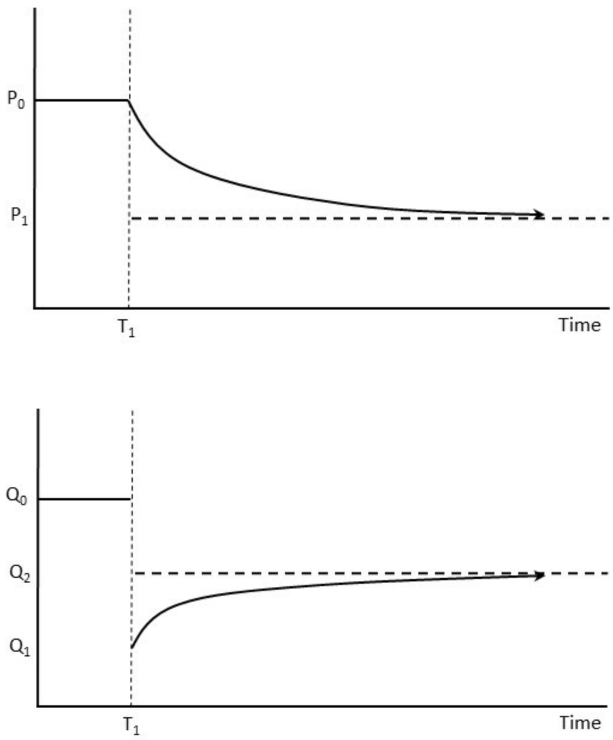
Consider now a decrease in demand for labor.

In this case the demand curve shifts to the left. We can find the new, long-run equilibrium immediately. It's where the new, lower demand curve and the supply curve crosses. In the new equilibrium, the price and quantity will be lower. But this time, the price (i.e., salary) doesn't fall immediately. As a result, at the old price but the new, lower demand curve, firms are only willing to hire Q_1 people. So employment drops a lot in this market. As the price adjusts downward, the quantity of people employed actually rises to the long-run equilibrium level. This sort of "overshooting" or "undershooting" of the long-run equilibrium is typical of the time path for the jumping variable since



it's overcompensating for the other variables slow adjustment.

The time paths will then reflect this. To draw them correctly, I often draw the time paths in the initial equilibrium. Then I move the curves and find the new, long-run equilibrium for the variables. I then add a line for that in the time path diagrams which shows where everything is headed. Now you can draw the time paths of each variable. The slowly adjusting one (here price) will just move slowly from it's current level toward the long-run equilibrium level. The jump one can be seen in the diagram and will jump past it's long-run equilibrium level and then approach it slowly as the slow variable adjusts.



This whole exercise can be redone assuming the quantity is slow to adjust and price is the jump variable. A good example of that sort of market is the market for homes. If demand increases today, the quantity of houses doesn't just increase suddenly. It takes time for the quantity of houses to increase. But the price of houses can change daily. So, it's a great market to think about with slowly adjusting quantities and quickly adjusting prices. If you consider an increase in demand, you should see that for the initial quantity, at the higher demand, the price has to jump up a lot. As the quantity slowly increases, the price declines to the new, long-run equilibrium level which is higher than the initial price. Again, this is overshooting.