"THE PRICE IS RIGHT":

USING AUCTION THEORY TO ENHANCE COMPETITION IN THE NPL MARKET*

Edoardo Gaffeo
Department of Economics & Management
University of Trento

Ronny Mazzocchi
European Parliament

Abstract

Almost a decade after the onset of the global financial crisis, a huge stock of non-performing loans (NPLs) still represents a major burden for European banks' profitability and a severe headwind for credit growth at an area-wide level. While a great deal has been done to establish stricter supervisory rules and more robust insolvency frameworks, the development of an efficient secondary market for impaired assets is currently lagging behind, especially in the countries where the level of troubled loans is more worrisome. To address this problem, the European Banking Authority has recently proposed to set up an EU-backed asset management company (AMC) for the exchange of NPLs. In addition to the difficulties associated to a full compliance of a public AMC with EU State aid rules, we argue that such a vehicle might be useful in solving just one of the three failures typically affecting the market for NPLs, that is the information asymmetry between buyers and sellers. To successfully tackle the other two – namely, market power and collusion – a correct design of the market is crucial. From this point of view, auction theory can be of great help.

Keywords: Non-performing loans; Asset management companies; Auction theory.

1. Introduction

An unpleasant legacy of the global financial crises and the ensuing economic downturn has been the buildup of a huge stock of non-performing loans (NPLs) on the balance sheets of European banks. Albeit slowly regressing from the peak, at the end of 2016 the group of most relevant entities directly supervised by the ECB still held on their books around €900 billion of troubled loans, a figure corresponding to 9% of the whole euro area GDP. The problem is particularly acute in six countries (Cyprus, Greece, Ireland, Italy, Portugal and Slovenia), where non-performing exposure ratios are at two digit levels. And given the size of its economy, it comes as no surprise that the case of Italy has been placed under special surveillance from several quarters (Garrido *et al.*, 2016; Gros and de Groen, 2016).

In addition to the risks for the area-wide financial stability stemming from negative spillovers flowing through the network of interbank exposures, policymakers and regulators have repeatedly expressed deep concerns about the possibility that the bulge of bad loans and credits of dubious quality saddling banks may reduce their capacity to lend, hindering at one time the transmission mechanism of monetary policy and the strength of the economic recovery. In particular, high levels of troubled loans can penalize the supply of credit through three distinct channels. First, high stocks of NPLs reduce the profitability of banks. This occurs either because troubled loans tend to generate lower income streams in comparison to performing ones, and because of the negative impact of higher provisions on net income. Second, the cost of funding increases as investors perceive an increase of risk associated with excessive volumes of NPLs. Finally, due to higher risk weights on impaired assets, NPLs – even if adequately provisioned – absorb valuable capital that could instead be used more efficiently for new lending. At the same time, since NPL sales occur at a price that is typically lower than their book value, banks' capital ratios tend to be seriously affected. Massive sales –instead of improving the soundness of balance sheets – can cause economic losses and capital shortfalls that banks may not be able to address. Paradoxically, this could determine a powerful disincentive for banks to sell their NPLs (Gangeri *et al.*, 2017).

As suggested by the IMF, the solution to the post-crisis NPL overhang can only pass through a comprehensive strategy based on three pillars (Ayar *et al.*, 2015): *i*) stricter supervisory rules; *ii*) legal reforms aimed at speeding enforcement procedures and enhancing insolvency regimes; *iii*) the development of a secondary market for NPLs, enabling their fast deconsolidation from banks' balance sheets. With regard to the first two pillars, it must be conceded that much has already been done. On one hand, in October 2013 the EBA defined technical standards on the definition of NPLs and forbearance, while at the time of writing the ECB is expected to issue a guidance to supervised banks on how to arrange annual plans on the recognition, classification, management, provisioning and impairment of troubled loans on a harmonized basis.[1] On the other hand, during the last few years many European countries have significantly overhauled their insolvency and foreclosure regimes and strengthened their judicial systems (IMF, 2015; Costancio, 2017). For example, estimates suggest that the series of legislative measures issued by Italian authorities in August 2015 should lead, once fully operational, to a fall in the average duration of bankruptcy procedures and foreclosures of about 50% and 25%, respectively (Marcucci *et al.*, 2015).

However, unless the third pillar will become truly effective the stock of NPLs accumulated so far by European banks is likely to remain a burden for a prolonged period. According to simulations reported in Jassaud and Kang (2015), starting from the current pace – with

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[1] The guidance was put on public consultation in October 2016. Its official release is expected by the first quarter of 2017.

transactions averaging at €30 billion per year during the period 2015/16 – the average NPL ratio of Italian banks might return to pre-crisis levels by 2021 only if the volume on this market increases fivefold. For this to happen it is necessary that the price gap between demand and supply could shrink significantly. In other words, the market for NPLs has to become more competitive. This could be achieved by reducing or eliminating the three types of failures that characterize this market: i) the presence of asymmetric information; ii) the significant market power of one of the parties involved (i.e., the buy side); iii) the possibility of collusion.

The purpose of this article is to contribute to the ongoing European debate on a viable and sustainable development of the third pillar. Starting from the financial turmoil which affected several East Asian countries at the end of the 1990s, a standard approach to a systemic resolution of banking crises have been the use of public asset management companies (AMCs) to purchase portfolios of NPLs booked on banks' balance sheets, with the aim of disposing or restructuring them (Campbell, 2007; Hryckiewicz, 2014).[2] A similar view has been recently endorsed by authoritative voices deeply involved in EU banking supervision. While we recognize that the establishment of an EU-wide AMC may help to simultaneously accelerate the process of value recovery for banks and prevent adverse macroeconomic side effects, we also highlight several constraints and limitations characterizing the proposal. In particular, we argue that the creation of a public AMC can reduce the problem of asymmetric information, but it is not able to properly face the other two market failures highlighted above. Hence, we present a mechanism for auctioning off NPLs that could be much more effective in reducing both the market power and the collusion problems.

2. The EBA proposal: merits and flaws

In the aftermath of the 2008 global financial crisis, several European countries have set up targeted asset management companies (AMCs) to kick-start a secondary market for the NPLs accumulated in their national banking systems, with the aim of shirking the large bid/ask spread depressing transaction volumes (Medina Cas and Peresa, 2016).[3] The reason behind this spread is typically determined by an irksome price-discovery process mostly related to the absence of liquidity. While sellers of NPLs may be either reluctant to accept heavy losses or unduly optimistic regarding the final expected recovery value, buyers may have limited information on the precise financial stance of the loans on sale. Their willingness to pay is therefore lowered, as they price in potential restructuring costs and additional risk premia. In addition, there could be a first mover disadvantage to sell into the market. Before disposing of their troubled loans, therefore, banks may be willing to wait for competitors to explore the market first. While in the wake of the crisis some AMCs have been set up with private capital in order to deal with specific assets classes on a relatively small scale, now that the issue has assumed systemic proportions purely private sector solutions are not deemed as sufficient to properly address all these problems (Costancio, 2017).

The establishment of a common European AMC – or the design of a coordinated blueprint for national government-sponsored AMCs – has been recently backed by the Chairperson of the European Banking Authority (EBA) Andrea Enria (2017). While several details are still missing, the general framework of the EBA's proposal proceeds along the following steps:

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[2] According to the Basel Committee on Banking Supervision (2015, p.65), an AMC is a "[...] special purpose company set up by a government, a bank, or by private investors to acquire loans and other assets, a majority of which are impaired, for subsequent management (including restructuring) and, in many cases, sale to investors".

[3] Relevant examples – all of them set up between 2009 and 2012 – are NAMA in Ireland, FMS in Germany and Sareb in Spain. The Hungarian MARK has been established in November 2014.

i) Stress-testing procedures are applied to each bank, with the aim of defining the capital shortfall that may be realized in an adverse provisioning scenario over a three-year horizon. The theoretical amount of potential State aid, in the form of precautionary recapitalization, is equal to the difference between the Real Economic Value (REV) and the Current Market Price (CMP) of NPLs.

ii) The sale of NPLs to the AMC takes place at a price equal to their REV, determined by the buyer as a result of due diligence. The transfer price should reflect the market value of NPLs in the absence of market failures. Obviously, the higher the level of provisioning, the more the REV would approximate the provisioned value of loans (net book value, NBV). Banks would not be formally obliged to carry out the sale, but should be pushed to do it by supervisory authorities.

iii) Any loss resulting from the initial transaction – defined by the difference between the NBV and the REV – is immediately absorbed by the bank's shareholders.

iv) The AMC is committed to sell on the secondary market the NPLs it has acquired from banks within a time period of three years. The selling price for these transactions represents the CMP.

v) If the selling price on the secondary market turns out to be lower than the REV, the difference (loss) is charged ex-post to the originating bank through the activation of *clawback* clauses. These clauses must be inserted in the original sale contract between the bank and the AMC.

vi) To absorb these potential losses, banks should issue stock warrants that would allow the State to subscribe new capital at an exercise price. In order to reduce moral hazard by participating banks, the strike price of the warrant should be penalizing for the issuer.

The proposal possesses undoubtedly three strengths. First, it can ease the achievement of a satisfactory critical mass of exchanged NPL volumes, encouraging the standardization of classification schemes and the kind of information made available to investors. Second, since the disposal of NPLs would take place at the REV and not at the CMP, banks might be encouraged to sell rather than to hold on provisioned loans. Third, the establishment of a single European AMC could command a higher credit standing than that of the countries/banks engulfed by large stocks of NPLs, and this could significantly reduce its cost of funding.

However, the proposal is also affected by two critical features that threaten to undermine its value. First, the presence of the *clawback* clause could prevent a full removal of loans from banks' balance sheets. Indeed, to allow for the derecognition of a financial asset, the IAS-39/IFRS-9 standard requires that all the risks and rewards related to written-off assets are effectively transferred. The presence of the warrant would not allow such a derecognition, however, either because the loss-absorption involvement of the State would be optional, and because the warrant should be accounted in the P&L statement of the bank as a financial liability measured at *fair value* until its final settlement. In principle, it could be possible to classify the sale for prudential purposes by following existing securitization rules, but the resulting capital requirement would be such as to nullify the benefit of any derecognition.[4]

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[4] As a result of the *clawback* clause, the bank would remain exposed to the first losses on the NPL portfolio. After that, it should apply a risk weight of 1250% or deduct the value of the assets sold from own funds.

The second concern regards the consistency of the whole proposal with the current State aid framework and the BRRD Directive. As regards the former, three are the main aspects to be taken into account. First, since the AMC has an implicit public guarantee, its funding costs on the debt market is likely to be low. If private funds are admitted in the AMC's capital base, as the EBA's proposal seems to admit, there is a transfer of benefits to private investors that could be considered as State aid. Second, if the purchase of NPLs by the AMC were to occur at prices higher than the market price, the transaction would qualify once again as State aid. However, such aid may be considered compatible with the Treaties provided that the transfer price does not exceed the REV, and provided that all the other requirements of the State aid discipline are fulfilled.[5] These include the approval of a restructuring plan and the application of *burden-sharing* measures (European Commission, 2013). With respect to the consistency of an EU-backed AMC with the recovery and resolution framework, in turn, art.32(4) of BRRD introduced certain specific requirements for the use of public funds outside resolution procedures. These include the possibility to execute a direct precautionary recapitalization of a solvent institution in covering the losses emerging in stress tests under an "adverse scenario". However, these provisions only refer to injections of public funds to *individual* banks, and not to indirect recapitalizations orchestrated through an AMC. In addition, since the potential exercise of the warrant by the State would occur only after the impairment loss has been realized, it is difficult for this type of intervention to be qualified as a precautionary one.

These aspects – rather than being determined by existing laws, communications and Treaties – are related to the fact that the EBA's proposal is not able to fix all the failures affecting the NPL market. While an AMC could be effective in overcoming asymmetries of information by leading to a comprehensive due diligence (Fell *et al*., 2016), neither the problem of market power on the demand side nor the risk of collusion among buyers are properly addressed. Private investors are still not incentivized to truthfully reveal their willingness to pay or to compete forcefully, so that the CMP may end up well below the reservation price of the originators. As a result, once the ACM goes to the secondary market the buy side is allowed to appropriate the entire surplus. These issues can be mitigated only by a proper design of the mechanism through which NPLs are marketed.

3.   A brief tutorial on auction theory

The key point is that both the market power on the demand side and the risk of collusion among buyers are strictly dependent on the market structure within which NPLs are sold, which invariably takes the form of an auction. In our case, the good for sale is the gross book value (GBV) of a troubled loan (for example, €100), while the allotment price is the net amount that the buyer pays to the seller (say, €34). At first glance, it could appear that selling an asset through a first-price ascending auction – a mechanism in which bidders gradually drop out as the seller steadily raises the price, while the highest bidder wins the object by paying the value of her bid – always represents an efficient way to allocate items: the bidder with the highest price is the one who values the good the most, while the seller succeeds in maximizing revenues. In fact, the matter is much more complicated than this, and decades of economic research have explained why.

In order for a first-price ascending auction to keep all its promises of efficiency and revenue maximization, it is necessary that the set of bidders is large and that none of them can exercise a significant market power. For example, if some of the potential bidders have binding budget

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[5] The REV is defined as the future cash flows likely to be generated by the assets, net of the workout costs, discounted to the present with a discount rate including a limited risk premium (Boudghene and Maes, 2012).

constraints, weaker competitors anticipate that the stronger ones can easily top their bids and will therefore have little incentive to participate in the auction from the start. Affected by limited competition due to entry deterrence, the highest price offered by the winner will be systematically lower than the efficient one.

A similar result occurs if *ex-post* – i.e., once awarded – the item is worth the same to every buyer, but bidders have different *ex-ante* estimates on how much value can be actually realized. Notice that this is precisely what occurs in the market for NPLs, where private investors acquire this kind of assets with a view of reselling them on a secondary market or managing them internally to gain a return. Assuming the buyers can do a comparable good job in reselling it or working it out, the item has an unknown but common value regardless of who acquires it. Buyers' estimates may differ if they have some private information about such common value, however, so that their valuations may differ as well. In this case participants discount the possibility that a success could simply mirror the chance of being the party who has most greatly overestimated the value of the prize – an outcome known as the "winner's curse" – incentivizing them to bid cautiously. Since every bidder bears this risk and the effect is amplified for weaker participants, the allotment price will once again turn out to be lower than optimal.

Finally, the escalation of bids over an ascending auction has the effect of transmitting useful information. In particular, the value each buyer assigns to the object may be affected by the knowledge of the other buyers' valuations. Buyers can thus use this knowledge to further refine their bidding strategy as the auction progresses. While such an iterative process of price discovery can in principle be conducive to a correct identification of the point where supply and demand cross each other, the generation and transmission of information may also support the emergence of (tacit or explicit) collusive behaviors aimed at restraining prices. Early stages can thus offer both a mechanism for punishing rivals deviating from the agreement, and to signal in advance who should win (Cramton and Schwartz, 2000).

To sum up, the allotment price will be efficient if and only if the auction is properly designed. In particular, the market mechanism should succeed in: *i*) attracting bidders; *ii*) encouraging participants to truthfully disclose the value they assign to the item; *iii*) limiting collusion. Unfortunately, a standard ascending auction does not necessarily represent an optimal scheme to deliver these goals, especially when a bank is pressed to sell NPLs for several billion Euros at once. These problems are well known not only to auction theorists, but also to the National authorities that over time have tried to sold valuable goods using ill-advised mechanisms. The failures of the 2000 auction for spectrum licenses in Switzerland and the 1999 one for electricity in the UK are still evoked in microeconomics manuals as horror stories.

4.   A Product-mix auction to sell NPLs

In the aftermath of the Northern Rock bank run, the Bank of England asked an Oxford-based auction theorist, Paul Klemperer, to design an efficient mechanism for providing liquidity to banks against collateral of different qualities. The solution that came out has been named *Product-Mix auction* (Klemperer, 2010), it is nowadays used on a regular basis (Bank of England, 2010; Frost *et al.*, 2015), and in the words of the former Governor of the Bank of England Mervyn King represents "[...] *a marvellous application of theoretical economics to a practical problem of vital importance to financial markets*".[6]

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[6] "A golden age of micro", *The Economist*, Oct. 19th, 2012.

The problem faced by the Bank of England was to sell close substitute goods – loans against strong collateral *versus* loans against weak collateral – making sure that bidders pay the right price (i.e., interest rate) for each one of them. This is a situation encountered in many different instances, from the sale of different types of electricity ("firm" versus "interruptible" contracts) to the allocation of time slots at an airport. In all these cases, the auctioneer wants to sell similar but distinct goods, which in the preferences expressed by buyers are largely but not perfectly substitutable. Treating all the goods as identical by running a single auction creates problems of adverse selection (in that the goods may be allocated to the wrong bidders) and dampens revenues, while conducting separate auctions for each variety turns out in an inefficient competition between varieties, since the seller has to guess how much of each variety to auction separately, while bidders have to guess which auction to bid in.

A possible way to overcome these problems is to use a *simultaneous multiple round* (SMR) auction, a mechanism introduced for the first time in 1994 by the U.S. Federal Communications Commission in selling spectrum licenses (McMillan, 1994). In a SMR auction all lots are on the block at the same time. Bidders may bid on any lot or combination of lots in each bidding round, and may shift their demand across products from round-to-round by topping previous bids. The auction continues until no bidder is willing to raise the last price on any of the items on sale. The bidder with the highest bid for each lot wins, by paying her bid for any items won. Unfortunately, the SMR auction is not immune from drawbacks. Two of them are particularly disturbing. First, the relative quantities of the different varieties to be sold must be chosen at the start of the auction, and do not depend on demand. Second, as the auction proceeds the transmission of information between bidders on one hand, and between the auction and other markets on the other one, may create opportunities for manipulation, collusion and predation.

The main lesson we can take home from a twenty-year history of practical implementations is that in a multi-item environment the auction design matters a lot in avoiding pricing distortions and inefficient allocations. The market for NPLs makes no exception. Under this broad label one finds several different categories of troubled loans varying with regard to the type and outlook of counterparts, level of arrears, purpose of credit facility or nature and location of collateral. Once segmented and grouped efficiently into homogeneous portfolios they form distinct asset classes with well-defined risk-return combinations. The classification adopted in the market – e.g., secured, mainly unsecured, unsecured, consumers, commercial real estate, etc. – largely reflects the different specialization of the private equity investors operating on the buy side. Differences in the business model they adopt in extracting value from distressed debts – ranging from restructuring to liquidation – mean that the price they are keen to pay is negatively affected by the heterogeneity of the bunch they are offered. In an efficient NPLs market two segmented portfolios should therefore command different prices, with their spread capturing the degree of substitutability between varieties rooted in investors' preferences.

This is where the Product-mix auction enters the scene. This type of auction presents a series of advantages if compared to traditional multi-unit ascending mechanisms: being organized in a single round, it is extremely fast; it avoids entry deterrence and potential collusion; it is difficult to manipulate; it provides a greater flexibility to the seller, who is not forced to establish in advance the total quantity that will be sold, but can use instead the information generated through bids to modulate the supply curve; it increases market efficiency by allowing the price paid by a player – conditional on winning – to be independent of her own bids; and, last but not least, in the case of two varieties it admits a geometric representation of immediate understanding.
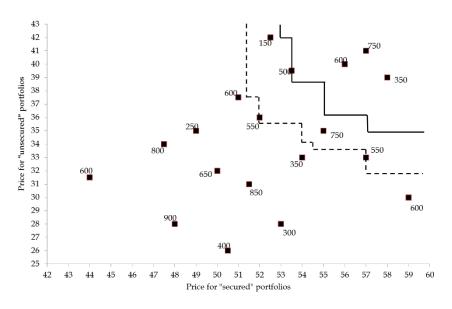
From a technical point of view, the Product-mix auction is a simplified version of the assignment problem analyzed by Milgrom (2009). Suppose that there are M varieties of a good which are offered for sale in positive quantities $(q_1,..., q_M)$ to a population of N bidders. Each bidder is allowed to submit an unlimited number of bids. The ith bid by bidder n is a $M+1$-vector $(z_n; p_{n1},..., p_{nM})$, where the first component (z_n) is a positive quantity and each other component (p_{nm}) is a price. The interpretation of this bid is that bidder n wishes to buy up to z_n units of the good and will pay up to p_{nm} per unit for variety m, while each offer is mutually exclusive. Furthermore, nothing prevents that a bidder chooses to submit a bid restricted to a single variety, $(z_n; 0,..., p_{nm}, ..., 0)$. These unlimited bids for different varieties of the good allow bidders to create a complete demand function.

The best way to grasp how this mechanism could be fruitfully applied to our case is to recur to a numeric example for a two-variety case. Suppose a bank wants to auction €8 billion of NPLs measured at their GBV. In order to exploit the fact that potential bidders differ as regard the niche in which they specialize and the business model they follow, the seller organizes the whole lot to be put on sale into two segmented portfolios – one for commercial real estate loans, and the other for non-collateralized impaired consumer loans – separable in units of €50 million each. For each loan in a pool, the bank provides the loan characteristics, including location, payment history, and any other relevant due diligence information. The auction takes place in a single round, during which each participant is allowed to submit any number of sealed bid as she likes. Each bid contains a proposal which reads as follows: "I'll buy €800 million of NPLs at a price equal to 51% of its nominal value if the NPLs belong to the secured portfolio, or at a price 35% if they are unsecured". The two options are therefore mutually excludable. In other terms, if the bank accepts the price 35% it will sell €800 million of unsecured NPLs only, while it will assign to the bidder €800 million of secured NPLs if the price accepted is 51%.

Once all bids have been sent in, the auctioneer analyzes them to establish unilaterally a minimum cut-off price for each lot. Suppose the selling bank fixes the cut-off for unsecured NPLs at 37.5. While any bid proposing a higher price will be accepted, each one of them will be assigned that particular item at the predetermined cut-off. In other terms, the auction envisages uniform prices: for each accepted offer that exceeds the minimum price, the bidder will pay this minimum irrespective of how much higher was the price she had actually offered. If a bid is such that the prices for both varieties are above the respective minimum cut-off, the seller will accept the offer for the variety that maximizes the bidder's surplus, which can be measured as the distance between the minimum price for each variety and the bid offer.

Compared to a classic multi-unit ascending auction, this procedure presents three advantages. First, since the allotment price is uniform for each variety, the mechanism ensures that bids are truthful revealing. Moreover, allowing offers for limited portions of the total amount potentially on sale encourages the participation also of weak bidders, limiting significantly the market power on the demand side. Finally, taking place in a single round the auction is very fast and minimizes the possibility of collusion.

Continuing with our numerical example, consider the case of a bidder who submits three bids: *i*) (€350 million; 58, 39); *ii*) (€550 million; 55, 36); *iii*) (€600 million; 44, 31.5). These bids, together with those submitted by all other participants, are represented in Figure 1, where the quantity by each square is the quantity of the bid (in € millions) and the offered prices for secured and unsecured portfolios are measured along the horizontal and vertical axis, respectively.

Figure 1

The overall request of NPLs expressed by the market can be obtained by summing all the quantities reported in each bid, which in our example is equal to €10.5 billion. While the maximum amount of disposal have been initially set at €8 billion, the total quantity actually allocated can be adapted in a flexible way to the information in the bidding, in order to respond to the seller's preferences. The two stepped curves in the figure represent frontiers of cut-off prices that the bank identifies if it decides to sell a total of €4.5 billion (solid line) or €6 billion (dotted line) of NPLs. Different frontiers correspond to different choices on demand rationing, ensuring a first degree of freedom to the seller who can choose which frontier is closer to the value it gives to its non-performing loans.

Suppose the bank decides in fact to sell €4.5 billion. In order to draw the corresponding frontier, let us start from the upper vertical segment. This is positioned in correspondence of the price for secured portfolios (53) such that all the bids that are to its right – that is, the accepted ones – sum up exactly to €4.5 billion. In this case the whole lot is allocated to secured NPLs, and nothing is accepted on unsecured ones. As the downward segment intercepts the highest price for the unsecured variety (42), the accepted set starts to substitute a certain portion of unsecured portfolios for secured ones. The frontier now proceeds along an horizontal segment, that continues until one finds the second price for secured loans (53.5), when another vertical segment begins. And so on and so forth. Notice that, for any given aggregate lot of NPLs on disposal, different points along the same frontier correspond to different combinations of secured and unsecured portfolios, such that the relative quantities of different varieties are dependent on their relative prices.

If the bank resolves to dispose of €4.5 billion of NPLs and chooses the pair of cut-off prices (55, 37.5) along the corresponding frontier, the situation is that shown in Figure 2. The bank accepts all the bids that are positioned above and to the right of the point, plus the marginal ones (here, the bids 600 and 750). The auction then assigns €2.1 billion of secured NPLs (47% of the total) and €2.4 billion (53% of the total) of unsecured NPLs at GBV, while the exact allocation is obtained by imposing a proportional rationing to the couple of marginal bids. The net revenue for the bank is €2.06 billion, with an average haircut of 54%. The latter, however, is chosen uniquely by the seller.
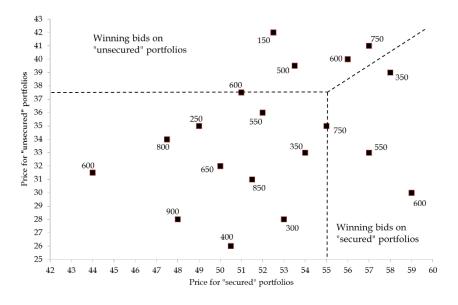
Figure 2

While the underlying idea is simple enough, any real-world attempt to employ a Product-mix auction in the NPL market should address a series of additional practical details, ranging from the possibility to auction more than two varieties at once to the possibility that bidders were allowed to submit bids specifying quantity constraints. Among them, a special attention should be devoted to a correct identification of the seller's reservation prices (Bresky, 2013).

5.   Conclusions

Low transaction volumes and large bid-ask spreads are signatures of market failures. This is precisely what occurs in the market for NPLs in several European countries. What is more, these failures loom greater in those countries where the problem of troubled loans is more serious. Obviously, fixing market failures means attacking their ultimate sources, which in our case belong to three different categories: *i*) informational asymmetries; *ii*) barriers to entry; *iii*) collusive behaviors. Though the establishment of an EU-backed AMC could partially solve the problem of asymmetric information, only a properly designed auction mechanism can address both the entry deterrence and collusion issues. Such a mechanism should force buyers to truthfully reveal their willingness to pay and allow allotment prices to reflect those that would be obtained in a truly competitive market.

In this paper we recommend the use of an auction originally designed for the management of liquidity injections by the Bank of England – the so-called Product-mix auction – which involves an unlimited bid, single-round process in which bids are made on different portfolios of NPLs simultaneously. Of course, the solution we advocate is not the only possible one. For example, a dynamic alternative worth exploring is the multi-unit auction proposed by Ausubel (2004). The main message we want to convey is in any case univocal: the cure of the market failures affecting distressed debt markets in Europe requires a problem-solving approach rooted on sound economic reasoning. To accomplish this endeavor, auction-theoretic tools and intuitions are fundamental.

Regardless of the mechanism to be used, the search for a method to elicit prices in a truthful and efficient way has an immediate systemic benefit. Since any public intervention on the NPL

market has to pass the test of the EU rules on State aid, designing auctions that yield competitive market prices is a fundamental requirement for any hypothesis of public bad bank. In this view, the Product-mix auction can be seen as a completion of an AMC. The ability to force the buyers to reveal their willingness to pay would overcome the problem of the estimation of the REV, and therefore of the distinction between REV and CMP. The surplus would then be fully transferred to the seller[7]. Rather than formally acquire NPLs from banks and try to sell them on the market, an AMC – thanks to the economies of scale it can realize in mitigating informational asymmetries – could thus act as a pure auctioneer.

In such a scheme, the AMC would simply collect NPLs from banks, group them efficiently in homogeneous portfolios and organize the auction. Net of administrative and management costs, the proceeds would then be transferred to originating banks. Clearly, banks would face the loss determined by the possible difference between the NBV of troubled loans they have on their books, and the sale price realized within the auction. In light of this loss, if a bank is unable to meet the capital ratios required by the prudential rules, a precautionary recapitalization as laid down in Article 32(4) of the BRRD would start. However, the Product-mix auction could avoid the other problems related to the *clawback* clauses and to the exercise of the warrant by the State.

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[7] Of course, a fairer distribution of the surplus among buyers and sellers could be possible.

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