



## On pricing anomalies and the limits of arbitrage

**Textbooks say that even minuscule differences in the price of identical goods in two places should be short-lived. But anomalies do exist, and they often persist for far longer than theories predict, write Denis Gromb and Dimitri Vayanos.**

An economist is walking down the road with a friend, who notices something out of the ordinary – a \$100 bill in the gutter. “It’s a fake,” says the economist, without even looking at the note. “How do you know?” the friend asks. “If it were genuine,” the economist replies, “then someone would have already picked it up.”

Anomalies in pricing make free-market economists uncomfortable. Like free lunches, and \$100 bills lying in the street, according to the cornerstones of financial economics such as the Law of One Price and the Efficient Market Hypothesis, they shouldn’t really exist. Prices for identical assets, such as a barrel of oil traded both in New York and London, should be identical.

Textbooks say that even minuscule differences in the price of identical goods in two places should be short-lived. Eagle-eyed arbitrage traders will swoop and make some easy money. For example, if crude oil is even one cent cheaper in Singapore than in London, say, then arbitrageurs can make a profit by buying oil in Asia and selling it immediately in the UK. Extra demand pushes the price of oil higher in Singapore, and extra supply pulls it lower in London, and so the price equalises.

But anomalies do exist, and they often persist for far longer than theories predict. As a result, economists are revisiting theories about arbitrage – the process which should equalise prices if they get out of line – in light of the recent financial crisis.

Many financial economists now argue that there are limits to arbitrage – and have started to come up with fresh insights and explanations. They have far-reaching implications for our understanding of how financial markets work and should be regulated.

For arbitrage to work in theory, banks and other financial institutions need sufficient capital so their trades are big enough and frequent enough to make anomalies in prices of commodities or bonds or shares disappear. This is the Unconstrained Arbitrage Hypothesis.

In real life, arbitrageurs may need an enormous amount of capital to make a profit out of tiny differences in price. Take the oil example, where the price differs by just one cent, to make one dollar of profit, you need to buy and sell one hundred barrels of oil. At \$100 a barrel, that’s \$10,000 of capital. Of course, much of that capital can be borrowed. But 100 per cent leverage is usually not possible and arbitrageurs must contribute some of

their own scarce capital.

After this latest financial crisis, everyone seems to be conserving capital and not risking it on arbitrage. Investment banks have cut back on in-house proprietary trading desks to keep regulators and shareholders happy. Hedge funds have suffered massive redemptions.

So arbitrageurs can't always raise the money they need even when they spot good investment opportunities. That has major implications.

If, and when, their capital is low, strange things happen. Instead of calming markets, arbitrageurs can destabilise them and help spread panic.

For a start, small changes can have big effects. Capital-strapped arbitrageurs may not be able to absorb a sudden price fall. Worse still, they might have to sell their existing holdings of that asset quickly to limit their capital losses. That pushes prices even lower.

Also, the effect can be contagious – and can help to explain why apparently unrelated markets can also fall. Arbitrageurs draw from the same pool of capital to absorb shocks in different markets. So they might have to sell assets in other markets too, driving prices of apparently unrelated assets lower as well.

### The research agenda

Research on the limits of arbitrage might very well reshape our understanding of financial markets. But most importantly, can it be useful when setting public policy?

Despite its relevance, welfare analysis of asset markets with limited arbitrage is still in its infancy. But it has great potential as it emphasises how the well-being of financial institutions affects the way markets function. When asset prices fall, their capital may not be sufficient.

So do arbitrageurs take risks with their capital in a way that is good for them and good for society as a whole? An earlier paper laying out a model of financially-constrained arbitrage (Gromb and Vayanos, 2002), explains why the answer is “no.”

Arbitrageurs must use their capital in one of two ways. On the one hand, they can take advantage of current opportunities. On the other hand, they can set aside capital for when the going gets tough.

Some prominent investors follow such a strategy. They have to weigh up the costs and benefits of keeping that money in reserve in case of a big market shock, against the costs of missing out on some risky but profitable opportunities in more

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normal times.

Standard theories suggest that the ‘invisible hand’ of the markets – that is, the pricing system – would guide them to do what’s best for society.

These theories, however, assume that the limits to arbitrage are so small as to be, by and large, negligible. Once such limits are introduced into the picture, the invisible hand gets shaky. As a result, like others acting in their own self-interest, arbitrageurs do not do what’s best for society. For instance, they tend to put much more of their capital to work – and at risk – to make money in ordinary conditions.

We’ve already seen how chain reactions deprive arbitrageurs of capital when markets plunge – in other words, at the very moment when arbitrage would be most socially useful.

So if the pricing system cannot do its job of guiding arbitrageurs to make the right choices, can someone else – a regulator perhaps – provide that guidance?

Incentivising through regulations or even forcing arbitrageurs to take less risk could make everyone better off, arbitrageurs included.

How might this be best achieved? Through risk-based capital requirements? Taxes and subsidies? A policy on lenders of last resort? Asset-purchase programmes? This is pretty much where the research agenda is right now.

The answers to these fascinating questions are still pending and keeping financial economists and central bankers busy. Hopefully, they’ll be ready by the time the next crisis hits.

In the meantime, if you see a \$100 bill lying in the gutter, pick it up. It might just be real – and your friendly neighbourhood arbitrageur might need it.

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For more on the ‘limits of arbitrage’, click here.

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