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Microeconomics

A golden age of micro

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MICROECONOMISTS are on the march, winning top awards (http://www.aeaweb.org/honors_awards/clark_medal.php) , helping battle the crisis, and advising the world's most innovative firms. This week the trend continued, with the Nobel Prize going to two microeconomists. Why are they doing so well?

First up, microeconomists seem to be very good at building new findings on old foundations. Take the Nobel Prize, covered by a colleague in the Free exchange print article—Game, set and match (http://www.economist.com/news/finance-and-economics/21564836-alvin-roth-and-lloyd-shapley-have-won-year%E2%80%99s-nobel-economics) —this week. The prize went to economists who built on cooperative game theory, an ancient development by economic standards (one of the main papers was published in 1962). Cooperative game theory looks at how well people can do when acting together; by examining all the possible combinations, theorists can spot outcomes that individuals acting alone cannot achieve. They then focus on something called the "core" of the game—those outcomes that are "stable" in the sense that no subgroup would do better by breaking away and acting alone. So far, so theoretical. But the theory is pivotal in understanding how to set up medical job-matching system in a stable way so that no hospital or medical school wants to break off and set up alone. Fifty years on, there are other applications too: cooperative game theory is still being used in cutting edge auction design.

And the Nobel is just one example of real-life problems solved by micro. A thoroughly macroeconomic problem—unconventional monetary policy—is another. In 2007 and 2008, central banks and finance ministries decided that it was a good idea to follow this policy which involves exchanging good assets (cash or treasury bills, for example) for illiquid ones. But working out exactly *how* to do it was a very different question. One major stumbling block was to work out what price to pay for the bad assets: markets were thinly traded and prices often did not exist.

Micro theorists came up with the answers. In America, various academics advised the US Treasury in 2008. But the best example of micro in action is Britain, where the Bank of England uses a new type of auction—the Product Mix auction—designed by Paul Klemperer (http://www.paulklemperer.org/) . The Bank's Governor, Sir Mervyn King, clearly finds micro theory useful:

> *"The Bank of England's use of Klemperer auctions in our liquidity insurance operations is a marvellous application of theoretical economics to a practical problem of vital importance to financial markets."*

There is an important lesson about making cutting edge economics accessible here. Auction theory uses *very* tough mathematics to grind out results. But micro theorists also work hard on the intuition for their work. As an example, the results from Mr Klemperer's auction can be set out in a simple graphical format, see (here (http://www.nuff.ox.ac.uk/users/klemperer/substsauc_NonConfidentialVersion.pdf)). This means non-specialists (like central bank governors) can access it easily, making it much more useful in policy settings. In macroeconomics, the opposite seems to be true: the maths is actually easier, but it is just hard enough to exclude non-specialists, and this shields models from popular scrutiny.

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Creating confidence in cash

A new auction mechanism devised at Oxford is strengthening the financial system, as *Anthea Milnes* discovers

'A world first in central banking...potentially a major step forward in practical policies to support financial stability'

Paul Fisher, Executive Director of the Bank of England

The Bank of England has started using a new auction designed by Paul Klemperer, the University's Edgeworth Professor of Economics, which should help make the financial system more robust.

Professor Klemperer has been helping the Bank *pro bono* since he was approached by Mervyn King, Governor of the Bank of England, at the onset of the credit crunch in 2007. Following the run on Northern Rock, King urgently needed to be able to pump large amounts of cash into the commercial banks and building societies in order to prevent the collapse of the financial system. The Bank's own auctions – in which the banks and building societies make bids to borrow money in return for interest payments – had failed to get funds to where they were most desperately needed.

'Successful auction design involves mathematical modelling, data analysis and a good understanding of both the bidders' and the auctioneer's objectives,' Klemperer explains. 'The rules that govern an auction will affect whether bidders participate, how they bid, and whether they will try to manipulate or undermine the auction.' The process of designing the auction therefore involved specifying what kinds of bids were possible, how the winners would be determined, what the winners would get, and what they would pay.

The Bank of England's situation was particularly challenging because different bidders were asking for loans of funds on different terms, specifically offering different collateral as security for these loans, and the Bank wanted to be able to charge winners different interest rates accordingly. (Charging the same interest rates for risky loans as for safe ones would encourage borrowers to undertake riskier activities.) Making things even harder, the Bank wanted the amount of funds linked to each different type of collateral to depend on the bidding, because the Bank neither had enough information to specify these amounts in advance, nor did it want to publicly reveal its own view of the severity of the crisis. Furthermore, bidders might want to make 'either/or' bids, for example, a bidder might like to win A or B but not both, or would be willing to pay £*x* more to receive A than to receive B.

Klemperer had developed auctions designed to generate multiple prices for multiple goods previously, including the 3G mobile phone licence auction, which sold five licences of three different sizes, famously netting the British government £22.5bn in 2000 – five times the predicted amount. However, that auction, and others like it, required many rounds of bidding: the 3G auction took 150 rounds which took place over seven weeks. Since financial markets move fast, the Bank of England's auction had to run instantaneously, so new techniques were required. Permitting the amounts of funds loaned to vary in response to the bidding was also an innovation.

Klemperer came up with a solution he christened the Product-Mix Auction, a single auction for multiple types of funds that would allow borrowers to simultaneously submit combinations of bids, and would also allow the Bank to avoid specifying the proportions of different types of funds it allocates until after the bidding. 'And crucially,' Klemperer explains, 'it is much quicker and simpler to use and less vulnerable to collusion than existing multi-price auctions.'

Paul Fisher, Executive Director of the Bank of England, commented: 'The Bank's Indexed Long-Term Repo [auctions] represent a world first in central banking...This is potentially a major step forward in practical policies to support financial stability.'

Now that Klemperer's design has been successfully used by the Bank of England, other Central Banks are considering implementing it. A similar approach could also have important applications elsewhere, such as the purchase of electricity generated in different locations. It might also be used as a mechanism for trading biodiversity, for example, by allowing developers to trade off development in one place against greater conservation elsewhere. Klemperer is working with doctoral students Elizabeth Baldwin and Daniel Marszalec on improving his design further.

'Many people think auctions are just about raising lots of money,' Klemperer says. 'It's nice to demonstrate that well-designed auctions can also help with more important problems, such as making the financial system safer, and conserving the environment.'

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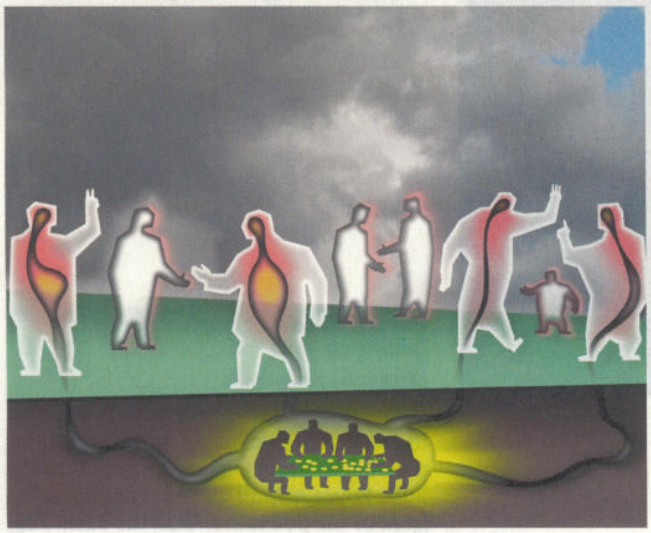
How auction theory can help improve the system for setting LIBOR



PITY the British Bankers' Association (BBA): it lacks the tools it needs to do its job. It sets one of finance's most important interest rates, but the prices it needs to do this do not exist. The London Inter-bank Offered Rate (LIBOR) aims to represent the prices banks charge when lending to one another. The rates are required every day, including in currencies and at maturities where actual transactions are rare. To find the right prices the BBA uses a system that works a bit like an auction. And auction theory might just help rectify the flaws in LIBOR.

No two auctions are exactly alike but the BBA could also borrow from the ideas of others. In 2007 and 2008 the Bank of England (BOE) and America's Treasury both wanted to push cash into illiquid markets by buying up dodgy collateral. But markets had dried up, so there were no prices for these assets. Both called in auction experts—Paul Klemperer of Oxford University for the BOE and Paul Milgrom of Stanford University for the Treasury.

In Mr Klemperer's "product mix" auction, bidders submit detailed bids, which include both the prices they would pay and quantities they would accept for a range of goods. Because bids are simultaneous and are never revealed, bidders cannot learn from one another, making collusion harder. Since the auctions are of the many-winner financial type, a knockout system, as in the stamp bidding ring, is unlikely.

Having received a set of bids for different goods, at various prices and quantities, the auctioneer in Mr Klemperer's set-up then conducts a proxy auction on bidders' behalf to see who should get what, and what the price should be. Because nothing is revealed to the bidders and they know they cannot influence this process, their best bet is to tell the truth. What is more, since the auctioneer has price information for a range of quantities, it is possible to see how prices change as supply does.

The BBA needs to rework LIBOR completely if it wants to save it. The kinds of ideas being used in auctions might help it do that. If it could elicit honest prices for various quantities of money-market lending it would be able to provide both an accurate LIBOR rate and information on how LIBOR might move as banks' financing needs change. This price information would be valuable to regulators. At the moment LIBOR is just a made-up price for an ill-defined quantity of money. Time to call an auctioneer. ■

* Papers cited in this article can be seen at economist.com/auctions12

Economist.com/blogs/freeexchange

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Why banks are going to auction

By Tim Harford

In 1873, Walter Bagehot famously argued that in a banking crisis, the Bank of England should be willing to lend "freely and readily" in exchange for good collateral. This view seemed quaint five years ago, when international capital markets were willing to pay cash for the most illiquid-seeming assets, but it quickly became relevant during the credit crunch.

Yet it is a challenge to support banks that are temporarily embarrassed by a lack of liquidity, without bailing out bankrupt banks or relieving them of all responsibility for their own liquidity management.

Paul Klemperer – the Oxford University theorist behind the auctions for "3G" mobile phone licences 11 years ago, and less gloriously my thesis supervisor – has been working with the Bank of England to design an auction to solve the problem. The design exploits a long tradition in auctions: that of proxy bidding.

In a standard auction, a proxy bid of, say, £260 for a case of champagne means that the buyer is happy to outbid all-comers until the bidding reaches £260.

The Klemperer auction design allows bidders to submit multiple proxy bids for different kinds of object. Imagine an auction in which both vintage and non-vintage champagne is available, and several cases of each are on offer. A package of bids might include one of £250 for a case of non-vintage champagne, plus a "paired" bid of either £300 for vintage champagne or £200 for non-vintage, plus a third, bottom-feeding, bid of £150 for a case of vintage or £100 for non-vintage, useful if prices are low. Depending on how prices in the auction work out, this package of bids might win up to three cases of champagne, and the quality would vary depending on which kind of champagne was more in demand.

Although it may need a computer to figure out exactly who gets what, this basic idea is not too troubling, and the multiple proxy bids enable a bidder to specify, quite intuitively, how much booze they'd like to buy, and what sort of price-differential would tempt them to favour one type of champagne over another.

This is roughly what the Bank of England is now doing to supply liquidity to banks. The banks bid different interest rates to borrow money from the Bank, and offer either higher- or lower-quality collateral, depending on the interest rate premium required for the lower-quality stuff.

(It would be possible to run two separate auctions or combine the two auctions into one, with some fixed premium for low-quality collateral. But the first alternative dilutes the competitiveness of the auctions, while the second will malfunction if the Bank misjudges the level of the premium.)

The Bank has been running these auctions every month since last summer, and seems pleased with the innovation. The auctions may seem fiddly, but "all the complexity lies on our side", says Chris Salmon, an executive director and chief cashier at the Bank of England. While they haven't yet been tested under stress, they offer something quite attractive: a flexible tool, ticking away in the background, with the ability to prevent old-fashioned, self-fulfilling bank runs.

Klemperer, meanwhile, has his eye on wider horizons. His auction design could, in principle, be used to buy – or sell – dozens, even hundreds, of substitute products at the same time.

This is an idea with many uses. It could be used to run electricity networks by selling intermittent power and baseload power in the same auction, or to sell planning permission on green-field and brown-field sites – a prospect to gladden George Osborne's heart. And in a future banking crisis, it could be used by a government wishing to establish a proper price for toxic assets. The Bank of England, I suspect, is hoping that particular use remains theoretical for many decades yet.

Tim Harford's latest book is 'Dear Undercover Economist' (Little, Brown)

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Central bank liquidity and "toxic asset" auctions

Paul Klemperer, 25 September 2009

The crisis set policymakers scrambling for appropriate mechanisms to respond to financial turmoil. This column proposes a new auction design that can be used for toxic asset purchases and central bank liquidity auctions in a credit crunch.

The crisis began in early August 2007, and a bank run led to Northern Rock's collapse in mid-September. The Bank of England wanted urgently to supply liquidity to banks and was therefore willing to accept a wider-than-usual range of collateral, but it wanted a correspondingly higher interest rate against any weaker collateral it took.

A similar problem faced the US Treasury during its autumn 2008 Troubled Asset Relief Program where it planned to spend up to $700 billion on "toxic assets" with a face value well in excess of $1 trillion (Pagano 2008). There were on the order of 25,000 closely related but distinct securities and perhaps 300 likely sellers, but the largest ten sellers held something like two-thirds of the toxic assets.

Complicating matters in both cases, the pace of financial markets required any auction to take place at a single instant, thus ruling out many of the multistage auction techniques used in other areas. The problem with multi-stage auctions in the financial world is that bidders who entered the highest bids in early stages might change their minds about wanting to be winners before the auction closed. Moreover, financial markets themselves might be influenced by the evolution of the auction creating opportunities for manipulation.

How to proceed: A new auction design

How should goods that both seller(s) and buyers view as imperfect substitutes be sold, especially when multi-round auctions are impractical? This column outlines a new solution to all these problems – the "Product-Mix Auction" (so-called because it solves the general problem of a firm that can offer multiple product varieties to customers with different preferences, subject to capacity and other constraints).

My design is straightforward in concept – each bidder can make one or more bids, and *each* bid contains a *set* of mutually exclusive offers. Each offer specifies a price (or, in the Bank of England's auction, an interest rate) for a quantity of a specific "variety". The auctioneer looks at all the bids and then selects a price for each "variety". From each set of offers in each bid, the auctioneer accepts the one that gives the bidder the greatest surplus evaluated at the selected prices or no offer if all the offers would give the bidder negative surplus. All accepted offers for a variety pay the same (uniform) price for that variety.

The idea is that the menu of mutually exclusive bids allows each bidder to approximate a demand function, so bidders can, in effect, decide how much of each variety to buy *after* seeing the prices chosen. Meanwhile the auctioneer can look at demand *before* choosing the prices. (Allowing the auctioneer to choose the prices *ex post* creates no problem here because it allocates to each bidder precisely what that bidder would have chosen given those prices in the environments for which the auction is proposed.) Importantly, offers for each variety provide a competitive discipline on the offers for the other varieties, because they are all being auctioned simultaneously.

Comparing a product-mix auction with existing approaches

Compare this with the three "standard" approaches:

The first traditional approach is to run a separate auction for each different "variety". In this case, outcomes are erratic and inefficient, because the auctioneer has to choose how much of each variety to offer before learning bidders' preferences, while bidders have to guess how much to bid in

each auction without knowing what the price differences between varieties will turn out to be. The wrong bidders may win, and those who do win may be inefficiently allocated across varieties.

Furthermore, each individual auction is much more sensitive to market power, manipulation, and informational asymmetries than if all offers compete directly with each other in a single auction. The auctioneer's revenues are correspondingly generally lower. Thus, for example, if the US Treasury had simply predetermined the amount of each type of security to purchase, ignoring the information about demand for the large number of closely related securities, competition would have been inadequate because of the highly concentrated ownership of the assets. All these problems also reduce the auctions' value as a source of information. They may also reduce participation, which can create "second-round" feedback effects further magnifying problems.

A second common approach is to set fixed price supplements for "superior" varieties and then auction all units as if they are otherwise homogeneous. This can sometimes work well, but such an auction cannot take any account of the auctioneer's preferences about the proportions of different varieties transacted. In any case, a central bank might not want to disclose its view of appropriate price-differentials for different collaterals to the market in advance of the auction. Furthermore, the auctioneer suffers from adverse selection. If, for example, the US Treasury had simply developed a "reference price" for each asset, the bidders would have sold it large quantities of the assets whose reference prices were set too high – and mistakes would have been inevitable, since the government had much less information than the sellers.

The final approach that is sometimes used is the simultaneous multiple round auction – the multi-stage auction in which bidders take turns bidding on multiple assets until no one wants to bid again on any asset. My product-mix auction yields similar outcomes but is more robust against collusion and other abuses of market-power. Furthermore a simultaneous multiple round auction is often infeasible – especially in financial markets – because of transaction costs, the time required to run it, or because its complexity is too off-putting to bidders.

In Klemperer (2009), I show how my new approach – the product-mix auction – can be implemented, and that it is simple, robust, and easy for bidders to understand, so that they are happy to participate.

The product-mix auction yields better "matching" between suppliers and demanders, reduced market power, greater volume and liquidity, and therefore also improved efficiency, revenue, and quality of information than feasible alternatives. Its potential applications therefore extend well beyond the financial context.

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