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UNDERSTANDING THE ARTWORK PRICING:  
SOME THEORETICAL MODELS

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Understanding the artwork pricing: some theoretical models

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Abstract
This paper analyses the pricing of new artworks sold for the first time in the private art market, investigating price-formation mechanisms at work. Using a bargaining game approach, we find that the bargaining power of each agent is key in identifying the market channel preferred by the artist and, then, her incentive in creating a new artwork.

JEL classification: C78, L11 Z11
Keywords: bargaining, pricing, cultural economics

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1 Introduction

The economic value of an artwork is determined by the art market structure and the relationships between the agents who buy and sell an artwork. The artists’ creativity can be stimulated by their economic performance, since the choice of creating a new artwork may also depend on its potential price. To investigate how the art market works, thus, we need to understand the price-formation mechanism and the behavior of artworks’ sellers and buyers. Given that “haggling for art” is a habit in the art market and the bargaining is the most used selling method, we want to study why certain art market channels emerge compared to others, and what equilibrium price of new artworks is observed in each art market channel. In particular, following a bargaining game approach (Wu 2004) and assuming that agents are price-maximizers with full information on other agents’ bargaining powers and reserve prices, we study the private art market over the primary, secondary, and tertiary markets. Moreover, we focus on the relationships between artwork prices and bargaining powers of agents working in each channel of the market, where bargaining is the used selling method.

Velthuis (2002) defines the primary market as the market where artworks are sold for the first time, while Candela & Scorcu (2004) introduce the distinction between primary, secondary, and tertiary market, where the first is the artist’s market, the second is the gallery’s market where artworks are resold, and the third is the auction’s market where auction houses are the main dealers. Furthermore, Velthuis (2002) introduces the distinction between public and private market, based on the availability of the information about the price of an artwork: private information about gallery sales is almost not available to unsophisticated collectors, since gallery prices are private attributes, as opposed to auction prices which are public and easily accessible. Therefore, any trades intermediated by auction houses will always have a public price. Conversely, when the dealer is a gallery, when an artist sells her artwork to collectors in primary market, or when a collector resells it to a gallery in secondary market, the artwork will have a private price. Building a theoretical framework of the relationship between art market structure and private prices of artworks is the aim of this study.

Gintis (2006, 2007) introduces private prices in evolutionary bargaining games, showing that, from an initial distribution of private prices, the economy evolves towards a quasi-public price structure and then to the market clearing price system. Mandel & Botta (2009) show that the stochastic stability of this general market equilibrium system depends on the fact that prices are private information. Flåm & Godal (2008) and Flåm (2013) study private prices in repeated bilateral barter. The role of private information has also been studied in two-sided markets such as the art market (Angelini 2017).
Pricing mechanism in the art market has been studied by several authors (Peterson 1997, Rengers & Velthuis 2002, Velthuis 2002, Caves 2003, Beckert & Rössel 2004, Hutter et al. 2007, Velthuis 2007, 2011, Beckert & Rössel 2013, Candela et al. 2016). In particular, Velthuis (2003) focused on the price-formation mechanism of art galleries identifying the existence of pricing scripts used by the dealers, that consist in a series of rules for which the price is never decreased but, at most, discounted; Schönfeld & Reinstaller (2007) develop a model of competition among galleries which is consistent with these pricing scripts. Besides Cellini & Cuccia (2014), who analyse the price-formation mechanism in the primary market, considering the artist and the art dealer as part of the same marketing channel, few attention has been paid to pricing mechanisms in the art primary market and to galleries’ and auction houses’ role on price formation in secondary and tertiary market.

To fill this gap and fully understand artwork pricing, in this paper we model the art market where new artworks are sold for the first time by the artist, and study the behavior of agents involved in the artwork trades and their role in each transaction.

The remainder of the paper is organized as follows. In Section 2 we set and solve the model, and in Section 3 we study the effect of the agents’ bargaining power on bargaining prices. Section 4 concludes the paper.

2 The model

In our model there are five types of agents: artists (a), galleries (g), auction houses (h), insider collectors (i), and outsider collectors (o). All agents play a Nash bargaining game on artworks’ price and have full information, besides outsiders, who are unsophisticated and imperfectly informed (Baumol 1986, Bonus & Ronze 1997). An artist can either a new artwork to an auction house, to a gallery, or to insider collectors. Insiders can resell the artworks either to a gallery or an auction house, while galleries can resell the artworks either to an outsider or an auction house. Thus, there are 7 potential bargaining between the following couples of agents: artist and auction house (ah), artist and gallery (ag), and artist and insider (ai) in the primary market; insider and gallery (ig) and insider and auction house (ih) in the secondary market;

gallery and outsider (go) and gallery and auction house (gh), in both secondary and tertiary market.\footnote{Among the possible bargainings, we omit the repurchases (i.e. the \textit{agi} chain), we assume that the insider can avoid the trade with the gallery buying directly from the artist (we exclude the \textit{agi} chain), and we assume that the outsider can only buy from a dealer.}

We define $P_{kj}^k$ as the price bargained between the couple of agents $k$ in the channel $j$, and $P_{R}^n$ and $P_{R}^o$ as the artists’s and the outsider’s reserve prices.\footnote{In order to assure the existence of the market, we assume that $0 \leq P_{R}^n \leq P_{R}^o$.} We assume that there is no arbitrage on artworks’ price in the secondary and tertiary market, so that the gallery’s posted price and the auction price are equal to $P_{R}^o$.

Bargaining price between the couple $k$ in the channel $j$ comes from the following optimization problem:

$$\max_{P_{kj}^k} \left[ \left( P_{kj}^k - y \right)^{\rho_k} \left( x - P_{kj}^k \right)^{1-\rho_k} \right]$$ \hspace{1cm} (1)

Since the bargaining power of each agent is the relative ability to influence over each other, we define $\rho_k \in (0, 1)$, $k = hl$, as an exogenous measure of agent $h$’s relative bargaining power over the bargaining between $h$ and $l$, assuming that $l$’s bargaining power is its complement to 1. The solution of the problem in (1) is:

$$P_{kj}^k = (1 - \rho_k)y + \rho_k x$$ \hspace{1cm} (2)

In Table 1, we present the bargaining prices of each couple $k$ in all studied channels, coming from the maximization problem in (1).\footnote{The full formulas of these prices can be found in Appendix A.}

3 Results

In this Section, we present the main results on bargaining prices for tertiary, secondary and primary market.\footnote{In the Lemmata and Propositions of this paper, we will not consider the cases of indifference between the choices of the agents.}

**Lemma 1** In the tertiary market, whatever the price the gallery pays to buy the artwork, the gallery will prefer to sell it:
Table 1: Bargaining prices from the solution in (2)

<table>
<thead>
<tr>
<th>$P^{gh}_{aigh}$</th>
<th>$P^{ig}_{aigh}$</th>
<th>$P^R_R$</th>
<th>$\rho_{gh}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P^{go}_{aigo}$</td>
<td>$P^{ig}_{aigo}$</td>
<td>$P^R_R$</td>
<td>$\rho_{go}$</td>
</tr>
<tr>
<td>$P^{gh}_{aigh}$</td>
<td>$P^{ig}_{aigh}$</td>
<td>$P^R_R$</td>
<td>$\rho_{gh}$</td>
</tr>
<tr>
<td>$P^{go}_{aigo}$</td>
<td>$P^{ig}_{aigo}$</td>
<td>$P^R_R$</td>
<td>$\rho_{go}$</td>
</tr>
<tr>
<td>$P^{gh}_{ah}$</td>
<td>$P^{ig}_{ah}$</td>
<td>$P^R_R$</td>
<td>$\rho_{gh}$</td>
</tr>
<tr>
<td>$P^{ag}_{aigh}$</td>
<td>$P^{ig}_{aigh}$</td>
<td>$P^R_R$</td>
<td>$\rho_{ag}$</td>
</tr>
<tr>
<td>$P^{go}_{aigo}$</td>
<td>$P^{ig}_{aigo}$</td>
<td>$P^R_R$</td>
<td>$\rho_{go}$</td>
</tr>
<tr>
<td>$P^{ah}_{ah}$</td>
<td>$P^R_R$</td>
<td>$P^R_R$</td>
<td>$\rho_{ah}$</td>
</tr>
<tr>
<td>$P^{ai}_{aigh}$</td>
<td>$P^R_R$</td>
<td>$P^{ig}_{aigh}$</td>
<td>$\rho_{ai}$</td>
</tr>
<tr>
<td>$P^{go}_{aigo}$</td>
<td>$P^R_R$</td>
<td>$P^{ig}_{aigo}$</td>
<td>$\rho_{ag}$</td>
</tr>
<tr>
<td>$P^{ah}_{ah}$</td>
<td>$P^R_R$</td>
<td>$P^{ig}_{aigh}$</td>
<td>$\rho_{ag}$</td>
</tr>
</tbody>
</table>

- **to the auction house rather than to the outsider** $(gh \succ go)$ if and only if:
  
  $$\rho_{gh} > \rho_{go}$$ (3)

- **to the outsider rather than to the auction house** $(go \succ gh)$ if and only if:
  
  $$\rho_{gh} < \rho_{go}$$ (4)

**Proof.** See Appendix B.1.

The choice of the gallery is only based on its ability in the bargaining process with the potential buyers. In fact, it is likely that the gallery can exploit its bargaining power versus the outsider in a more effective way than what it could do with the auction house. Thus, an artwork that reaches a gallery is more likely to be sold to an outlier than to be sold to an auction house.

**Lemma 2** In the secondary market, whatever the price the insider pays to buy the artwork, he will prefer to sell it:

- **to the auction house rather than to the gallery** $(ih \succ ig)$ if and only if:
  
  $$\rho_{ih} > \frac{\rho_{ig} \max\{\rho_{gh}, \rho_{go}\}}{1 - \rho_{ig} (1 - \max\{\rho_{gh}, \rho_{go}\})}$$ (5)
• to the gallery rather than to the auction house \((ig > ih)\) if and only if:

\[
\rho_{ih} < \frac{\rho_{ig} \max \{\rho_{gh}, \rho_{go}\}}{1 - \rho_{ig} \left(1 - \max \{\rho_{gh}, \rho_{go}\}\right)}
\]  

(6)

**Proof.** See Appendix B.2. ■

The dominance of bargaining over auctioning in the choice of the insider depends on a comparison between the insider’s bargaining power against the auction house and his bargaining power against the gallery, weighted for the bargaining power of the gallery in the potential step forward.

Given that the insider collector is not a professional agent, one could reasonably expect that the auction house has a high ability in the bargaining process with this agent. Thus, it is likely that the insider will sell the artwork to the gallery. Furthermore, one could expect that, in the bargaining between the gallery and the insider, the former will be able to exploit its bargaining power to gain more than half of the price spread.

**Proposition 1** In the primary market, the artist can choose between selling the artwork to the auction house, to the insider, or to the gallery, depending on the conditions on Lemmata 1 and 2 and on the conditions that follow.

1.1 The artist sells to the insider \((aih > agh \land aih > ah \lor aih > ago \land aih > ah)\) when either (3) or (4), together with (5), holds if and only if:

\[
\rho_{ah} < \frac{\rho_{ai} \rho_{ih}}{1 - \rho_{ai} \left(1 - \rho_{ih}\right)} \land \rho_{ag} < \frac{\rho_{ai} \rho_{ih}}{\rho_{ai} \rho_{ih} + \max \{\rho_{gh}, \rho_{go}\} \left(1 - \rho_{ai}\right)}
\]  

(7)

1.2 The artist sells to the insider \((aigh > agh \land aigh > ah \lor aigo > ago \land aigo > ah)\) when either (3) or (4), together with (6), holds if and only if:

\[
\rho_{ah} < \frac{\rho_{ai} \rho_{ig} \max \{\rho_{gh}, \rho_{go}\}}{1 - \rho_{ai} \left(1 - \rho_{ig}\right) - \rho_{ig} \left(1 - \max \{\rho_{gh}, \rho_{go}\}\right)} \land \rho_{ag} < \frac{\rho_{ai} \rho_{ig}}{1 - \rho_{ai} \left(1 - \rho_{ig}\right) - \rho_{ig} \left(1 - \max \{\rho_{gh}, \rho_{go}\}\right) + \rho_{ai} \rho_{ig} \left(1 - \max \{\rho_{gh}, \rho_{go}\}\right)}
\]  

(8)

1.3 The artist sells to the gallery \((agh > aih \land agh > ah \lor ago > aih \land ago > ah)\) when either (3) or (4), together with (5), holds if and only if:

\[
\rho_{ah} < \frac{\rho_{ag} \max \{\rho_{gh}, \rho_{go}\}}{1 - \rho_{ag} \left(1 - \max \{\rho_{gh}, \rho_{go}\}\right)} \land \rho_{ag} > \frac{\rho_{ai} \rho_{ih}}{\rho_{ai} \rho_{ih} + \max \{\rho_{gh}, \rho_{go}\} \left(1 - \rho_{ai}\right)}
\]  

(9)
1.4 The artist sells to the gallery \((\text{agh} \succ aigh \land \text{agh} \succ \text{ah} \lor \text{ago} \succ \text{aigo} \land \text{ago} \succ \text{ah})\) when either (3) or (4), together with (6), holds if and only if:

\[
\rho_{ah} < \frac{\rho_{ag} \max \{\rho_{gh}, \rho_{go}\}}{1 - \rho_{ag}(1 - \max \{\rho_{gh}, \rho_{go}\})} \land \rho_{ag} > \frac{\rho_{ai}\rho_{ag}}{1 - \rho_{ai}(1 - \rho_{ig}) - \rho_{ig}(1 - \max \{\rho_{gh}, \rho_{go}\}) + \rho_{ai}\rho_{ig}(1 - \max \{\rho_{gh}, \rho_{go}\})}
\] (10)

1.5 The artist sells to the auction house \((\text{ah} \succ aih \land \text{ah} \succ agh \lor \text{ah} \succ aih \land \text{ah} \succ \text{ago})\) when either (3) or (4), together with (5), holds if and only if:

\[
\rho_{ah} > \frac{\rho_{ag} \max \{\rho_{gh}, \rho_{go}\}}{1 - \rho_{ag}(1 - \max \{\rho_{gh}, \rho_{go}\})} \land \rho_{ah} > \frac{\rho_{ai}\rho_{ih}}{1 - \rho_{ai}(1 - \rho_{ih})}
\] (11)

1.6 The artist sells to the auction house \((\text{ah} \succ aigh \land \text{ah} \succ agh \lor \text{ah} \succ aigo \land \text{ah} \succ \text{ago})\) when either (3) or (4), together with (6), holds if and only if:

\[
\rho_{ah} > \frac{\rho_{ag} \max \{\rho_{gh}, \rho_{go}\}}{1 - \rho_{ag}(1 - \max \{\rho_{gh}, \rho_{go}\})} \land \rho_{ah} > \frac{\rho_{ai}\rho_{ih} \max \{\rho_{gh}, \rho_{go}\}}{1 - \rho_{ai}(1 - \rho_{ih}) - \rho_{ih}(1 - \max \{\rho_{gh}, \rho_{go}\})}
\] (12)

**Proof.** See Appendix C. 

Once the artwork has been created, the artist chooses what is the chain through which the artwork will reach the public market, maximizing her surplus. This is done considering all agents’ bargaining powers, and then all their optimal choices that could or will follow the artist’s choice. The dominance of a certain chain on the others depends on the relative ability of the artist to bargain against each of the potential buyers, in the current step (the primary market), and on the bargaining powers of the other agents in the following steps (the secondary and tertiary market). In particular, the choice on which chain to follow is based on a comparison of the relative bargaining powers of the artist, discounted by the bargaining powers of all agents that will operate in each chain, that is, considering the fall-back positions she faces.

Finally, the artist’s choice will lead to a set of equilibrium prices that will depend on the bargaining powers of the agents on the chosen chain only.

7
4 Conclusions

In this paper, we present a Nash bargaining model of the private art market in which new artworks are traded, in order to explain the market functioning and characterize the main relationships between agents that operate in this shadow market.

In the model, the artist creates the artwork and sells it in the primary market, in which auction houses, insider collectors, and galleries operate; insiders can resell the artwork to the gallery in the secondary market, and galleries can resell it, both in secondary and tertiary market, to outsider collectors, depending on the market in which the artwork has been bought; both insiders and galleries can also sell an artwork in the public market, through the intermediation of an auction house.

Our setting provides an ideal framework of the private art market that could be used to test the efficiency of the Artist Re-sale Rights (the royalty an artist could receive when her artwork is resold through a dealer), as well as other public interventions in the art market to support one or more agents/chains. Given the valuable effects of artists’ innovation on art, policy-makers could stimulate the artists’ economic performance by funding exhibitions of the less famous but more creative among them (i.e. public exhibitions), changing the regulation and the structure of the market (i.e. innovation channels), and opening public galleries to support artists’ revenue, fostering innovation by fixing high posted prices for new artworks.

Our framework can also be adopted to analyse two-sided markets as the market of patents, where the inventor would take the role of the artist, the gallery would be replaced by a patent broker, the auction house by the agents who sell the patents in auction, that are recently emerged in the market of the intellectual property, while the insider and the outsider would be replaced respectively by a more and a less informed firm.\footnote{For an analysis of patent brokerage firms, intellectual property auctions, and other intermediaries in the intellectual property market, see Hagiu & Yoffie (2013).}

References


A Complete price formulas

In this section, we report the complete price formulas obtained combining the prices in Table 1.

A.1 The aigo path

In the aigo path, the outsider buys the artwork from the gallery paying:

\[ P_{aigo}^{go} = (1 - \rho_{go})P_{aigo}^{g} + \rho_{go}P_{R}^{g} \]  

(13)
The gallery buys the artwork from the insider paying a price equal to:

\[
P_{\text{aigo}}^{\text{ig}} = (1 - \rho_{\text{ig}})P_{\text{aigo}}^{\text{ai}} + \rho_{\text{ig}}P_{\text{aigo}}^{\text{go}}
\] (14)

The insider buys the artwork from the artist, paying:

\[
P_{\text{aigo}}^{\text{ai}} = (1 - \rho_{\text{ai}})P_{\text{R}}^{\text{ai}} + \rho_{\text{ai}}P_{\text{aigo}}^{\text{ig}}
\] (15)

Given (14) and (15), the price paid by the outsider, as in equation (13), can be rewritten as:

\[
P_{\text{aigo}}^{\text{go}} = \frac{(1 - \rho_{\text{go}})(1 - \rho_{\text{ai}})(1 - \rho_{\text{ig}})P_{\text{R}}^{\text{ai}} + \rho_{\text{go}}P_{\text{R}}^{\text{go}}[1 - \rho_{\text{ai}}(1 - \rho_{\text{ig}})]P_{\text{R}}^{\text{ig}}}{1 - \rho_{\text{ai}}(1 - \rho_{\text{ig}}) - \rho_{\text{ig}}(1 - \rho_{\text{go}})}
\] (16)

The price paid by the gallery to the insider, in (14), can be rewritten using (13) and (15) as follows:

\[
P_{\text{aigo}}^{\text{ig}} = \frac{(1 - \rho_{\text{ai}})(1 - \rho_{\text{ai}})P_{\text{R}}^{\text{ai}} + \rho_{\text{ig}}\rho_{\text{go}}P_{\text{R}}^{\text{go}}}{1 - \rho_{\text{ai}}(1 - \rho_{\text{ig}}) - \rho_{\text{ig}}(1 - \rho_{\text{go}})}
\] (17)

The price paid by the insider to the artist, substituting (17) in (15), is equal to:

\[
P_{\text{aigo}}^{\text{ai}} = \frac{(1 - \rho_{\text{ai}})[1 - \rho_{\text{ai}}(1 - \rho_{\text{go}})]P_{\text{R}}^{\text{ai}} + \rho_{\text{ai}}\rho_{\text{ig}}\rho_{\text{go}}P_{\text{R}}^{\text{go}}}{1 - \rho_{\text{ig}}(1 - \rho_{\text{go}}) - \rho_{\text{ai}}(1 - \rho_{\text{ig}})}
\] (18)

A.2 The $aigh$ path

In the $aigh$ path, the gallery will sell the artwork to the auction house at a price equal to:

\[
P_{\text{aigh}}^{\text{gh}} = (1 - \rho_{\text{gh}})P_{\text{aigh}}^{\text{ig}} + \rho_{\text{gh}}P_{\text{R}}^{\text{go}}
\] (19)

The gallery buys the artwork from the insider paying the following price:

\[
P_{\text{aigh}}^{\text{ig}} = (1 - \rho_{\text{ig}})P_{\text{aigh}}^{\text{ai}} + \rho_{\text{ig}}P_{\text{aigh}}^{\text{gh}}
\] (20)

The insider buys the artwork from the artist, paying:

\[
P_{\text{aigh}}^{\text{ai}} = (1 - \rho_{\text{ai}})P_{\text{R}}^{\text{ai}} + \rho_{\text{ai}}P_{\text{aigh}}^{\text{ig}}
\] (21)
Considering the price paid by the insider in (21) together with (20), we can rewrite (19) as:

$$P_{agh} = (1 - \rho_{gh})(1 - \rho_{ai})(1 - \rho_{ig})P_R^a + \rho_{gh}[1 - \rho_{ai}(1 - \rho_{ig})]P_R^b$$

(22)

The price paid by the gallery as in (20), given (19) and (21), can be rewritten as:

$$P_{aigh} = (1 - \rho_{ig})(1 - \rho_{ai})P_R^a + \rho_{ig}\rho_{gh}P_R^b$$

(23)

The price paid by the insider as in (21), can be rewritten, using (23), as follows:

$$P_{aih} = (1 - \rho_{ai})(1 - \rho_{ig})P_R^a + \rho_{ai}\rho_{ig}\rho_{gh}P_R^b$$

(24)

A.3 The ago path

In the ago path, the gallery sells the artwork to the outsider at a price equal to:

$$P_{ago} = (1 - \rho_{go})P_{ago}^a + \rho_{go}P_R^a$$

(25)

The gallery will buy the artwork from the artist, paying:

$$P_{ago} = (1 - \rho_{ag})P_R^a + \rho_{ag}P_{ago}^a$$

(26)

Substituting (26), (25) can be rewritten as:

$$P_{ago} = (1 - \rho_{go})(1 - \rho_{ag})P_R^a + \rho_{go}\rho_{ag}P_R^a$$

(27)

The price paid by the gallery to the artist, substituting (27) in (26), is equal to:

$$P_{ago} = (1 - \rho_{ag})P_R^a + \rho_{ag}\rho_{go}P_R^a$$

(28)

A.4 The agh path

In the agh path, the auction house buys from the gallery paying:

$$P_{agh} = (1 - \rho_{gh})P_{agh}^a + \rho_{gh}P_R^a$$

(29)
The gallery buys the artwork from the artist paying:

\[ P_{agh}^{ag} = (1 - \rho_{ag})P_R^a + \rho_{ag}P_{agh}^g \]  

(30)

Substituting (30) in (29), we get:

\[ P_{agh}^g = \frac{(1 - \rho_{gh})(1 - \rho_{ag})P_R^a + \rho_{gh}P_R^p}{1 - \rho_{ag}(1 - \rho_{gh})} \]  

(31)

The price paid by the gallery to the artist, substituting (31) in (30), is equal to:

\[ P_{ag}^{ag} = \frac{(1 - \rho_{ag})P_R^a + \rho_{ag}\rho_{gh}P_R^p}{1 - \rho_{ag}(1 - \rho_{gh})} \]  

(32)

A.5 The aih path

In the aih path, the insider sells the artwork to the auction house at a price equal to:

\[ P_{aih}^{ih} = (1 - \rho_{ih})P_{aih}^i + \rho_{ih}P_R^p \]  

(33)

The insider buys from the artist paying:

\[ P_{ai}^{ai} = (1 - \rho_{ai})P_R^a + \rho_{ai}P_{aih}^{ih} \]  

(34)

Given (34), (33) can be rewritten as:

\[ P_{aih}^{ih} = \frac{(1 - \rho_{ih})(1 - \rho_{ai})P_R^a + \rho_{ih}P_R^p}{1 - \rho_{ai}(1 - \rho_{ih})} \]  

(35)

The price paid by the insider to the artist can be rewritten as:

\[ P_{ai}^{ai} = \frac{(1 - \rho_{ai})P_R^a + \rho_{ai}\rho_{ih}P_R^p}{1 - \rho_{ai}(1 - \rho_{ih})} \]  

(36)
B Proof of Lemmata

B.1 Proof of Lemma 1

The gallery will either buy the artwork from the insider or from the artist, depending if the gallery is in the aigo/aigh or in the ago/agh channel. In any case, once the gallery has bought the artwork, it can decide to sell it either to the outsider or to the auction house. We are going to demonstrate here that, whatever the price the gallery paid to buy the artwork, it will be sold to the auction house if and only if (3) holds, while it will be sold to the outsider if and only if (4) holds.

The proof is divided in two parts.

Proof. Assume the gallery received the artwork from the insider, paying (14). The gallery can choose to sell it to the outsider or to the auction house. If the artwork is sold to the outsider, the price will be equal to (13). If the artwork will be sold to the auction house, in some sense “deviating” from the channel the insider considered when he bargained the price with the gallery, the price will be:

\[ P_{aigh} \mid P_{aigo} = (1 - \rho_{gh}) P_{aigo} + \rho_{gh} P_R \]  \hfill (37)

where \( P_{aigh} \mid P_{aigo} \) indicates that the gallery sells the artwork to the auction house also if it has been bought from the insider as if he thought it will be sold to the outsider.

The price in (37) can be rewritten (using (14) and (16)) as:

\[
P_{aigh} \mid P_{aigo} = \frac{(1 - \rho_{gh})(1 - \rho_{ai})(1 - \rho_{ig})P_R + \rho_{gh}[1 - \rho_{ai}(1 - \rho_{ig})]P_R}{1 - \rho_{ai}(1 - \rho_{ig})} + \frac{\rho_{ig}(1 - \rho_{gh})}{1 - \rho_{ai}(1 - \rho_{ig})} \left[ \frac{(1 - \rho_{go})(1 - \rho_{ai})(1 - \rho_{ig})P_R + \rho_{go}[1 - \rho_{ai}(1 - \rho_{ig})]P_R}{1 - \rho_{ai}(1 - \rho_{ig}) - \rho_{ig}(1 - \rho_{go})} \right] \]  \hfill (38)

Selling the artwork to the auction house instead of selling it to the outsider, that is aigh \( \succ \) aigo, is the preferred choice if the price obtained from the auction house will be higher than the one obtained from the outsider, \( P_{aigh} \mid P_{aigo} > P_{ago} \). This is solved for \( \rho_{gh} > \rho_{go} \), which is (3).

The “only if” part of the relation is easy to prove, since \( P_{aigh} \mid P_{aigo} > P_{ago} \) and \( \rho_{gh} > \rho_{go} \) are equivalent, and aigh \( \succ \) aigo implies that the price obtained in the aigh channel thanks to the “deviation” is higher than the one obtained from the aigo channel.

14
Assume now that the gallery receives the artwork from the insider given that he thinks the
gallery will sell the artwork to the auction house after that, so that the gallery pays (20). If the
gallery sells the artwork to the auction house, as expected by the insider, the price it receives
will be (19). If, instead, the gallery “deviates” from what the insider expected, the price that
the outsider pays will be:

$$P_{\text{ago}}|P_{\text{aigh}} = (1 - \rho_{\text{go}})P_{\text{aigh}} + \rho_{\text{go}}P_{\text{R}}$$  \hfill (39)$$

The intuition behind the notation of the left-hand side of (39) is the same explained above for
(37).

Using (22) together with (21) and (20), we can rewrite (39) as:

$$P_{\text{ago}}|P_{\text{aigh}} = \frac{(1 - \rho_{\text{go}})(1 - \rho_{\text{ai}})(1 - \rho_{\text{ig}})P_{\text{R}} + \rho_{\text{go}} [1 - \rho_{\text{ai}} (1 - \rho_{\text{ig}})] P_{\text{R}}}{1 - \rho_{\text{ai}} (1 - \rho_{\text{ig}})} + \frac{\rho_{\text{ig}} (1 - \rho_{\text{go}})}{1 - \rho_{\text{ai}} (1 - \rho_{\text{ig}})} \left[ \frac{(1 - \rho_{\text{gh}})(1 - \rho_{\text{ai}})(1 - \rho_{\text{ig}})P_{\text{R}} + \rho_{\text{gh}} [1 - \rho_{\text{ai}} (1 - \rho_{\text{ig}})] P_{\text{R}}}{1 - \rho_{\text{ai}} (1 - \rho_{\text{ig}})} \right]$$  \hfill (40)$$

Thus, \text{aigh} \succ \text{ago} can be rewritten using the prices in (22) and in (40) as
$$P_{\text{agh}}|P_{\text{ago}} > P_{\text{ago}}|P_{\text{aigh}}$$

that is solved for (3).

The “only if” part of the relation is again easy to prove, since the relation \text{aigh} \succ \text{ago} implies
$$P_{\text{agh}}|P_{\text{ago}} > P_{\text{ago}}|P_{\text{aigh}}$$

Assume now that, being on the \text{ago/agh} channel, the gallery buys the artwork from the
artist at a price equal the result of the bargaining between the artist and the gallery when the
artist thinks that the gallery will sell the artwork to the outsider afterward, which is equal to
(26). If the gallery sells the artwork to the outsider, the price will be equal to (25). If, instead,
the gallery sells it to the auction house, “deviating” from what the artist thought, the price will
be equal to:

$$P_{\text{agh}}|P_{\text{ago}} = (1 - \rho_{\text{gh}})P_{\text{ago}} + \rho_{\text{gh}}P_{\text{R}}$$  \hfill (41)$$

Substituting (26) and (27) in (41), we get:

$$P_{\text{agh}}|P_{\text{ago}} = \frac{(1 - \rho_{\text{gh}})(1 - \rho_{\text{ag}})P_{\text{R}} + [\rho_{\text{ag}} (\rho_{\text{go}} - \rho_{\text{gh}}) + \rho_{\text{gh}}] P_{\text{R}}}{1 - \rho_{\text{ag}} (1 - \rho_{\text{go}})}$$  \hfill (42)$$

The gallery will prefer to sell to the auction house (\text{agh} \succ \text{ago}) if the price obtained in this case
will be higher, that is, using (27) and (42), if \( P_{agh} | P_{ago}^g > P_{ago}^o \), which is solved for (3).

The “only if” part of the relation is again straightforward to prove, since \( \rho_{gh} > \rho_{go} \) is equivalent to \( P_{agh}^g | P_{ago}^g > P_{ago}^o \), and the former expression is true if \( agh > ago \).

Assume that the gallery buys the artwork paying the price bargained with the artist as if she thinks the gallery will sell the artwork to the auction house afterward, which is equal to (30). If the gallery will sell the artwork to the auction house, it will sell at a price equal to (29). If, instead, the gallery sells the artwork to the outsider, the price will be equal to:

\[
P_{ago}^o | P_{agh}^g = (1 - \rho_{go}) P_{agh}^g + \rho_{go} P_R^o
\]

Substituting (31) and (30) into (43), we obtain:

\[
P_{ago}^o | P_{agh}^g = \frac{(1 - \rho_{go})(1 - \rho_{ag}) P_R^g + [\rho_{ag}(\rho_{gh} - \rho_{go}) + \rho_{go}] P_R^o}{1 - \rho_{ag}(1 - \rho_{gh})}
\]

The gallery will prefer to sell to the auction house (\( agh > ago \)) if the price it will obtain will be higher, that is, using (31) and (44), if \( P_{agh}^g > P_{ago}^o | P_{agh}^g \), that is solved for (3).

The “only if” part of the relation is straightforward to prove, since (3) is equivalent to \( P_{agh}^g > P_{ago}^o | P_{agh}^g \), and this last expression is implied by \( agh > ago \).

This completes the first part of the proof.

Assume the gallery bought the artwork from the insider paying a price equal to \( P_{aigo}^i \), that is, having that the insider thought that the gallery will sell it to the outsider afterwards. If the gallery sells it to the outsider, the price will be \( P_{aigo}^o \) as in (16), while if it sells the artwork to the auction house, the price will be the one in (38). Comparing these two prices, selling to the outsider will be preferred to selling to the auction house (\( aigo > aigh \)) when \( P_{aigo}^o > P_{aigh}^g | P_{aigo}^i \) and this is equivalent to (4).

Assume now that the gallery received the artwork from the insider, by paying \( P_{aigh}^i \), since the insider thought he was on the \( aigh \) channel. If the gallery sells the artwork to the auction house as thought by the insider, the price will be \( P_{aigh}^g \) as in (22), while if it “deviates” and sells it to the outsider, the price will be the one in (40). For the gallery, \( aigo > aigh \) is equivalent to \( P_{aigo}^o | P_{aigh}^g > P_{aigh}^g \), which is solved for (4).
Assume, finally, that the gallery bought the artwork from the artist, paying \( P_{ago} \), that is, paying a bargaining price that is the result of the bargaining between the gallery and the artist when she thinks the gallery will sell the artwork to the outsider afterwards. If the gallery sells the artwork to the outsider, the price it receives will be equal to (27), while if it sells the artwork to the auction house, the price will be equal to the one in (42). The gallery will sell the artwork to the outsider if \( ago \succ agh \), which is equivalent to \( P_{ago} > P_{agh} | P_{ago} \), which is solved for (4).

Assume now that the gallery bought the artwork from the artist, paying \( P_{agh} \); the price is the solution of the bargaining between the gallery and the artist when the latter thinks that the gallery will sell the artwork to the auction house afterwards. If the gallery actually sells the artwork to the auction house, the price will be the one in (31), while if it “deviates” and sells it to the outsider, the price will be (44). The gallery will prefer selling the artwork to the outsider if \( ago \succ agh \), that is, if \( P_{ago} | P_{agh} > P_{agh} \), which is solved for (4).

This completes the proof. ■

B.2 Proof of Lemma 2

We now demonstrate that, independently on what is the price paid by the insider, he will sell the artwork to the auction house when either (3) or (4) and (5) hold, and he will sell the artwork to the gallery when either (3) or (4) and (6) hold. The proof is made up of four parts.

Proof. Assume the insider paid \( P_{aih}^{ai} \) for the artwork, since the artist thought he would have sold it to the auction house afterwards. If the insider actually sells the artwork to the auction house, he will obtain a price equal to (33). If, instead, the insider sells the artwork to the gallery, knowing that the gallery will sell the artwork to the auction house (given that (3) holds by assumption), he will get a price equal to \( P_{aih}^{ig} | P_{aih}^{ai} \), which will be equal to:

\[
P_{aih}^{ig} | P_{aih}^{ai} = (1 - \rho_{ig})P_{aih}^{ai} + \rho_{ig}P_{aih}^{gh} | P_{aih}^{ai}
\]

where \( P_{aih}^{gh} | P_{aih}^{ai} = (1 - \rho_{gh})P_{aih}^{ig} | P_{aih}^{ai} + \rho_{gh}P_{R}^{o} \). Using (34) and (35), we can rewrite (45) as:

\[
P_{aih}^{ig} | P_{aih}^{ai} = \frac{(1 - \rho_{ig})(1 - \rho_{ai})P_{R}^{a} + \rho_{ai}\rho_{ih}(1 - \rho_{ig})P_{R}^{o}}{[1 - \rho_{ig}(1 - \rho_{gh})][1 - \rho_{ai}(1 - \rho_{ih})]} + \frac{\rho_{ig}\rho_{gh}P_{R}^{o}}{1 - \rho_{ig}(1 - \rho_{gh})}
\]

The insider will prefer to sell the artwork to the auction house \( (aih \succ aih) \) when the price
in (35) is greater than the one in (46), that is, when $\rho_{ih} > \frac{\rho_{ah}\rho_{gh}}{1-\rho_{ig}(1-\rho_{gh})}$, which is equal to the condition in (5) when (3) holds.

Assume now that the insider bought the artwork from the artist paying (21). If the insider sells the artwork to the gallery as expected by the artist (and, afterwards, the gallery will sell the artwork to the auction house, given that (3) holds), he will get $P_{aigh}^{ig}$ as in (23). Instead, if the insider sells the artwork to the auction house directly, he will get $P_{aih}^{ih}\frac{P_{ai}^{ai}}{P_{aih}^{aih}}$ which, using (21) and (23), can be rewritten as:

$$P_{aih}^{ih}|P_{aigh}^{ai} = \rho_{ih}P_{R}^{o} + \frac{(1-\rho_{ih})(1-\rho_{ai})(1-\rho_{ig}(1-\rho_{gh}))}{1-\rho_{ai}(1-\rho_{ig})-\rho_{ig}(1-\rho_{gh})}$$

(47)

The insider will prefer to sell the artwork directly to the auction house ($aih \succ aigh$) when the price in (47) is greater than the one in (23); this is equivalent to have the condition in (5) to hold when (3) is verified.

This completes the first part of the proof.

Assume now that the insider bought the artwork from the artist paying $P_{aih}^{ai}$; if he sells the artwork to the auction house as expected by the artist, he will get $P_{aih}^{ih}$ as it is in (35), while if he sells the artwork to the gallery (that, then, will sell the artwork to the outsider), he will get $P_{aigo}^{ig}|P_{aih}^{ai} = (1-\rho_{ig})P_{aih}^{ai} + \rho_{ig}P_{R}^{go}|P_{aih}^{aih}$, where $P_{aigo}^{go}|P_{aih}^{ai} = (1-\rho_{go})P_{aih}^{ai} + \rho_{go}P_{R}^{o}$ and $P_{aih}^{ai}$ is given by (34). Using (35) and (34), we have:

$$P_{aigo}^{ig}|P_{aih}^{ai} = \frac{(1-\rho_{ig})(1-\rho_{ai})P_{R}^{o} + \rho_{ah}\rho_{ih}(1-\rho_{ig})P_{R}^{o}}{1-\rho_{ai}(1-\rho_{ig})-\rho_{ig}(1-\rho_{gh})} + \frac{\rho_{ig}\rho_{go}P_{R}^{o}}{1-\rho_{ig}(1-\rho_{go})}$$

(48)

The insider will prefer to sell the artwork to the auction house instead of to the gallery ($aih \succ aigo$) when the price in (35) is greater than the one in (48), and this is equivalent to have (5) to hold when (4) is verified.

Assume now that the insider bought the artwork paying $P_{aigo}^{ai}$; if he actually sells the artwork to the gallery as expected by the artist, he will get $P_{aigo}^{ig}$ as it is in (17). If, instead, the insider sells the artwork to the auction house deviating from what the artist thought, he will get
\[ P_{aih} \mid P_{aigo} = (1 - \rho_{ih})P_{aigo} + \rho_{ih}P_{R}, \] which, using (15) and (17), becomes:

\[ P_{aih} \mid P_{aigo} = \rho_{ih}P_{R} + \frac{(1 - \rho_{ih})(1 - \rho_{ai})[1 - \rho_{ig}(1 - \rho_{go})]P_{R} + \rho_{ai}\rho_{ig}\rho_{go}(1 - \rho_{ih})P_{R}}{1 - \rho_{ai}(1 - \rho_{ig}) - \rho_{ig}(1 - \rho_{go})} \]  \hspace{1cm} (49)

The insider will prefer to sell the artwork to the auction house \((aih \succ aigo)\) when the price in (49) is greater than the one in (17), which is true when condition in (5) holds when (4) is verified.

This completes the second part of the proof.

Assume that the insider bought the artwork at a price equal to \(P_{aih}^{aih}\) from the artist; if he sells the artwork to the auction house as expected by the artist, he will receive a price equal to \(P_{aih}^{ih}\), as it is in (35); if, instead, he will sell the artwork to the gallery, he will get \(P_{aigh}^{aih} \mid P_{aih}\), as it is in (46). The insider will prefer to sell the artwork to the gallery \((aigh \succ aih)\) when (46) is greater than (35), which is equivalent to have (6) to hold when (3) is verified.

Assume instead that the insider bought the artwork paying \(P_{aigh}^{aih}\) from the artist; if he sells the artwork to the gallery, he will obtain a price equal to the one in (23), while if he sells it to the auction house, “deviating” from what the artists expects, he will obtain \(P_{aih}^{ih} \mid P_{aih}\), as it is in (47). He will prefer to sell the artwork to the gallery \((aigh \succ aih)\) if the first of these two prices is larger than the second one, that is, when (6) holds and (3) is verified.

This completes the third part of the proof.

Assume the insider paid \(P_{aih}^{aih}\) to the artist; if he sells the artwork to the auction house, he will get \(P_{aih}^{ih}\) as it is in (35), while if he sells it to the gallery he will get \(P_{aigo}^{aih} \mid P_{aih}\), as it is in (48). He will prefer to sell the artwork to the outsider (that is, \(aigo \succ aih\)) when the price in (48) is higher than the one in (35), which is true when (6) holds and (4) is verified.

Assuming instead that the insider paid \(P_{aigo}^{aih}\) to buy the artwork. If he actually sells the artwork to the gallery, he will get \(P_{aigo}^{ig}\), as it is in (17), while if he “deviates” from what the artist thought and sells the artwork to the auction house, he will obtain the price in (49). The insider will prefer the \(aigo\) channel to the \(aih\) channel when the price in (17) is greater than the one in (49), which happens when (6) holds and (4) is verified.
This completes the proof. ■

C Proof of Proposition 1

We now prove each of the Subpropositions of Proposition 1.

C.1 Proof of Proposition 1.1

Proof. To prove that the artist prefers selling her artwork to the insider instead of to the gallery and to the auction house, given that conditions in (3) and (5) hold, we need the two prices the artist would get from selling the artwork to the gallery (knowing that it will be sold directly to the auction house afterwards) and to the auction house to be smaller than the one that she will get if she sells it to the insider (knowing that he will sell it to the auction house afterwards).

This is represented in the following system of conditions:

\[
\begin{align*}
\frac{(1-\rho_{ai})P_{aR}^0 + \rho_{ai}\rho_{ih}P_{gR}^0}{1-\rho_{ai}(1-\rho_{ih})} & > \frac{(1-\rho_{ag})P_{aR}^0 + \rho_{ag}\rho_{gh}P_{gR}^0}{1-\rho_{ag}(1-\rho_{gh})} \\
\frac{(1-\rho_{ai})P_{aR}^0 + \rho_{ai}\rho_{ih}P_{gR}^0}{1-\rho_{ai}(1-\rho_{ih})} & > (1-\rho_{ah})P_{aR}^0 + \rho_{ah}P_{gR}^0 \\
\rho_{ih}\rho_{gh} - \rho_{ih} + \rho_{ih}\rho_{ig} - \rho_{ih}\rho_{ig}\rho_{gh} & < 0 \\
\rho_{gh} & > \rho_{go} 
\end{align*}
\]

(50)

The system is solved for the conditions reported in (7), when (3) and (5) hold.

This completes the first part of the proof.

Given (4) and (5), the artist will prefer to sell the artwork to the insider (knowing that he will sell the artwork to the auction house afterwards) to sell it to the gallery (knowing that it will be sold to the outsider) or to the auction house \((aih \succ ago \land aih \succ ah)\) when the price she obtains from the first bargaining is the highest among the three bargained prices. Analytically,
this is equivalent to the following system:

\[
\begin{align*}
\left\{ \begin{array}{l}
(1-\rho_{ai})P_{aR}^a + \rho_{ai}\rho_{ih}P_{R}^o > (1-\rho_{ag})P_{aR}^a + \rho_{ag}\rho_{go}P_{R}^o \\
(1-\rho_{ai})P_{aR}^a + \rho_{ai}\rho_{ih}P_{R}^o > (1 - \rho_{ah})P_{aR}^a + \rho_{ah}P_{R}^o \\
\rho_{ig}\rho_{go} - \rho_{ih} + \rho_{ih}\rho_{ig} - \rho_{ih}\rho_{ig}\rho_{go} < 0 \\
\rho_{ih} < \rho_{go}
\end{array} \right. \\
\rho_{gh} < \rho_{go}
\end{align*}
\]

The system is solved for the conditions reported in (7), when (4) and (5) hold. This completes the proof.  

C.2 Proof of Proposition 1.2

**Proof.** Given (3) and (6), the artist will prefer to sell the artwork to the insider (that, then, will sell the artwork to the gallery and it will end up to be sold to the auction house) instead of to the gallery (that will sell the artwork to the auction house) or to the auction house, that is, \( aigh \succ agh \land aigh \succ ah \), when the price she obtains from the first bargaining is greater than the ones she may obtain from the other two, namely:

\[
\begin{align*}
\left\{ \begin{array}{l}
(1-\rho_{ai})[1-\rho_{ig}(1-\rho_{gh})]P_{aR}^a + \rho_{ai}\rho_{ih}\rho_{gh}P_{R}^o > (1-\rho_{ag})P_{aR}^a + \rho_{ag}\rho_{go}P_{R}^o \\
(1-\rho_{ai})[1-\rho_{ig}(1-\rho_{gh})]P_{aR}^a + \rho_{ai}\rho_{ih}\rho_{gh}P_{R}^o > (1 - \rho_{ah})P_{aR}^a + \rho_{ah}P_{R}^o \\
\rho_{ig}\rho_{gh} - \rho_{ih} + \rho_{ih}\rho_{ig} - \rho_{ih}\rho_{ig}\rho_{gh} > 0 \\
\rho_{gh} > \rho_{go}
\end{array} \right. \\
\rho_{gh} > \rho_{go}
\end{align*}
\]

The system above is solved for the conditions reported in (8), when (3) and (5) hold. This completes the first part of the proof.

Given (4) and (6), the artist will prefer to sell the artwork to the insider (that will sell the artwork to the gallery, which, in turn, will sell it to the outsider) to sell the artwork to the the gallery (that will sell it to the outsider) or to the auction house (that is, \( aigo \succ ago \land aigo \succ ah \)), when the price she obtains from the bargaining with the insider is the highest among the three
prices. This is analytically represented by the following system:

$$\begin{align*}
\frac{(1-\rho_{ag})[1-\rho_{ig}(1-\rho_{go})]}{1-\rho_{ig}(1-\rho_{go})} + \frac{\rho_{ai} \rho_{rg} P_R^o}{1-\rho_{ag}(1-\rho_{io})} & > \frac{(1-\rho_{ai}) P_R^o + \rho_{ai} \rho_{rg} P_R^o}{1-\rho_{ai}(1-\rho_{rg})} \\
\frac{(1-\rho_{ai})[1-\rho_{ig}(1-\rho_{go})]}{1-\rho_{ig}(1-\rho_{go})} + \frac{\rho_{ai} \rho_{rg} P_R^o}{1-\rho_{ai}(1-\rho_{rg})} & > (1 - \rho_{ah}) P_R^o + \rho_{ah} P_R^o \\
\rho_{ig} \rho_{go} - \rho_{ih} + \rho_{ih} \rho_{ig} - \rho_{ih} \rho_{ig} \rho_{go} & > 0 \\
\rho_{gh} & < \rho_{go}
\end{align*}$$

The system is solved for the conditions in (8), when (4) and (5) hold.

This completes the proof. □

C.3 Proof of Proposition 1.3

**Proof.** Given (3) and (5), the artist will prefer to sell the artwork to the gallery \( (agh) \) instead of to the insider \( (aih) \) or to the auction house \( (ah) \) if the price she will get from the first one will be greater than the ones she could get from the other two potential buyers. This is analytically represented in the following system (in which also the two conditions coming from the Proposition are present):

$$\begin{align*}
\frac{(1-\rho_{ag})P_R^o + \rho_{ah} \rho_{gh} P_R^o}{1-\rho_{ag}(1-\rho_{gh})} & > \frac{(1-\rho_{ai}) P_R^o + \rho_{ai} \rho_{ih} P_R^o}{1-\rho_{ai}(1-\rho_{ih})} \\
\frac{(1-\rho_{ai})P_R^o + \rho_{ah} \rho_{gh} P_R^o}{1-\rho_{ai}(1-\rho_{gh})} & > (1 - \rho_{ah}) P_R^o + \rho_{ah} P_R^o \\
\rho_{ig} \rho_{gh} - \rho_{ih} + \rho_{ih} \rho_{ig} - \rho_{ih} \rho_{ig} \rho_{gh} & > 0 \\
\rho_{gh} & > \rho_{go}
\end{align*}$$

The system is solved for the values of the parameters reported in (9), when (3) and (5) hold.

This completes the first part of the proof.

Given (4) and (5), the artist will prefer to sell the artwork to the gallery instead of to the insider or to the auction house \( (ago \succ aih \land ago \succ ah) \) as long as the price she obtains from the bargaining with the gallery is higher than the one she may obtain from the bargaining with the
other two potential buyers. This is equivalent to the following system:

\[
\begin{align*}
&\frac{(1-\rho_{ag})P_R^a + \rho_{ag}\rho_{go}P_R^o}{1-\rho_{ag}(1-\rho_{go})} > \frac{(1-\rho_{ai})P_R^i + \rho_{ai}\rho_{ih}P_R^h}{1-\rho_{ai}(1-\rho_{ih})} \\
&\frac{(1-\rho_{ag})P_R^a + \rho_{ag}\rho_{go}P_R^o}{1-\rho_{ag}(1-\rho_{go})} > (1-\rho_{ah})P_R^a + \rho_{ah}P_R^o \\
&\rho_{ig}\rho_{go} - \rho_{ih} + \rho_{ih}\rho_{ig} - \rho_{ih}\rho_{ig}\rho_{go} < 0 \\
&\rho_{gh} < \rho_{go}
\end{align*}
\]

The system is solved for the conditions in (9), when (4) and (5) hold.
This completes the proof. ■

C.4 Proof of Proposition 1.4

**Proof.** The artist will prefer to sell the artwork to the gallery \((agh)\) instead of selling the artwork to the insider \((aigh)\) or the auction house \((ah)\), given (3) and (6), when the price she obtains in the bargaining with the gallery is the highest among all the three prices. Analytically, this is represented in the following system:

\[
\begin{align*}
&\frac{(1-\rho_{ag})P_R^a + \rho_{ag}\rho_{gh}P_R^h}{1-\rho_{ag}(1-\rho_{gh})} > \frac{(1-\rho_{ai})[1-\rho_{ag}(1-\rho_{gh})]P_R^a + \rho_{ai}\rho_{ig}\rho_{gh}P_R^i}{1-\rho_{ai}(1-\rho_{ig})} \\
&\frac{(1-\rho_{ag})P_R^a + \rho_{ag}\rho_{gh}P_R^h}{1-\rho_{ag}(1-\rho_{gh})} > (1-\rho_{ah})P_R^a + \rho_{ah}P_R^o \\
&\rho_{ig}\rho_{gh} - \rho_{ih} + \rho_{ih}\rho_{ig} - \rho_{ih}\rho_{ig}\rho_{gh} > 0 \\
&\rho_{gh} > \rho_{go}
\end{align*}
\]

The system is solved for the conditions in (10), when (3) and (6) hold.
This completes the first part of the proof.

Given (4) and (6), the artist will sell the artwork to the gallery \((ago)\) instead of selling the artwork to the insider \((aigo)\) or to the auction house \((ah)\) when the price she obtains from the bargaining with the gallery is higher than the ones she may obtain from the bargaining with
each of the other two potential buyers. This is equivalent to the following system:

\[
\begin{cases}
(1 - \rho_{ah}) P_R^a + \rho_{ah} P_R^p > \frac{(1 - \rho_{ai})(1 - \rho_{ah})}{1 - \rho_{ai}(1 - \rho_{agh})} P_R^a + \rho_{ai} \rho_{agh} P_R^p \\
(1 - \rho_{ag}) P_R^a + \rho_{ag} P_R^p > \frac{(1 - \rho_{ah})}{1 - \rho_{ag}(1 - \rho_{go})} P_R^a + \rho_{ah} P_R^p \\
\rho_{ig} \rho_{go} - \rho_{ih} + \rho_{ih} \rho_{ig} - \rho_{ih} \rho_{ig} \rho_{go} > 0 \\
\rho_{gh} < \rho_{go}
\end{cases}
\]

The system above is solved for the conditions in (10), when (4) and (6) hold.

This completes the proof. \(\blacksquare\)

C.5 Proof of Proposition 1.5

**Proof.** The artist will prefer to sell the artwork to the auction house directly instead of selling the artwork to the insider or to the gallery \((ah \succ aih \land ah \succ agh)\) if the price she obtains from the first bargaining is greater than the one she may obtain from the other two. This is represented in the following system:

\[
\begin{cases}
(1 - \rho_{ah}) P_R^a + \rho_{ah} P_R^p > \frac{(1 - \rho_{ai})(1 - \rho_{ah})}{1 - \rho_{ai}(1 - \rho_{agh})} P_R^a + \rho_{ai} \rho_{agh} P_R^p \\
(1 - \rho_{ag}) P_R^a + \rho_{ag} P_R^p > \frac{(1 - \rho_{ah})}{1 - \rho_{ag}(1 - \rho_{go})} P_R^a + \rho_{ah} P_R^p \\
\rho_{ig} \rho_{go} - \rho_{ih} + \rho_{ih} \rho_{ig} - \rho_{ih} \rho_{ig} \rho_{go} > 0 \\
\rho_{gh} > \rho_{go}
\end{cases}
\]

The system above is equivalent to the conditions in (11), when (3) and (5) hold.

This completes the first part of the proof.

Given (4) and (5), the artist will prefer to sell the artwork to the auction house directly instead of selling the artwork indirectly to the auction house through the insider or to sell it to the gallery (that will sell the artwork to the outsider) when the price she obtains from the first bargaining is higher than the ones she may obtain from the other two. This is analytically
represented by the following system:

\[
\begin{align*}
(1 - \rho_{ah})P_{R}^{n} + \rho_{ah}P_{R}^{o} > & \frac{(1-\rho_{ai})P_{R}^{n} + \rho_{ai}\rho_{ih}P_{R}^{o}}{1-\rho_{ai}(1-\rho_{ih})} \\
(1 - \rho_{ah})P_{R}^{n} + \rho_{ah}P_{R}^{o} > & \frac{(1-\rho_{ag})P_{R}^{n} + \rho_{ag}\rho_{gh}P_{R}^{o}}{1-\rho_{ag}(1-\rho_{gh})} \\
\rho_{ig}\rho_{go} - \rho_{ih} + \rho_{ih}\rho_{ig} - \rho_{ih}\rho_{ih}\rho_{go} < & 0 \\
\rho_{gh} < & \rho_{go}
\end{align*}
\] (59)

The system is solved for the condition in (11), when (4) and (5) hold.

This completes the proof. ■

C.6 Proof of Proposition 1.6

Proof. The artist will sell the artwork to the auction house instead of selling the artwork to the insider \((aigh)\) or to the gallery \((agh)\) when the price she obtains in the \(agh\) channel is higher than the one she may obtain in the other two channels. This is analytically equivalent to the following system, which considers also the conditions in (3) and in (6):

\[
\begin{align*}
(1 - \rho_{ah})P_{R}^{n} + \rho_{ah}P_{R}^{o} > & \frac{(1-\rho_{ai})[1-\rho_{ig}(1-\rho_{gh})]P_{R}^{n} + \rho_{ai}\rho_{ih}\rho_{gh}P_{R}^{o}}{1-\rho_{ai}(1-\rho_{ih})} \\
(1 - \rho_{ah})P_{R}^{n} + \rho_{ah}P_{R}^{o} > & \frac{(1-\rho_{ag})P_{R}^{n} + \rho_{ag}\rho_{gh}P_{R}^{o}}{1-\rho_{ag}(1-\rho_{gh})} \\
\rho_{ig}\rho_{gh} - \rho_{ih} + \rho_{ih}\rho_{ig} - \rho_{ih}\rho_{ig}\rho_{gh} > & 0 \\
\rho_{gh} > & \rho_{go}
\end{align*}
\] (60)

The system is solved for the conditions we reported in (12), when (3) and (6) hold.

This completes the first part of the proof.

Given (4) and (6), the artist will prefer to sell the artwork to the auction house instead of selling the artwork to the gallery or to the insider (that is, \(ah \succ aigo\wedge ah \succ ago\)) when the price she obtains from the bargaining with the auction house is higher than the other two prices she may obtain from the bargaining with the other potential buyers. Analytically, this is equivalent
to the following system:

\[
\begin{align*}
(1 - \rho_{ah}) P_R^a + \rho_{ah} P_R^o &> \frac{(1-\rho_{ai})[1-\rho_{ig}(1-\rho_{go})]P_R^a + \rho_{ai}\rho_{ig}\rho_{go}P_R^o}{1-\rho_{ig}(1-\rho_{go}) - \rho_{ai}(1-\rho_{ig})} \\
(1 - \rho_{ah}) P_R^a + \rho_{ah} P_R^o &> \frac{(1-\rho_{ag})P_R^a + \rho_{ag}P_R^o}{1-\rho_{ag}(1-\rho_{go})} \\
\rho_{ig}\rho_{go} - \rho_{ih} + \rho_{ih}\rho_{ig} - \rho_{ih}\rho_{ig}\rho_{go} &> 0 \\
\rho_{gh} &< \rho_{go}
\end{align*}
\]

The system is solved for the conditions in (12), when (4) and (6) hold.

This completes the proof. ■