# Knowledge and prices

*We must look at the price system as such a mechanism for communicating information if we want to understand its real function … The most significant fact about this system is the economy with which it operates, or how little the individual participants need to know in order to be able to take the right action.*

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Friedrich Hayek (1945). The Use of Knowledge in Society.
In Bruce Caldwell (ed.), *The Market and Other Orders*, XV
(Liberty Fund Library, 2014): 100.

Imagine a jigsaw puzzle of one billion pieces. These pieces are scattered randomly across a pasture that is one million square miles—specifically, a square pasture with each side measuring 1,000 miles in length. If someone assigns to you the task of finding all these pieces, how would you do so?

One option is to search for each of these billion pieces by yourself. If you choose this option, you'll likely die before you complete the task. Even if you live for 95 years and begin searching nonstop for the pieces the moment you are born, you'd have to find one piece every three seconds to find them all before you die.

But suppose you enlist the help of 1,000 friends to fan out with you across the pasture, searching for the pieces. The task is now much easier. If each of you finds just one piece every 30 seconds, you and your friends together will complete the task in a little less than one year.

Of course, this task can be made even easier by enlisting the help of one million people or, better still, 100 million people. With 100 million people

scouring the pasture for puzzle pieces, each person would have to find an average of only ten pieces. And so, if each of these 100 million searchers finds a piece every 30 seconds, the task will be completed in a mere five minutes.

Human cooperation is powerfully productive. Still, in this example, simply collecting all the pieces of the jigsaw puzzle is not by itself a very valuable achievement. The puzzle must eventually be put together properly to justify the time and effort spent on finding all the scattered pieces.

Think of each jigsaw puzzle piece as a unit of information that is potentially useful for making the economy work successfully. One piece might be

the information that deposits of bauxite exist in a certain location in Australia. Another piece might be the information about which mining engineers are especially skilled at designing an operation for extracting bauxite from the ground.

A third piece is information about how best to transport the bauxite to a processing factory. A fourth piece is information on how to make a crucial part for the engine of the truck or the locomotive that will transport the bauxite. A fifth piece is how to design the roads or rails on which that truck or locomotive will be driven.

Clearly, the number of pieces of information that must be found and used for bauxite to become, say, the aluminum sheeting that forms the casing of the printing press that produced the pages that you are now reading is staggeringly large. It is a number far larger than the mere one billion pieces of the jigsaw puzzle in my example.

It's foolish to expect any one person (or small group of people) to find all the pieces of information necessary for the production of aluminum sheeting (and for the production of fuselages for airliners, the production of oven foil, the production of soda cans ... the list is long).

Not only is the mere *finding* of all the many pieces of information too difficult to entrust to a small group of people; so, too, is the task of putting these pieces together in a way that yields useful final products.

Let's now amend the example to make the jigsaw puzzle an even better metaphor for economic reality. Suppose that, unlike with regular jigsaw puzzles, each piece of this puzzle can be made to fit snugly and smoothly with any other piece. In this case, merely assembling all of the one billion puzzle pieces so that they fit together neatly is easy. But note that it is possible to create an unfathomably large number of scenes with these pieces.

Trouble is, only a tiny handful of these scenes will please the human eye. Most of the scenes will be visual gibberish. The challenge is to arrange the pieces together so that the final result is a recognizable scene—say, of a field of sunflowers or of a bustling city street. Only if the scene is recognizable is the assembled puzzle valuable.

Now imagine yourself standing alone before a gigantic table covered with these one billion puzzle pieces. What are the chances that you alone can put these pieces together so that the final result is a coherent visual image—a useful and valuable final result?

The answer is "virtually zero."

The number of different ways to combine these one billion pieces together is unfathomable—it rivals the number of atoms in the universe. So even if the number of possible valuable scenes is one million, that's still only a minuscule fraction of the gargantuan number of possible ways that this puzzle can be assembled. The vast majority of images that can be created by arranging and rearranging these one billion pieces will be meaningless and, hence, worthless.

The size and complexity of the puzzle ensures that putting a central planner (or committee of planners) in charge of assembling the puzzle won't work. There's simply no way that a planner, gazing at a huge pile of puzzle pieces, can foresee any of the possible meaningful pictures that might emerge once these billion pieces are assembled.

So the planner must *discover* what meaningful pictures are possible. Yet he can make this discovery only in the process of actually assembling the puzzle. This jigsaw puzzle doesn't come in a box whose cover depicts the final result.

Of course, the planner can't assemble all one billion pieces at once. At each point in time, the human limits of the planner's attention and capacity enable him to take notice of, and to fit together, only a tiny fraction of the billion pieces.

How can the planner know, as he proceeds, if the groups of pieces that he has so far assembled will or will not turn out to be part of a larger, meaningful picture? Are the five million pieces assembled so far, although the image they now depict looks like nonsense (say, a green glob), destined to become part of a meaningful image (say, a forest) once they are combined with another five million or another 500 million pieces? Or is the current assembly of the five million pieces destined to remain meaningless—impossible when fitted with the other pieces to be part of a meaningful, pleasing image?

How is the planner to sensibly choose whether to keep going with his current assembly or to start over? The best he can do is guess. Unable to see the future, the planner has no way to know if the image depicted by the five million pieces that he has assembled so far will prove to be useful or useless when they are combined with the remaining 995,000,000 pieces. Although all-powerful in deciding which pieces go where, the planner is flying blind.

Yet the planner faces a second insurmountable difficulty. Even if he somehow could foresee from the start what the final image will be if the puzzle is assembled correctly, the planner is incapable of arranging and re-arranging such a huge number of pieces in ways that will bring about this final, valuable image. The puzzle pieces are too many, and the ways that they can be combined with each other too great, to enable a planner to perform the assembly successfully.

Clearly, planning is a terrible way to assemble the puzzle. A far better way is to let the puzzle assemble itself.

Sounds odd. But what if each puzzle piece came equipped with a monitor that provides feedback on how likely it is that connecting at such-and-such an angle with this or that other piece would be a step on the way to creating a larger, meaningful, and beautiful picture? What if, for example, each piece *beeps* whenever it connects productively with another piece—that is, whenever it connects with another piece in a way that contributes toward making the eventual final outcome a beautiful picture? And what if the volume of each beep were determined by how likely it is that any particular connection of two pieces will help in producing a beautiful overall outcome? The more likely any particular connection is to work toward a successful overall outcome, the louder the beep.

Now, finally, imagine each of these billion puzzle pieces having a mind of its own, as well the ability to move by itself. Each piece loves hearing these beeps—and the louder the beep, the happier the piece.

This puzzle—strange as it seems—will assemble itself into a configuration that results in a meaningful and beautiful picture. It will self-assemble in this way without any of the individual pieces intending to contribute to this outcome.

Each individual piece is motivated only to connect with other pieces in ways that produce the loudest beeps. Opportunities to connect that result in no beeps will be avoided in favour of opportunities that produce at least soft beeps. And opportunities to connect that produce soft beeps will be rejected in favour of opportunities to connect that produce loud beeps.

As long as the loudness of the beeps corresponds to ways of connecting that result in a meaningful, beautiful picture, such a picture will be produced without any person (or any puzzle piece) intending to produce it.

This puzzle will "self-organize" into a beautiful whole that is far greater than the sum of the intentions of the individual pieces.

Of course, no real-world jigsaw puzzle has pieces that move on their own in search of beeping sounds. But carry this puzzle analogy over to the real-world economy. Each owner of private property has incentives to use his or her property in ways that produce the greatest return—the "loudest beeps," if you will. The landowner can connect with tractor manufacturers and farm workers to grow corn, or with architects and construction workers to erect a building on the land. The option he chooses is the one that screams most loudly to him "Choose me! I'll make the greatest contribution to your wealth!"

Likewise for the individual worker who owns only his own labour services. He will combine his labour with the labour and assets of those other private-property owners who promise him the largest return on his work effort—that is, who promise him the highest pay.

With each private-property owner seeking only the highest returns on the use of his or her property, an overall economic order is brought about as each owner directs his property toward those uses that pay the highest prices. Similarly, consumers seeking only to get as much satisfaction as they can from spending their income avoid inefficient suppliers (whose prices are relatively high) and patronize efficient suppliers (whose prices are relatively low). Inefficient suppliers either increase their efficiency or switch to other lines of production. Efficiency is improved and a complex pattern of productive uses of resources emerges (as Hayek said) *spontaneously*.

This order—this overall outcome—is intended by no one. It is spontaneous.

And because this unintended, spontaneous outcome emerges from the self-interested actions of owners of private property, each of these owners is made better off. No one is forced to do business with those whom he'd prefer to avoid, and—being free to take advantage of any and all existing opportunities—each person chooses those available opportunities that improve his lot in life by the greatest degree.

One of Hayek's deepest insights is that the signals received by private-property owners on how best to use their property come chiefly in the form of prices—the prices of some options *relative to* the prices of others. A worker offered $30 per hour for his labour time by factory X and $25 per hour by

factory Y will likely choose to work for factory X because factory X pays relatively more than does factory Y.

Similarly, customers who offer to pay $50 per unit for the output of the factory are more likely to acquire that output than are customers who offer only $45.

Responding to prices in this way doesn't produce heaven on earth. But it does encourage millions of people to interact peacefully with each other in ways that are mutually beneficial.

No person, no council, no committee, no congress, no parliament plans this successful overall economic outcome. And that's a beautiful picture, one that shows that we can have economic prosperity without giving enormous power to government officials—officials who, being human, will always be tempted to abuse such power.