

Homework 2

Market Equilibrium and Shocks

Econ 101
Professor Guse

1. This question is taken verbatim from the study guide accompanying the 1967 edition of the classic *Economics* textbook by Paul Samuelson. We say that in a competitive market, there is an “equilibrium” price at which demand and supply curves intersect.
 - (a) Why do we single out this intersection and call the price there “equilibrium price”? What makes this price different from other prices, and what do we mean by equilibrium?**ANSWER.** This special price at the intersection is the *market clearing* price. It is (usually) the only price at which the quantity demanded of the good is equal to the quantity supplied. We (economists) tend to believe that market forces will push the price for a good toward this clearing price in equilibrium. Why? When an economic system is in equilibrium it means that none of the participants have an incentive to change their behavior. In the type of market environments we are talking about, this means that buyers (demand) have no incentive to change the quantity they buy each period and suppliers have no incentive to change the quantity they produce and sell each period. Our claim is that the market clearing price is the equilibrium price. To see why, imagine that the price is above the market clearing price. Then the quantity suppliers are willing to bring to market exceeds the quantity demanders are willing to purchase. Suppliers will be left with unsold goods at the end of the trading period. Do they have incentive to change their behavior? Yes! Unless they want to pay the cost of keeping large inventories, at the very least they will have incentive to produce less output in the next period. Alternatively, they could continue to produce the same amount and lower the price so that they sell more. Or they may pursue some blend of these tactics. Either way, the price and quantity in the next period would move in the direction of the market clearing price and associated quantity.
 - (b) Is there any reason to suppose that in the actual dealings between buyers and sellers there will be forces at work tending to push price to this level? If so, what are those forces? Explain as carefully as you can.
2. Consider the market for gasoline. For each of the following shocks, draw a diagram illustrating the direction of change in price and quantity of gasoline traded. Note that for some, there may be more than one correct answer, so be sure to explain your reasoning.
 - (a) World income increases causing an outward shift in the demand for crude oil. (Crude is an input in the production of gasoline.)**ANSWER** One possible answer. Demand for crude

shifts out (and up). *Ceteris paribus*, this means the new equilibrium price of crude will be higher. Since crude oil is an input in the production of gasoline, we should see a shift in (and up) in the supply of gasoline. This leads to a higher price and lower quantity exchanged of gasoline. **COMMENT 1** Have we described the story with causality in the right direction? Maybe not. World income increases should have its first-order influence on final products and services. In other words, there is good reason to think that an increase in world income will lead to an outward shift in the demand for things like car travel, jet travel, larger homes, and freight transport and therefore gasoline, jet fuel, heating oil and deisel. The increased demand for these refined products should in turn increase their price which in turn shifts out the demand for the input, crude oil. So a slightly more sophisticated look at the increased demand for refined products might ask whether, for example, the outward shift in the demand for gasoline was greater or less than the average outward shift in the demand for other refined products (deisel, jet fuel, etc.). What do I mean by this? How would you measure it? and why do we care? Suppose the really big jump in demand was in freight transport and therefore diesel fuel and there was only a small direct outward shift in the demand for personal transport (and therefore gasoline). This would indeed put upward pressure on the price of crude oil, which normally (in *ceteris paribus* world) would mean a shift up in the supply curve of gasoline. However *ceteris* is not *paribus*. Besides the upward pressure on gasoline's supply curve because of the increase in the price of oil, there may also be some counter veiling downward pressure on that supply curve to the extent that deisel and gasoline are complements in production in the short run.¹ Moreover there is the simultaneously outward shift in the demand for gas.² So what do we have? Suppose we knew the upward pressure on the supply curve for gas was greater than the downward pressure (because the complement in production effect is small), then we would certainly be able to say that the new price of gas is going to be higher. But the quantity movement is less certain. The supply shift pushes quantity lower while the demand shift pushes quantity higher. Now overall the quantity of crude oil should be increasing, so we expect overall to have more refined products, but not necessarily in a uniform manner. All the prices (for LPG, gas, deisel, jet fuel, heating oil) will probably be higher, but in some of these markets the supply shift due to the increased price of crude will overpower the demand shift and quantities may be lower. **COMMENT 2** Global versus local. Crude oil trades in a truly integrated world market. It is very difficult for the price of crude oil to be radically different in Texas than it is in Indonesia (adjusted for grade of course). This is because demanders of crude oil have the freedom to order it up from whom ever is offering the best deal. That freedom derives from low to non-existent trade barriers and ability of modern tankers and pipelines to carry the stuff over long distances at low

¹Without knowing how easily and in what time frame a oil refineries can shift the proportion of crude they make into various refined products, we cannot say precisely whether two refined products are substitutes or complements in production. However, I think it is safe to say that the longer the length of run the more substitutes in production there will be.

²Both because of the primary income motivate increase in demand for personal transport and also because diesel and gasoline are substitutes in consumption

cost.³ That said, this is less true for refined products. Refineries tend to be located closer to where the final products are consumed. Gasoline tends to get shipped around in smaller batches over shorter distances. Therefore gasoline markets have a little local flavor to them. It is possible to sustain higher prices of gasoline in one country or region than another - at least in the short term. So one way to read this problem is to assume that non-U.S. demand for crude oil shifted out. Then from the point of view of U.S. refiners and U.S. consumers, the story really is as simple as the first answer.

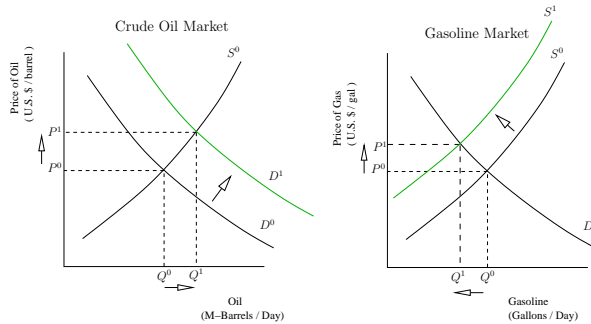


Figure 1. The left diagram illustrates the effect of raising world income in the crude oil market. In particular, it shows that this demand shift would lead to an increase in price for crude oil. The diagram on the right shows how we expect the increase in the price of crude oil to affect the gasoline market. It would shift supply up and to the left, increasing price and decreasing quantity.

- (b) The price of steel increases which raises the cost of producing automobiles. **ANSWER** A good diagram for the automobile market would show the supply curve shifting in (and up). This means that the price of automobiles should increase and their quantity decrease. Ceteris paribus, an increase in the price of a complement to gasoline (automobiles) should cause the demand curve for gasoline to shift in (and down). Therefore we expect to see a lower price of gasoline and lower quantity traded. See Figure 2.

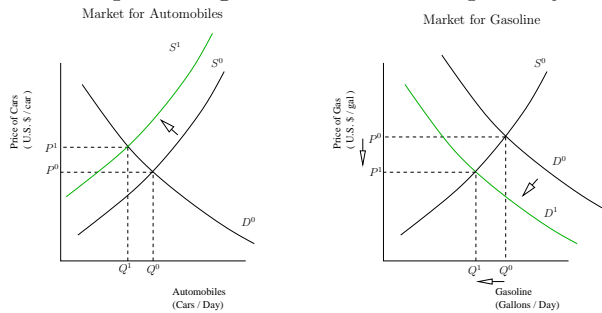


Figure 2. An increase in the price of steel might be expected to put downward pressure on the price for gasoline (via the market for autos).

- (c) Congress increases highway spending by \$100 billion. **ANSWER** It is useful to consider the demand for driving as the intermediary between roads and gasoline. Whether or not the shock described in the problem shifts the demand for gasoline in or out will depend on how the shock affects the quantity and quality of miles driven. In the short run,

³Note, this is why economists cringe whenever politicians say “we have to reduce our dependence on oil from the middle east”. It doesn’t matter where the oil comes from. Our demand contributes to the price and middle-eastern suppliers will enjoy that price whether we buy it from them or the norwegians.

destinations and origins are fixed and in the very short run even the number of trips people make between these destinations and origins may be fixed. In this case, it is easy to imagine that new road improvements may not change the number of miles driven and may even reduce congestion in such a way that less gas is burned per mile driven. Such a quality change in miles driven could actually cause the demand for gas to shift in. The first of these stories is illustrated in Figure 3 in the top two diagrams. In this picture the demand for miles is very inelastic and so the new lower cost of driving does not change miles driven very much. Another story one could tell, is that with destinations and trips fixed in the short run, even the quantity of miles driven could decrease as new (shorter) routes become available for executing those trips. In this the short-run demand for miles drive may actually be *upward sloping* (not shown).

In the long-run, we expect the demand for miles to be much more elastic. This is due to the fact that trips and even the destinations and origins themselves will not be fixed. In other words, as roads improve, people will not only make more frequent trips to and from the same places, they may also create new destinations in such a way that number of miles traveled per trip increases. For example, they may move out to the burbs. Residential areas develop further from work and shopping centers and it is likely that overall demand for fuel increases - shifts out and up. This leads to higher gasoline prices and higher quantity traded. See the lower two diagrams in Figure 3.

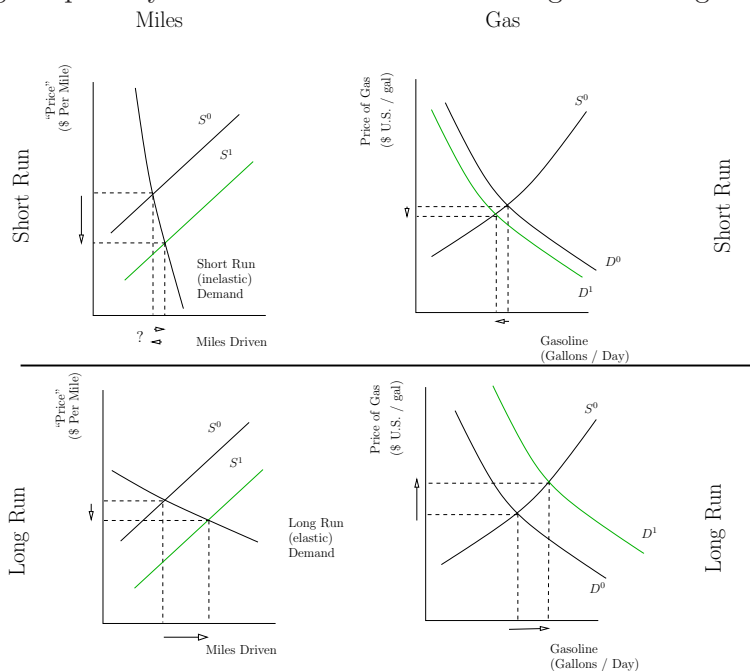


Figure 3. Possible effect of an increase in road-building in the short and long run.

- (d) The heavy construction experiences a downturn which lowers the demand for heavy (deisel-consuming) equipment. (Perhaps, like me, you are not sure of the answer or suspect the answer may be "it depends". Please just explain your answer as well as you can and state your assumptions clearly.) **ANSWER** Easy part first. Diesel and gasoline are almost certainly substitutes in consumption. At least some households own

both diesel and gasoline powered cars, so we should see the demand for gasoline shift in (and down). What about supply? As mentioned in part (a), it is hard to know to what extent gasoline and diesel are substitutes or complements in production. The longer the run the more they are substitutes in production, but in the very short run at least they may be complements in production. Under the assumption that they are substitutes in production, we should see the supply curve for gasoline to shift down (and out). Hence, under this assumption, both shifts contribute a lower price for gasoline, while the supply and demand shifts work in opposite directions w.r.t. quantity. See Figure 4.

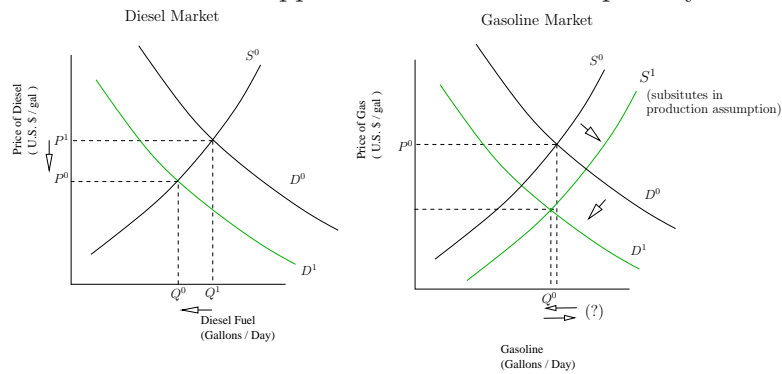


Figure 4. The effect of the downturn in heavy construction on the gasoline market (via the market for deisel) under the assumption that diesel and gasoline are substitutes in production and consumption.

- (e) Food and health care prices increase while wages remain stagnant. **ANSWER.** This sounds a lot like an income decrease. In fact, it is equivalent. When the prices of most things increase and wages / income do not increase it looks very similar to the kind of budget line shift cause by an decrease in income. It is accurate to call this a decrease in “real” income. So demand shifts in (and down). Quantity and price of gasoline both decrease. See Figure 5.

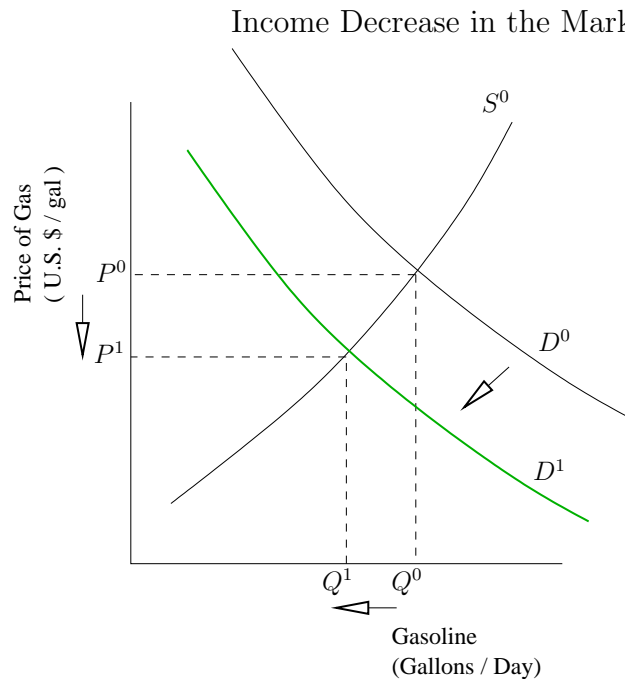


Figure 5. The effect of the downturn in heavy construction on the gasoline market (via the market for deisel) under the assumption that diesel and gasoline are substitutes in production and consumption.

- (f) The U.S. signs a global warming treaty and agrees to reduce CO₂ emissions by imposing a tax on all fossil fuel extraction and importation. However, the full amount of the tax is rebated back to each citizen in equal shares. **ANSWER** The fossil fuel tax will increase the price of crude oil faced by refiners. Therefore we certainly will see a shift up (and left) in the Supply curve for Gas. The rebate will shift Demand out (and up). Both of these work to push price up. However the effect on quantity would appear to be ambiguous, since the supply shift pushes quantity down and the demand shift pushes quantity up. Can we say any more? It depends on several things. First a fossil fuel tax would also be applied to coal and natural gas, so one question is what percentage of the tax is being paid by the gasoline market? Do the participants in this market as a whole expect to receive more in rebates then they pay in tax? If so and the overall rebate to the gasoline market is significantly larger than what is paid in tax, then we might expect to see an overall increase in gasoline consumption.⁴ Suppose, however, that the gasoline market overall pays about the same in tax and they receive in rebates. Then we can expect the *substitution effect* to outstrip the *income effect* and see the quantity of gasoline to decrease. Note this may not hold on an individual household level. Households who consume significantly less gasoline than average will be getting rebate checks larger than their contribution to the tax. Some of these households may demand more gasoline.

⁴This is probably a more realistic story for natural gas. Natural gas is a fossil fuel but one which would be subject to a relatively low tax rate per BTU under a carbon tax. Hence it is easy to imagine how under such a policy the overall volume of natural gas could increase.

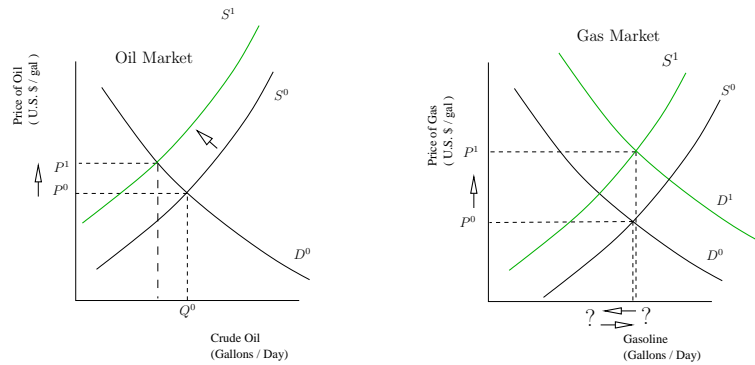


Figure 6. Carbon Tax effect on the gasoline market.

- (g) A company invents a new battery and builds an electric car capable of 400 miles on a single charge. **ANSWER** This would lower the demand for gasoline powered cars and therefore lower the demand for gasoline. We would price and quantity go down. Similar to picture in Figure 5.
- (h) A new national trend in zoning laws encourages redevelopment of dense neighborhoods near city centers. **ANSWER.** Some cities in recent years have begun to reverse the doughnut effect of suburban sprawl. Residential areas near the center of the city which were abandoned in the 60s 70s and 80s get re-populated. To the extent that these people now live closer to their work and shopping districts, demand for gasoline should shift down and in. I have seen this happen quite dramatically in Madison, WI as well as certain neighborhoods in Chicago and Baltimore. Though I do not know whether it was motivated by zoning laws or something else. Again, graphically this looks like the shift in Figure 5.