How Markets Use Knowledge

By Russ Roberts

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Economists will often say that prices steer knowledge and resources. Prices are traffic cops that signal to buyers and sellers what is scarce and what is valuable. But what does this mean exactly? How do prices achieve this?

The simple answer is that prices change to clear the market. Price adjusts to equate how much of something people want to buy with how much of something people want to sell. You can view this as trivial (there's stuff on the shelves) or profound (there's stuff on the shelves even when things are changing such as costs or income or prices of related goods and that allows me to plan my life knowing that stuff is going to be there). But either way, it's only the beginning of the story, a story we usually cut short in class when we shift a supply curve or a demand curve. We shift one of the curves and say that price adjusts in a predictable way. But there is more to the story. And the rest of the story is really the part that's most interesting.

Right now, there's a price for graphite, the material used in fishing rods and tennis racquets and a bunch of other industrial uses. Let's suppose that the price is $8 a ton and that at that price, there are 28 million tons sold each year. Evidently, that's the amount people want to buy when the price is $8 a ton and that is also the amount people want to sell when the price is $8 a ton.

That's all we actually observe. The price and the quantities that change hands at that price.

(We actually don't really see it all that clearly—the price moves around and not all transactions take place at one price. There are differences in quality that are hard to account for, etc. Let's ignore all that.)

What if price were higher, say $10 a ton? The various customers, the makers of fishing rods and tennis racquets would want to buy less. How much less? Well that would depend on how easy it is to do without graphite. Are there good substitutes? Are there substitutes for the things that graphite goes into? If the price of graphite goes up, tennis racquet manufacturers will raise their price for graphite racquets which in turn will encourage some tennis players to use wooden racquets or racquets that use less graphite. So there will be substitution. How much depends on the adequacy of the substitutes.

At $10 a ton, sellers of graphite will want to sell more because they will find it profitable to draw graphite out of the ground that wasn't worth mining before. How much more will they want to sell? That depends on just how expensive and difficult it is to get to additional graphite.

Those factors, the quality of substitutes on the demand side (and their cost) and the costs of getting extra graphite out of the ground will determine the shape of the demand and supply curves as a we move away from the point where supply and demand cross at a price of $8 and a quantity of 28 million tons. If there are a lot of easy and cheap substitutes for graphite, then the demand curve will be relatively flat as we move to a price of $10—that is, there will be a big drop-off in the amount of graphite people want to buy. But if the substitutes are expensive and don't work very well, people won't want to cut back as much. But either way, people want to buy less at $10. It's just a question of how much less.

And similarly, suppliers want to sell more at $10 than they do at $8.

Which is why price isn't $10. At $10, suppliers want to sell more graphite than consumers want to buy. So that price can't be sustained. Suppliers will find themselves with extra on their hands and will have to cut price if they want to sell it.

And similarly, consumers would like to pay $6 rather than $10. But at $6, consumers want to buy more graphite than sellers want to sell. So $6 can't be sustained. But at $8, suppliers want to sell 28 million tons and buyers want to buy 28 million tons. So the price of $8 persists.

These points other than a price of $8 and a quantity of 28 million tons seem irrelevant. And they are, unless something changes.

Suppose carmakers realize that you can use graphite in the brake linings of the cars they make. They want 26 million tons of graphite to line the brakes of new cars.

So now we have a problem. There isn't enough graphite to go around. Each year, 28 million tons are coming out of the ground and the demanders of graphite now want 54 million (28 plus the new 26 from carmakers). Something's got to give.

What do we do now? There's no "we." But we can imagine all of the suppliers and demanders and the demanders of the final products that use graphite getting together in a big room to work out this problem.

We could have graphite miners mine more graphite

We could have current users cut back

We could tell the carmakers to settle for less—even zero.

Which of those is ideal?

Or is a mix of those is ideal?

What do we mean by ideal? How can we decide on the mix? What do we want to have happen? How should this problem be solved?

There could be a war, a negotiation, a rule for sharing when demands compete. There could be a graphite czar who would-be buyers have to visit and plead their case as to why they deserve of graphite. If there were such a czar and he was a nice person rather than a power-crazy monster, what would he want to know in deciding how to solve this problem?

A bunch of stuff he can't know even if he had a thousand lifetimes—

How much does it cost to get an extra million tons of graphite? An extra two million tons. Three million and so on. How much do tennis players like graphite racquets more than wood ones? What are the options for using less graphite (rather than zero) in manufacturing the racquets? How much better are thick-throated racquets vs. thin-throated racquets?

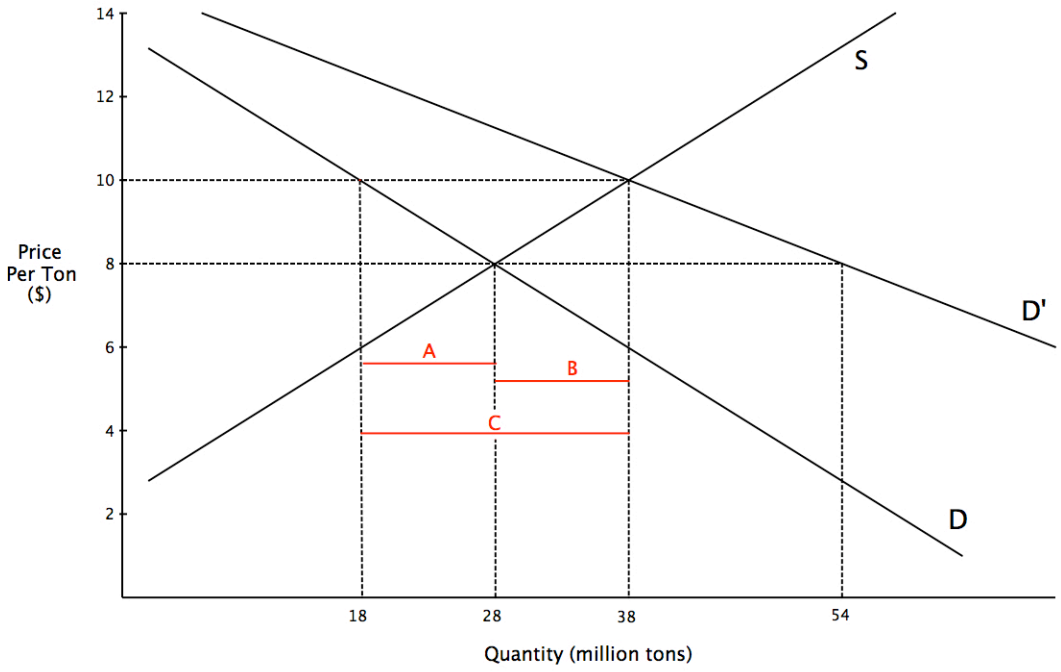
This would have to be done with every end-user and every manufacturer.

As James Buchanan has pointed out, it's not even clear that the answers to these questions are even known to the people you would want to ask. A graphite mining company may not have an accurate idea of what it would cost to find more graphite and get it out of the ground. Double the price of graphite, though and they'll start looking.

But there is knowledge out there. Some of it is literally known to someone out there in the world. Some of it will be discovered if the incentive to discover it is there. How do you get that knowledge produced and used? The graphite czar can't discover or uncover that knowledge in a thousand lifetimes. And by the time he figured it out, it would be obsolete. But the problem has to be solved somehow. There isn't enough graphite to go around. This is an unrelenting reality.

So what actually happens in a market system where price is free to adjust and people are free to buy and sell?

The demand shifts out to D':



(The shift out isn't parallel. Think for a moment why not. A new demand curve has been added to the old one. Because all demand curves slope downward, adding the new one to the existing demanding curve by all other users (the non-carmakers) means that the horizontal distance between the old demand curve and the new one has to be larger at lower prices than at higher prices.)

The price of graphite rises to $10. The total quantity of graphite bought and sold increases to 38 million tons. Problem solved. This is where the usual classroom exercise ends. The market for graphite is back in equilibrium. The market for graphite clears once again, but at a higher price and a larger quantity.

But look how the problem got solved via a mix of the solutions proposed earlier:

Existing users have cut back.

Suppliers have found more graphite.

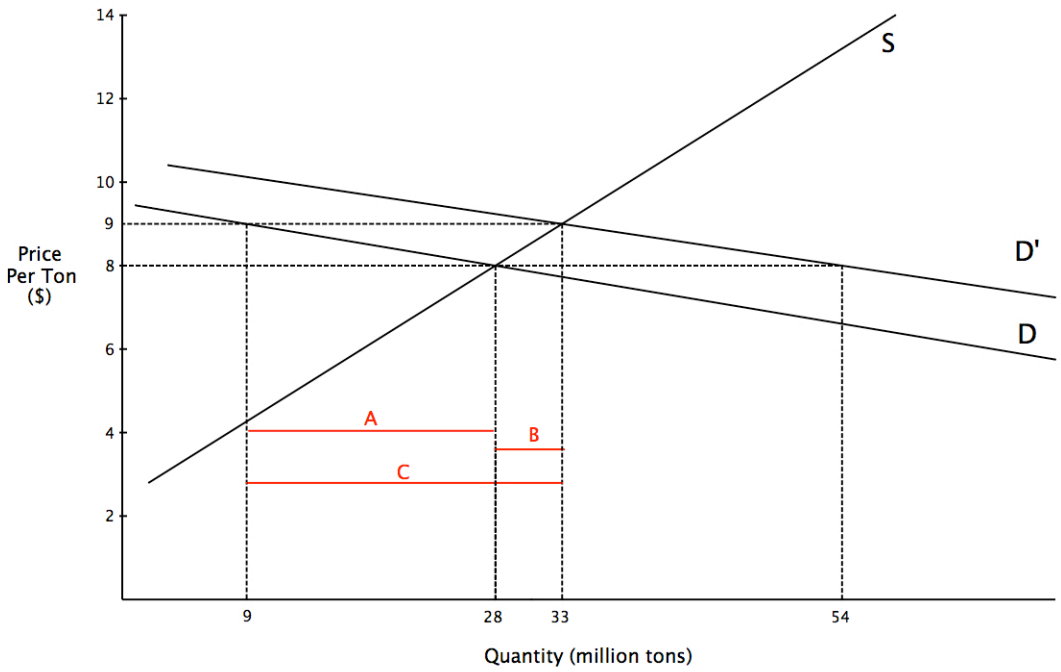
Carmakers have settled for less than they would have liked.

Where are these amounts in the graph?

The demand curve by existing users (demanders who aren't carmakers) is still the original demand curve, D. They've reduced their quantity demanded to 18 million tons. The higher price of $10 has induced them to find alternatives to graphite or to simply buy less. This reduction is the distance A in the graph. Suppliers have gone out and found and mined more graphite. The higher price has encouraged them and made it worthwhile to increase the quantity supplied by 10 million tons. This increase in the amount of graphite that is mined and supplied is the distance B in the graph. So carmakers get 20 million tons—not the 26 million tons they would have liked at a price of $8, but the higher price has induced them to settle for less. The amount carmakers end up with is the distance C in the graph—it's the horizontal distance between D and D' at $10 per ton.

The amount carmakers end up with comes from two sources—a reduction in the amount used by existing users and an expansion of the quantity supplied. And both of these changes come about by the price increase.

But suppose that demand by the original users is very elastic at $8:



That is, suppose, it is relatively easy for existing, non-carmaker demanders to find alternatives to graphite. (Or that end users find alternatives when the products that use graphite get more expensive.)

First, price only rises to $9. And total quantity expands but only to 33 million tons. The **increase** in quantity supplied is only 5 million tons because the price hasn't gone up as much.

But because the original demand curve, D, is very responsive to price at the original equilibrium point, the reduction in the quantity demanded by non-carmakers is very large—19 million tons. That is the distance A in the graph. And that means that the carmakers get more than they got before—24 million tons—almost everything they wanted—distance C.

See how beautifully the price system uses the knowledge and steers resources.

Look at how different the lengths A, B, and C are in the two diagrams, in the two situations that differ by the ease of using alternatives. When non-carmakers have lots of alternatives, look what follows:

Price rises less

Quantity supplied goes up less

Carmakers get more of what they want

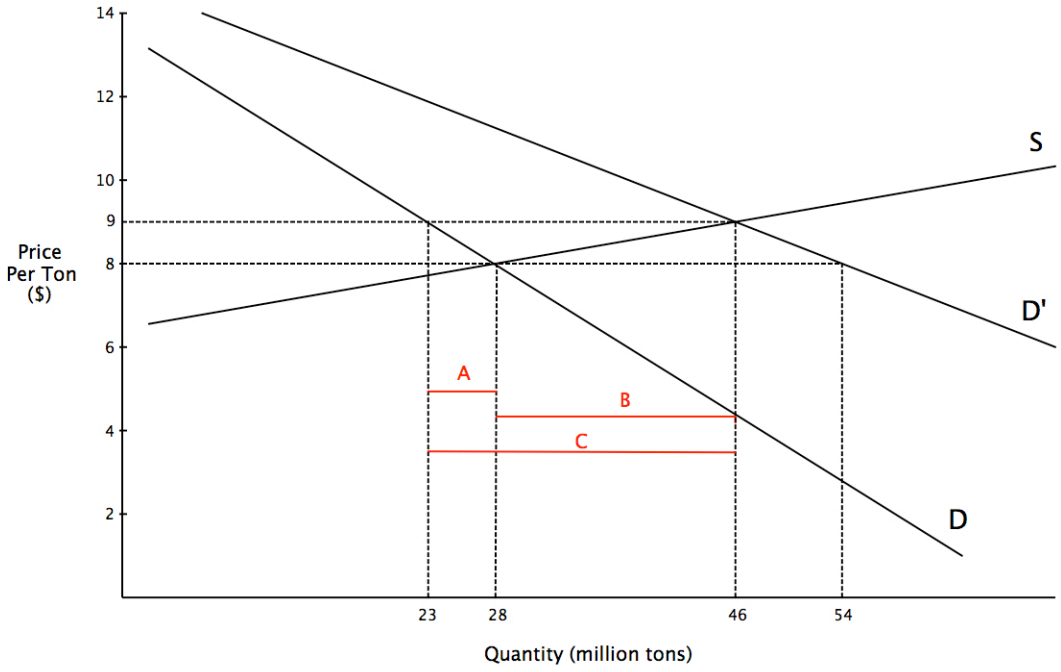
Existing users reduce by more

But this is exactly what we'd want to have a czar accomplish. If a czar could interview everyone who's already using graphite and find out just what alternatives they have available and how easy it is for end-users to find alternatives for goods that use graphite, this is exactly what the czar would do, have the existing users cut back a lot so that extra resources don't have to flow into the graphite industry looking for new graphite and getting it out of the ground and letting carmakers get most of what they wanted.

The market "solves" the problem just the way the czar would. Except the czar couldn't do it and the market doesn't really "solve" anything. Using the word "solve" suggests intention. In fact, people are just trying to get a good deal on both sides-buyers and sellers. But the end result, that no one intends, is to steer fewer resources into graphite excavation, steer more

graphite into the hands of carmakers rather than fishing rod makers and all by "using" the knowledge that existing demanders can find substitutes. But no single mind has that knowledge. No single mind, no czar could have that knowledge.

Now suppose that demand is as it was in the first example, but it's very easy for suppliers to find new supplies and get them out of the ground:



As I've set up the example, price rises to $9 again, but a very different set of changes are set in motion. Just as in the last case, carmakers get almost all that they want, in this case 23 million of the 26 million tons they initially wanted when the price was $8. But instead of most of that quantity coming via cutbacks from existing users (distance A in the graph), most of it comes

from an expansion in the quantity that suppliers want to supply (distance B in the graph), and that occurs without much of a price increase.

But as before, this is what we'd want to have happen if someone were in charge. If it's relatively cheap and easy to get additional quantities of graphite out of the ground, and relatively difficult for existing users of graphite to find substitutes, we don't want price to rise much and we want more resources steered toward getting more graphite out of the ground.

Prices create harmony. They settle what would otherwise be disputes between buyers and sellers. They adjudicate. They create information and encourage people to use that information in ways that could never be done by a human settler of disputes, a graphite czar.

I thank Josh Hill for drawing the diagrams. Any errors are mine. Here is some additional reading for the interested reader:

The Price of Everything: A Parable of Possibility and Prosperity by Russell Roberts
http://www.amazon.com/exec/obidos/ASIN/0691135096/invisiblehear-20

"The Use of Knowledge in Society," by Friedrich A. Hayek. American Economic Review, XXXV, No. 4; September, 1945.
http://www.econlib.org/Library/Essays/hykKnw1.html

"I, Pencil," by Leonard Read
http://www.econlib.org/LIBRARY/Essays/rdPncl1.html

"A Marvel of Cooperation: How Order Emerges Without a Conscious Planner," by Russell Roberts at the Library of Economics and Liberty
http://www.econlib.org/library/Columns/y2005/Robertsmarvel.html

Some questions to test your knowledge:

1. True, false, or uncertain: If carmakers find that cotton balls work better than graphite in brake linings and stop buying graphite, then the demand for graphite by pencil makers will increase.

2. True, false, or uncertain: If carmakers find that cotton balls work better than graphite in brake linings and stop buying graphite, then the price of tennis racquets will go down.

3. How do prices coordinate knowledge that is dispersed among producers and consumers?

4. How do prices produce harmony among competing demands for products?

5. There are many suppliers of graphite around the world, No one is in charge of the overall supply. So who decides how much extra graphite in total should be dug out of the ground when a new use for graphite is discovered by the auto industry?

6. Graphite comes from many places around the world. Suppose a new mine is discovered in Sri Lanka. How does this affect the users of graphite?