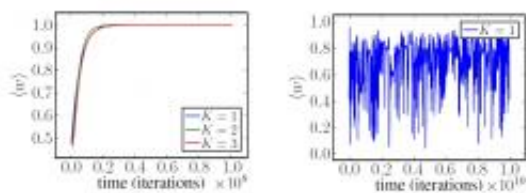


High gas prices may be explained by self-organized cartel behavior

June 21 2012, by Lisa Zyga



(Left) When buyers update their strategy at a fast rate relative to sellers, a product's value (w) increases toward 1.0, resulting in low prices and a buyer's market. (Right) When sellers update their strategy faster than a critical value, a product's value fluctuates around values less than 1.0, resulting in high, fluctuating prices that benefit sellers. This cartel-like behavior emerges spontaneously based on the relative speeds with which buyers and sellers update their strategies. Image credit: Peixoto and Bornholdt. ©2012 American Physical Society

(Phys.org) -- Rapid increases and unpredictable fluctuations in gas prices annoy many drivers, especially since it may seem that oil companies are secretly conspiring to keep prices high by forming a cartel in an effort to increase their profits. But a new study shows that cartel-like price dynamics of certain commodities, such as gasoline, can emerge spontaneously in a strategic model without any collusion among the sellers. The finding doesn't necessarily mean that companies don't intentionally form cartels, but the possibility of self-organized cartel formation could have implications for market regulations.

The researchers, physicists Tiago P. Peixoto and Stefan Bornholdt of the University of Bremen in Bremen, Germany, have published their study, called “No Need for Conspiracy: Self-Organized [Cartel](#) Formation in a Modified Trust Game,” in a recent issue of *Physical Review Letters*.

“Our work shows that, under very reasonable and simple assumptions of the market dynamics, cartel-like behavior can emerge, without an explicit agreement between sellers,” Bornholdt told *Phys.org*. “This is, to our knowledge, completely new and we feel that it comes somewhat unexpected, for example in the context of German [gasoline](#) price discussions in the media. For example, a few months ago, the German governmental cartel agency searched the offices of large gasoline companies in search of evidence of cartel behavior. We asked ourselves if a cartel-like dynamics could emerge by itself, without leaving traces of evidence. As [gas prices](#) in Germany were – and still are – strongly fluctuating in time and space, this made us curious whether this could be a sign for an interesting collective dynamics, of gas sellers, interacting with each other in a funny way.”

The spontaneous emergence of cartel-like behavior appears in a model that the researchers developed, which is based on a real-life market scenario. The model involves one million agents, each of whom has the role of both buyer and seller of a necessary commodity, such as groceries or (for drivers) gasoline. As buyers, the agents must buy the product in question, but they can choose which seller they buy from. As sellers, the agents can set their price, knowing that too low of a price will not make them much [profit](#), and too high of a price will drive buyers away to another seller.

As the game evolves, buyers and sellers continuously update their strategies: buyers change where they shop by comparing prices, and sellers raise or lower their prices by replicating the prices of other sellers who have higher profits.

The key variable in the game is who can update their strategy the fastest. If buyers can update their strategy at a fast rate relative to sellers, the model shows that the pricing favors the buyers. Since the sellers offering the lowest prices will profit most, other sellers will replicate these low prices until all sellers have the same low price.

But if sellers can update their strategy at a fast rate above a critical value compared to buyers, then the entire population of sellers benefits at the expense of all the buyers. This is because the sellers are quick enough to copy the high prices of more profitable sellers before the buyers have a chance to react. Soon, there are no low-priced options available, marking the emergence of a cartel-like phase.

“Our work shows that the deciding factor for whether a cartel can self-organize is the relative speed of buyers in comparison to sellers in updating their strategy,” Bornholdt said. “For consumers, price comparison websites and smartphone apps can be a potential means to react more quickly to price changes. If a global and real-time ranking of sellers is available, this could significantly thwart a cartel-like scenario. Note that the mere existence of such catalogs is not enough, it has to be used by a significant portion of the buyers; otherwise it has no effect, since a small number of buyers will not be able to benefit from it in the long run.”

Unlike the first scenario where prices settle at a stable low point, in the cartel-like scenario the model shows that the high prices fluctuate tremendously due to the ongoing competition among sellers, sometimes dipping down to reasonable prices. The price fluctuations are highest at relative strategy update rates close to the critical value, demonstrating typical critical behavior. When the sellers’ strategy update rate far exceeds the critical value, the price fluctuations diminish somewhat, but remain significant.

The model also shows another interesting feature of these price fluctuations: the average price often rises very quickly and decreases more slowly. This type of oscillation, called an Edgeworth price cycle, is often observed in real life and can be predicted by simple models when just two sellers are involved. In contrast, the model used here incorporates numerous sellers as well as the impact of buyer behavior, providing a more realistic system. Nevertheless, the researchers explain that using the model to predict future prices would be difficult, since the price cycle dynamics are aperiodic and not easily predictable.

However, the results could still be useful for market regulation, where regulators often discuss whether price fluctuations result from collusion among companies in an attempt to increase profit. If [sellers](#) are just quick to individually update their pricing strategies, then high gas [prices](#) may simply be a natural result of the market. The researchers plan to improve the model in the future.

“The model can be made more realistic in a number of ways, in particular by implementing spatial constraints (a cheaper gas station which is 100 km away is not a viable option),” Bornholdt said. “Spatial constraints can sometimes significantly alter the dynamics in this type of system.”

More information: Tiago P. Peixoto and Stefan Bornholdt. “No Need for Conspiracy: Self-Organized Cartel Formation in a Modified Trust Game.” *Physical Review Letters* 108, 218702 (2012). [DOI: 10.1103/PhysRevLett.108.218702](https://doi.org/10.1103/PhysRevLett.108.218702)

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Citation: High gas prices may be explained by self-organized cartel behavior (2012, June 21)
retrieved 23 April 2024 from
<https://phys.org/news/2012-06-high-gas-prices-self-organized-cartel.html>

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