Chapter 6

ALTERNATIVE APPROACH TO PUBLIC PROCUREMENT: SELLING PUT OPTIONS VIA ELECTRONIC AUCTION

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I. INTRODUCTION

Competitive tendering has established itself as the most preferred method to conduct public procurement of goods, services and work. Exposing firms to competition for public contracts promotes, *by definition*, competition between firms, though the practice has also been associated with curbing corruption, improving fair price discovery and providing better compatibility with taxpayers' interests (Tadelis & Bajari, 2006). In the European Union, tendering may take place either as open or restricted, through negotiation or competitive dialogue, or via electronic auction. Direct contract awarding on the other hand is strictly restricted. Namely, there shall exist (i) emergencies due to unforeseeable events; *or* (ii) contracts that - for technical reasons or because of exclusive rights - can only be carried out by one particular company; *or* (iii) contracts that by law are excluded from public procurement (Georgopoulos, Hoekman, & Mavroidis, 2017)

This paper proposes an alternative method to carry out a bidding contest for public contracts. The context is highlighted by Table 1, which provides a concise literature review on predatory bidding, collusive tendering, regulatory burden, corruption and discrimination in public procurement. Accordingly, the suggested method's specific focus is on (curbing) anti-competitive practices. These issues are not necessarily trivial as each year public procurements account for ~14 % of EU gross domestic product. However, the true value is considerably higher when political and social aspirations are considered. Namely, EU seeks to utilize public procurements as a policy tool to support and promote environmental protection, social responsibility, innovation,

TABLE 1
Summarization of the Most Commonly Identified and Most Damaging Frauds, Shortcomings, Problems and Misconducts in Public Procurement

Problem	Definition	Outcome	Evidence By
Predatory bidding	Bid < supplier's costs. The aim is to drive competitors out of the market	Cost overrun/winner unable to make the delivery	Alexandersson and Hultén (2006); Conti and Naldi (2008); Gani (2017); Gunduz and Karacan (2017); Ibrahimi (2017); Kim (1998); Sherrer (1981)
Bid rigging/ collusive tendering	Horizontal agreements between firms to curb competition with a target to raise prices and/or share markets	No real competition. Procurement organization pays a price > fair price	Bajari (2001); Bhagat (2017); Dorée (2004); Porter & Zona (1993); Sanchez-Graells (2013)
Administrative/ regulatory burden	Costs generated by compliance	Otherwise good suppliers cannot join the competition for economic reasons: adverse selection	Flynn & Davis (2016); Kovacic (1992)
Corruption	An unlawful act, which mutually benefits the buyer and the seller, but is detrimental to public interest	Loss of integrity, welfare losses, moral hazard	Søreide (2002); Ferwerda et al. (2017); Kane & White (2009)
Discrimination	Favoring domestic companies vs. foreign	A barrier to trade and competition. Price increase and/or decrease in quality	Naegelen & Mougeot (1998); Ngeno et al. (2014); Keulemans & Van de Walle (2017); Rickard & Kono (2014)

and economic growth via higher SME participation. (European Commission, 2016).

The suggested approach is a novel contribution to the previous research on competitive tendering in public procurement. The method has certain limitations, which we will address later in the paper. The paper is organized as follows: Section 2 provides a conceptual approach to electronic auctions and financial options. Section 3

describes how options trading is applied and conducted within the suggested method; in addition, the method's compatibility with current regulatory environment is analyzed. Lastly, the chapter discusses the managerial implications and limitations of the method as well as those features that shall be subject to future research.

II. THEORETICAL BACKGROUND

2.1. Critical Factors of Public Contract Auctions

The essential objective in public procurement of goods, services and work is to obtain the lowest price without loss of quality. In a broad sense, the procurer may try to achieve the target either via auction, where the buyer does not engage in any substantive communication with bidders or through negotiations, where the tender parameters specify during individual and personal communications between the buyer and the bidders[1] (Antal-Pomázi, 2012). The focus of this paper is on competitive bidding settings. They have gained substantial popularity as evidence suggest a more efficient fair price discovery and less inclination to corruption due to objective criterion for selecting the winning bid (Bajari, Houghton, & Tadelis, 2014). Moreover, the technological shift towards electronically executed auctions has improved foreign suppliers' chances to cost effectively participate in the bidding process (Hartley, Lane, & Hong, 2004; Tassabehji, 2010).

However, the success of an auction is sensitive to certain preconditions. Concentrated market, small number of bidders and asymmetric information among the bidders may promote collusive behavior among the dominant ones, making the competition unattractive and thus reducing the number of potential bidders (Chong, Staropoli, & Yvrande-Billon, 2013). Onur, Özcan, and Taş (2012) suggest that competitive environment improves the effectiveness of government purchasing auctions. They conclude a negative relationship between the number of bidders and procurement price. The requirement for sufficient level of competition is further supported by Iimi (2006).

Bajari, McMillan, and Tadelis (2009) found that (in private sector construction) auctions might perform poorly when the project is complex, contractual design incomplete, and there are few available bidders. In such cases, the buyer is unable to specify the contract in open auction. Conversely, small contracts are less prone to

specification issues and as such, pose less risks of additional ex-post transaction cost. Interestingly, Chever, Saussier, and Yvrande-Billon (2017) note that it is quite common for public buyers to restrict competition even for small contracts. They conclude that restricted entry preserves a high level of competition between the pre-qualified firms. In addition, mitigating competition may reduce *ex ante* transaction costs due to offers being limited only to the most efficient bidders.

Based on previous research, the method introduced by this paper is suggested to be applied to smaller, less complex and shorter-term procurements.

2.2. The Option Payoff

Option is a derivative contract, which gives holder the right, but not the obligation, to buy (call option) or sell (put option) an underlying asset at a pre-agreed price on a specified date in the future. Thus, the payoff is determined by the option's type, the trader's side/position in the contract and the difference between the fixed pre-agreed contract price (strike price) and the market price (spot price) at which the underlying asset is trading at. Table 2 illustrates the dynamics. Consider, for instance, a call option on a stock, which is currently trading at a price (S) that is higher than the strike price (K). Effectively, the holder could now exercise her right to buy the stock at a discount and sell it to the markets at a higher price. Evidently, the contract would yield a profit (contract is said to be "in-the-money").

Due to the asymmetry between *rights* and *obligations*, holder (buyer) pays a premium (option price) to the option writer (seller) as a compensation. Consequently, the holder's downside is capped at the option price: if the contract expires worthless, the holder does not exercise her right to buy/sell the underlying, thus losing the premium, but *only* the premium. On the other hand, the writer of a call option (put option) exposes herself to risk of infinite losses (strike price less the

TABLE 2
The Option "Moneyness" with Respect to the Contract Type

Long Position	In-The-Money	At-The-Money	Out-Of-The-Money
Put	+, K > S	0, K = S	-, S > K
Call	+, S > K	0, K = S	-, K > S

premium) (Carter, 2007). For the purpose of this paper, we now shall focus on put option contracts.

The effective payoff of a long put option increases with respect to the amount of strike price *K* exceeding the underlying spot price *S and* the premium at expiration:

$$\max(K - S(T), 0) - FV(K, T) \quad (1)$$

Conversely, we see that the writer's upside is capped at the premium:

$$-\max(K - S(T), 0) + FV(K, T) \quad (2)$$

2.3. The Option Premium

The premium consists of intrinsic value and time (extrinsic) value. The former is the difference between strike price and the underlying spot price. Time value is the proportion of premium that exceeds the option's intrinsic value. Time value, naturally, converges to zero, as the expiration date gets closer. Conversely, longer the contract's remaining time-to-expiration, greater the probability of the underlying asset moving towards the desired direction before maturity. Similarly, option sellers demand higher premium to price in the risk of spot price moving against them. As there exists uncertainty regarding future, the time value must reflect the supply-demand-equilibrium matching buyers' and sellers' expectations of spot price direction and volatility (Mishra & Debasish, 2007):

$$Time\ Value = Option\ Premium - Intrinsic\ Value \quad (3)$$

Further, financial options are nonlinear securities whose price presents a second derivative (≠ 0) with respect to a parameter, or a "Greek". Namely, (i) the sensitivity of the option price to the change in the underlying asset price (Delta); (ii) the sensitivity of the option delta to the change in the underlying asset price (Gamma); (iii) the sensitivity of the option price to the change in implied volatility (Vega); (iv) the sensitivity of the option price to interest rates or dividend payout (Rho); *and* (v) the expected change in the option price as days to expiration approach zero (Theta) (Taleb, 1997).

For instance, assume a stock option contract. Table 3 demonstrates how an increase in one economic variable affects the value of the contract. Namely, when the stock soars, the value of a *call* option increases – or, when the interest rates increase, the value of a *put* option decreases:

TABLE 3
Assuming an Increase in Variable X

Increase in	Call Value	Put Value
Spot price	+	-
Strike price	-	+
Volatility of returns of the underlying asset	+	+
Time to expiration	+	+
Interest rates	+	-
Dividends	-	+

Note: The table shows the corresponding change in option value for a call and a put with the same underlying asset, strike price and maturity.

Although the (financial) options pricing models are not within the scope of this paper, it shall be pointed out that under efficient markets assumption (the no-arbitrage condition), the option price is bounded between upper and lower bands (Hull, 2002). Consequently, the price of a call option on a stock can never be worth more than the stock:

$$c \leq S_0 \; and \; C \leq S_0 \tag{4}$$

If the option price did exceed the price of the underlying stock, an arbitrageur would make a riskless profit by buying the stock and selling the call option. Conversely, the put option can never be worth more than the strike price. If the following did not hold true, one would write the option and invest the premium at the risk-free interest rate:

$$p \leq K \; and \; P \leq K \tag{4.1}$$

Thirdly, assume a European (which can be exercised only at maturity) call option on a stock that does not pay dividends during contract's lifetime. Call option can expire worthless, but worthless only. As the option price cannot be negative, the lower bound must be:

$$c \geq \max(S_0 - Ke^{-rT}, 0) \tag{5}$$

Conversely, the lower bound for European put option with the same underlying must be then:

$$p \geq \max(Ke^{-rT} - S_0, 0) \tag{5.1}$$

III. PUT OPTION CONTRACT WITH A PUBLIC PURCHASE AS THE UNDERLYING ASSET

3.1. The Auction Mechanism and Trading Platform

The approach proposed in this paper bears certain resemblance to treasury auction, where primary dealers competitively bid for newly issued government debt (Tchuindjo, 2015). However, instead of debt offering the responsible procurement organization writes (sells) a put option on a good, service or work it desires to purchase in the future. Effectively, bidders engage in competition for the *right* to sell the underlying asset to government body.

The auction follows a three-step cycle with announcement date, bidding phase and issuance. The auction announcement shall specify contract details, the first and last auction date as well as the issuance date and procedures. The subsequent bidding phase lasts either for a fixed period or, if needed, until the single highest bid emerges. Thus, firms participating in the competition do not disclose tender documentation *per se*. Rather, the bid price *is* the tender. During issuance, the winner of the auction pays the premium (the winning bid) and enters the long position. The procurement organization takes the subsequent short side in the contract. Likewise, the issuance indicates the start of contract's time-to-expiration unless another date has been decided between the counterparties.

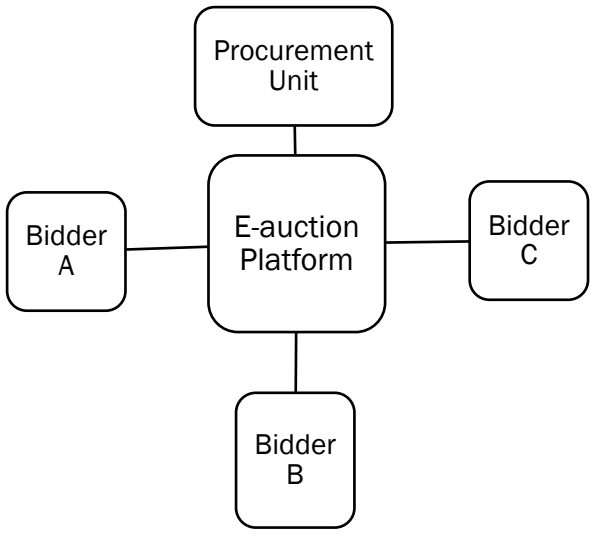
Deciding the winner via auction is not the contribution of this paper, though the suggested mechanism has two distinctive features worth pointing out to. First, any business can enter its bid in the system vis-à-vis to the restricted auction-based tendering in the EU.[2] Secondly, the mechanism is a mixture of two most commonly applied auction designs. Namely, in reverse auction, a single buyer notifies potential sellers of her intention to purchase a specified item. The prospective sellers subsequently bid against one another, driving the price *downward*. The forward auction, on the other hand, consists of a single seller and prospective buyers who compete against each other by bidding the price *upward* (Arnold & Schnabel, 2008). The proposed auction mechanism, however, consists of a single buyer and multiple sellers, but in contrast to reverse auction, the *highest* bid secures the business. This is since bidders are initially competing for the *right* to sell rather than offering the actual item for a sale.

Figure 1 displays a simplified auction of one buyer and three willing sellers. More importantly, the graph is to illustrate the fact that both the initial listing of the put option contract (announcement date) and the subsequent submission of bids (bidding phase) are being executed in the same electronic platform.

The use of "electronic auction platform" here is only to broadly address the nature and venue of the bidding contest in the model. Since the financial crisis, EU has introduced new regulation that needs to be incorporated into the model. The regulation of over-the-counter derivatives trading is discussed later in Section 3.3. For now, we shall address certain issues regarding the auction platform itself.

In 2014, the European Commission adopted *Markets in Financial Instruments Directive* (2014/65/EU) and *Markets in Financial Instruments Regulation* (EU) No 600/2014. Applicable since 3 January 2018, MiFID 2 and MiFIR lay out rules for trading on regulated platforms as well as requirements regarding mandatory trading of derivatives on organized venues. Accordingly, MiFID 2 identifies three

GRAPH 1
The General E-Auction Framework within the Suggested Model



types of trading venues: Regulated Market, Multilateral Trading Facility and Organized Trading Facility (Article 4(1)(21-23)). As the proposed model involves over-the-counter trading of option contracts, the platform should not therefore be operated by the same government body, which conducts the procurement. Rather, in order to correspond better with regulatory environment, it is suggested that the auction takes place on a Multilateral Trading Facility.

MTF is a financial service provided by a third-party operator, such as an investment bank or market operator, which brings together multiple third-party buying and selling interests in financial instruments in a way that results in a contract (Article 4(1)(22)). MTFs are required to publish, maintain and implement transparent and non-discriminatory rules, based on objective criteria, governing access to its facility (Article 18(3)) as well as for the execution of orders in the system (Article 19(1)). Membership or right to participate may be admitted for investment firms, credit institutions or other persons, who have (i) sufficient repute; (ii) sufficient level of trading ability, competence and experience; (iii) adequate organizational arrangements; and (iv) sufficient resources for the role they are to perform (Article 53(3)). Recital 16 further defines members and participants broadly as persons having access to regulated markets or MTFs. Both terms are thus interchangeable.

Investment firms (either as members or as participants) may act on behalf of their clients. Whenever, they shall comply with Articles 24 (general principles and information to clients), 25 (assessment of suitability and appropriateness and reporting to clients), 27 (obligation to execute orders on terms most favorable to the client), and 28 (client order handling rules). In consequence, the principal shall consider client's knowledge, competence and experience during any interaction. Further, client orders shall be executed in a prompt, fair and expeditious way while taking into account price, costs, the likelihood of execution and settlement, and the size and nature of the order. As an exemption, the party operating the MTF cannot execute client orders against proprietary capital, or to engage in matched principal trading. (Haentjens & de Gioia-Carabellese, 2017)

3.2. Value Drivers and Pricing of the Contract

The contract details specified in the auction announcement shall include:

1. The underlying asset: the product, service or work the government body wants to purchase.
2. Strike price: the price procurer will pay to the supplier upon successful delivery.
3. Settlement date: the last date *by* which the delivery must be completed. The option is American, which can be exercised anytime during its lifetime: that is, the delivery of the underlying may take place before maturity.
4. Standard Terms and Conditions: litigants' rights and liabilities and qualitative and quantitative requirements of the underlying asset, delivery and settlement.

The option premium has a twofold role within the model. One on hand, premium serves the precondition required to decide the supplier. On the other hand, premium is a compensation for the procurement organization, which faces uncertainty regarding the successful delivery of the underlying in the future. Further, the model treats the underlying spot price as the supplier's total costs resulting directly from carrying out the contract. Due to the discrepancy in the meaning of spot price, the pricing of the contract differs from that of a financial option.

Nonetheless, the bid must clearly reflect the firm's view on the value of the contract. In general terms, we expect the option value to be positively correlated with strike price and the time-to-expiration, but negatively associated with the variance of expected project costs. Thus, the bidder shall estimate the probability that the actual costs ≠ expected costs at expiration as the payoff is determined by the following inequality:

$$Strike\ price > Spot\ price + Premium \qquad (6)$$

For instance, consider a one-year put option on, say, IT infrastructure project, with a strike price of 1,000,000 euros. Further, assume that supplier's direct costs stemming from the project would total at 750,000 euros at expiration. As the maximum upside is capped at the fixed strike price, the supplier would profit 250,000 euros from exercising the contract. In retrospect, the bidder would therefore estimate the present value of 250,000 euros received in one year and then price in a sufficient risk premium to reflect the uncertainty regarding costs and time delays.

The bidder may also possess certain intangible assets, such as previous experience on similar projects or other specific competencies and recourses that might add on the attractiveness to join the competition. As Wang (2013) notes, procurement auctions include a consideration of other dimensions besides price, such as technical and aesthetic properties of the item, delivery lead time, payment conditions, amount and quality of service, and supplier reliability. In contrast to simple auction where the bidder with lowest cost wins, this added complexity introduces several strategic issues in regards to the bidding contest.

The bidder can approach the auction from the perspective of a capital investment decision. This paper addresses a simple method of calculating the present value of expected net cash flow. Assume a contract maturity of one year:

$$P_0 = \frac{C_t}{(1+i)^t} \quad (7)$$

Where,

$P_0 = the\ option\ value$

$i = the\ required\ rate\ of\ return$

$C_t = the\ expected\ net\ cash\ flow\ at\ time\ t$

The discount factor shall be such that it reflects the risk and uncertainty. While the strike price is known, the realized costs may differ significantly from those estimated. Thus, the method is intuitive, but severely prone to forecasting errors.

The bidder may estimate project costs by applying different probabilities to different scenarios. As a result, the bidder can then calculate the expected value of costs as an average over each outcome:

$$E(X) = \sum x\ p(x) \quad (8)$$

The variance of the expected value of project costs $\mu = E(X)$ is then:

$$\sigma^2(X) = \rho_1(x_1 - \mu)^2 + \rho_2(x_2 - \mu)^2 + \cdots + \rho_n(x_n - \mu)^2 \quad (8.1)$$

As noted earlier, the variance of expected costs increases the risk premium and, conversely, decreases the value of the option.

3.3 Compatibility with OTC Derivatives Trading Regulation

On 16 August 2012, the *European Market Infrastructure Regulation* (EU) No 648/2012 entered into force with a target of improving transparency and reducing systemic risks of over-the-counter derivatives markets. Two topics in the Regulation are of particular relevance and interest. First, details of every transaction with both OTC and exchange-traded derivatives as well as any modification or termination of the contract must be reported to a registered Trade Repository. Reporting requirement allows "regulators to fulfil their mandates, in particular when it comes to financial stability" and "ensuring the proper monitoring of exposures". The disclosure of information shall identify the parties to the derivative contract, or if different, the beneficiary of the rights and obligations arising from that contract. Counterparties to contract are further mandated to cover the following characteristics of the trade: the type of contract, underlying maturity, notional value, price, and settlement date as well as details regarding contract valuation and collateral. (Article 9; Article 1(1) of Commission Delegated Regulation (EU) No 148/2013).

Secondly, counterparties shall clear all OTC contracts that have been declared subject to central clearing (Article 4(1)). Under EMIR, the OTC derivative contract constitutes as a derivative contract that is not traded on a regulated market (Article 2(7)). However, derivatives whose execution takes place on Multilateral Trading Facility are treated as OTC derivatives under EMIR. Further, the category "counterparty" includes financial counterparties (FC) such as banks, insurers, investment firms and fund managers, and non-financial counterparties (NFC), which are defined as entities that are not involved in financial services. In general, clearing obligation is also applied if a non-EU counterparty trades with entities located in the EU; or if two non-EU counterparties are trading in a way that has a "direct, substantial and foreseeable effect in the EU".

Article 4(1) is not unambiguous though. Namely, NFC is subject to clearing obligation only when its exposure exceeds a pre-defined clearing threshold in any contract class that is subject to Central Counterparty clearing. Moreover, those derivative contracts that are used to reduce risks relating to the commercial or treasury financing activity of the NFC, are excluded from the calculation. Thresholds in gross notional values for credit, equity, interest rate, FX, commodity

and those derivatives not included in the preceding categories, are one, one, three, three and three billion euros, respectively. Whether NFC's rolling average exposure exceeds or stays below the threshold over 30 working days, it is classified as NFC+ or NFC-, respectively. (Article 10(1-2)).

Commission Delegated Regulation (EU) No 149/2013 supplements EMIR with rules regarding the assessment of contracts' eligibility to CCP clearing. European Securities and Markets Authority's decisions shall be based on the overarching aim of reducing systemic risk, and should also take into consideration the degree of standardization of the contractual terms and operational processes. To meet the former, the contract class should incorporate the commonly used legal documentation, such as master netting agreements, definitions and standard terms. Secondly, the sufficient degree of operational standardization requires that the contract's lifecycle events are managed in a "common manner" and that the operational processes are subject to automated post-trade processing. In addition, the contract class as well as each contract within the class should have sufficient trading volume, liquidity, as well as stable market size and depth over time. ESMA shall further consider the availability of fair, reliable and generally accepted pricing information. The information should be easily accessible to market participants on a reasonable commercial basis, and would continue to be so should the contract became subject to the clearing obligation (Article 7(1-3)).

Contracts that are deemed ineligible for central clearing are nonetheless subject to risk mitigation techniques that aim to replicate the conditions and risk management procedures obtained in CCP clearing. Accordingly, non-cleared contracts concluded between FCs or NFCs shall be confirmed, preferably via electronic means, as soon as possible. FCs and NFCs are further required (i) to perform portfolio reconciliation with a frequency dependent on the number of contracts outstanding; (ii) to regularly, but at least twice a year, conduct an analysis on whether it would be possible to reduce notional outstanding positions through portfolio compression, thus reducing either one's counterparty credit risk; (iii) to have agreed detailed procedures and processes for dispute resolution; and (iv) to mark-to-market the outstanding contracts on a daily basis (Articles 10-15 of (EU) No 149/2013). However, a situation may occur where market conditions prevent marking-to-market. According to Article 16(1), the

situation applies when the market is inactive[3], the range of fair value estimates is significant, and the probabilities related to those estimates cannot reasonably be assessed. The insufficient price information, which prevents marking-to-market must be substituted with marking-to-model that incorporates all relevant factors counterparties would rely on in setting a price, is consistent with accepted methodologies for pricing financial instruments and is calibrated and tested with prices from latest transactions in the same instrument (Article 17)

Lastly, non-cleared positions must be adequately collateralized. The collateral structure is twofold: mark-to-market exposures are covered with daily exchange of 1-way variation margin, whereas expected losses resulting from a counterparty default are managed with initial margin collected on a 2-way gross basis as opposed to netting the margins against each other. However, the option seller who receives a premium upfront does not have a current or potential future exposure to the counterparty. This holds true for the daily mark-to-market exposures as well. Thus, EMIR does not require option writer to collect initial or variation margin. This is in contrast to the option holder for whom the margin requirement does apply (Recital 5 of *Commission Delegated Regulation* (EU) 2016/2251). Even so, the margin requirements should still be expected to remain irrelevant in the context of this model, as the applicability to non-financial counterparties is dependent on the NFC+ status, as defined in Article 11 of (EU) No 149/2013.

Based on the current status of the regulation, the auctioned option contracts would not become subject to CCP clearing. First, the contracts would not meet the degree of standardization required for central clearing. Secondly, it is likely that the auction would not meet the expected level of trading volume, liquidity or availability and accessibility of price information. Thirdly, it is expected that the counterparties (the option holders) would primarily constitute as NFCs with exposures not exceeding the relevant thresholds. As of the risk-mitigation techniques, apart from dispute resolution procedures, which are partially considered by the “Standard Terms and Conditions” in auction announcement, it remains unclear how they would be applied.

IV. CONCLUSION

The proposed approach has certain essential and substantial limitations. The paper acknowledges that the method is highly theoretical, almost to a fault. The scientific contribution is somewhat inevident due to the lack of testing the method's applicability. It is therefore proposed that the paper shall serve as a mere opening for a new area of research within the public procurement and auction designs.

Nonetheless, the method may provide certain managerial implications. First, firms taking part to the auction do not gain edge by predatory bidding. On the other hand, the downside risk for procurement organization is capped at the strike price less the premium it receives upfront; meanwhile the supplier carries the risk of cost overrun. Thirdly, the bid submission is the sole sine qua non to join the competition. Consequently, the costs associated with planning and compiling the tender do not create a barrier to entry. Effectively, the model prevents adverse selection: the otherwise best supplier will not lose the competition due to lack of know-how on crafting proper and legally compliant tender documents. Nonetheless, the reporting requirement under EMIR induces certain administrative burden and as such may pose some adverse impact detrimental to the model's target of increasing efficiency of any kind.

The auction allows an efficient and straightforward mechanism to match suppliers' and procurers' interests. In consequence, the option writer (procurement organization) cannot solely dictate strike price, time-to-expiration or other variables affecting the option value, as no profit-seeking supplier would bid for the contract. Moreover, the auction provides important price information, which can be utilized in subsequent procurements with similar characteristics. Compliance with MiFID 2 and EMIR provides transparency and a level playing field. Objective criteria for market access and the harmonization of cross-border competition protects foreign bidders against discrimination. The model concurrently supports the anti-corruption policies, as the selection mechanism does not involve personal judgment. Lastly, the model utilizes the already existing technology as well as regulatory and market structure frameworks, thus curbing excessive implementation costs.

V. FUTURE RESEARCH

Some inconclusive aspects of the method remain for future research. Namely, the future research shall add on the robustness and practicability of the pricing methods as well as to address in more detail the model's compatibility with the surrounding regulatory environment. In contrast to financial options, the holder's downside is not bounded to the premium. As the holder is running up costs through time-to-expiration, she wants to exercise even when the contract expires out-of-the-money. Thus, it shall be assessed whether Central Counterparty clearing could be utilized in order to increase and replicate the financial option's true optionality to not exercise, when $S_T > K_T$.

CCP is a legal entity that interposes itself between the trading parties A and B. In contrast to the bilateral arrangements, the original trade is replaced by two equivalent transactions where CCP becomes a buyer to the original seller and a seller to the original buyer. This is called novation, which consequently cancels out the direct bilateral obligations between A and B, thus transforming their individual exposures against the CCP. The key role of CCP clearing lies within the middle phase of the contract's lifetime after the successful execution of the trade and before the legal fulfillment of specified obligations either at expiration, settlement or any day the said obligations are being properly matched. It is argued that CCP infrastructure improves the management, identification and monitoring of (systemic) risks. (Chande, Labelle, & Tuer, 2010).

Secondly, the Article 18(2) of MiFID 2 requires the MTF operator to provide and maintain criteria to determine which type of financial instruments are eligible for trading under its systems. For now, it remains unclear whether the type of put option contract proposed by this paper would match the criteria of any currently operating MTF. Thirdly, it remains unclear whether the auction-based option issuance would be compatible with the nature of "trading" under MTF.

Lastly, future research shall conclude the model's applicability with options on longer lasting procurements. For now, two possibilities are pointed out. Either the procurement organization splits the procurement into several sequential fractions and writes puts on each individual stage (multiple suppliers/holders) or auction a *cliquet* put option with single supplier/holder over contract's lifetime. A cliquet option is a series of consecutive forward-starting at-the-money options.

For instance, a one-year cliquet can be composed of 12 one-month options. The premium is determined upfront, but the strike price is reset at-the-money at the end of each period. The payout can either be paid at final maturity or at the end of each reset period (Gaudenzi & Zanette, 2011; Bernard & Li, 2013). Reset periods in the context of this model would reflect the different stages of the project. However, the strike price would not fluctuate on a relative basis, but should be set at some fixed level and paid in proportions at the end of each period upon successful period-related delivery.

NOTES

1. Auctions can be further classified as open or restricted, where only the pre-selected firms may post a bid (Chever, Saussier, & Yvrande-Billon, 2017).
2. Before auction, initial evaluation of tenders is first carried out, and only then, the admissible ones are invited to take part in the competition. See: https://europa.eu/youreurope/business/public-tenders/rules-procedures/index_en.htm
3. Article 16(2): "A market for an OTC derivative contract shall be considered inactive when quoted prices are not readily and regularly available and those prices available do not represent actual and regularly occurring market transactions on an arm's length basis".

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