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Adverse Selection in the Market for Slaves in Mauritius, 1825-1835

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Abstract: Evidence on adverse selection in slave markets remains inconclusive. We study this question through notarial acts on public slave auctions in Mauritius between 1825 and 1835, involving 4,286 slaves. In addition to slave characteristics, the acts document the identities of buyers and sellers. We use this information to determine whether the buyer of a slave was related (e.g. a relative or a spouse) to the original slave owner, and thus most likely better–informed than other bidders. Auction–theoretic models predict that bidding should be more aggressive when informed bidders are present in open–bids, ascending auctions, such as slave auctions. By proxying informed bidders by related bidders, our results consistently indicate that this is the case, pointing toward presence of residual adverse selection in the market for slaves in Mauritius.

Keywords: Adverse Selection, Information Asymmetry Test, English Auctions, Slavery, Mauritius

JEL Classification: D82, N37

Résumé: La présence d'antisélection dans les marchés d'esclaves demeure une question ouverte. Nous analysons cette énigme en utilisant des actes notariés de vente d'esclaves à des enchères publiques à l'Île Maurice entre 1825 et 1835, impliquant 4 286 esclaves. En plus de documenter des caractéristiques des esclaves, les actes donnent de l'information sur l'identité des vendeurs et des acheteurs. Nous utilisons cette information afin de déterminer si l'acheteur d'un esclave avait des liens (marital ou autre) avec le propriétaire de l'esclave et possédait ainsi plus d'information que les autres participants à l'enchère. La théorie des enchères prédit que les mises devraient être plus agressives lorsque des participants mieux informés sont présents dans des enchères ouvertes ascendantes, comme l'étaient les enchères d'esclaves. En utilisant les liens avec l'ancien propriétaire pour définir les participants les mieux informés, nos résultats indiquent qu'il existait de l'antisélection résiduelle dans le marché des esclaves à l'Île Maurice durant la période étudiée.

Mots clés: Antisélection, test d'asymétrie d'information résiduelle, enchère anglaise, esclavage, Île Maurice

1 Introduction

1.1 Issues and motivation

According to Akerlof (1970) adverse selection should be anticipated when four conditions are present. First, one party to the sale should be more informed than the other. Second, the quality of the product or service being sold should be valuable to both parties. Third, price should not be set by the more informed party. Finally, uncertainty should not be completely dissipated by extra-trading arrangements, such as warranties or litigation practices.

Based on these characteristics, the market for slaves would certainly satisfy the necessary conditions for adverse selection. Buying a slave remained a risky investment in which the buyer was at an informational disadvantage compared to the seller (Fede, 1987; Wahl, 1996). First, a slave-owner would undoubtedly have had more time to assess the productive abilities of a given slave.[1] Second, with the exception of slaves bought for manumission, the vast majority of slaves that were sold went from one productive activity to another. Unless involving an important change of type of work (e.g. from field hand to skilled work), sellers and buyers would presumably value the same characteristics. Third, slaves were usually sold in competitive auction markets (Freudenberger and Pritchett, 1991), thereby limiting the scope for market manipulation by informed sellers. Finally, although much more complex than commercial law, the law governing slave sales was generally unable to eliminate the negative effects of information asymmetry completely (Wahl, 1996).

Unfortunately, empirical evaluation of adverse selection in any market is not guided by clear theoretical prescriptions; although intuitively appealing, the Akerlof conditions for adverse selection to be present are difficult to assess in practice (Chiappori and Salanié, 2000, p. 57).

[1] Although professional slave traders might not have had this informational advantage, the usually long periods between taking charge of a slave and final sale would have given them time to assess temperament, propensity to flee, resistance to illness, ... For example, Freudenberger and Pritchett (1991) estimate a modal duration of two to three months for interstate trade toward the New Orleans market.

One approach proposed by Genesove (1993) is that the intensity of the marginal propensity to sell should be inversely related to adverse selection. Hence, a seller with surplus holdings of a good for which he has little alternative uses should sell all of his stocks, good and bad quality alike. Conversely, a seller with alternative uses, and little surplus, should sell only the low-quality goods, keeping the high-quality ones for himself. To the extent that observable characteristics of the seller provide information as to which case applies, the culling behavior of the latter is anticipated by the market, and a discount is imposed to the goods he sells. Applications of this framework are found in the markets for used cars (Genesove, 1993), for thoroughbred yearlings (Chezum and Wimmer, 1997) or for displaced workers (Gibbons and Katz, 1991).

On the basis of similar tests, although adverse selection is likely to have been present in slave markets, the empirical evidence concerning its incidence remains inconclusive. On the one hand, Greenwald and Glasspiegel (1983) contend that adverse selection was empirically important. Studying the New Orleans market for local and imported slaves they rely on the origin of the slave as observable seller characteristic to gauge the degree of adverse selection. Greenwald and Glasspiegel (1983) conjecture that owners from low-productivity areas (e.g. Old South, or Border States) had a higher marginal propensity to sell and therefore no interest in keeping only the best slaves and selling the low-quality ones. In comparison, owners from high-productivity Louisiana would cull bad slaves for resale purposes. Consequently, prices for imported slaves in the New Orleans market would be higher than for local slaves. Their empirical results confirm this intuition. Similarly, Choo and Eid (2004) find that they cannot reject the null hypothesis of low–productivity slaves culling from high-productivity suppliers of slaves to the New Orleans market, even controlling for unobservable variables, such as the number of bidders.

However, Pritchett and Chamberlain (1993) criticize this conjecture that higher imported slave prices reflected adverse selection. First, they argue that one setting in which adverse selection ought to be minimized was during estate sales where assets (including slaves) were liquidated following the death of the owner. In comparison, voluntary sales should be more subject to bad slaves culling and therefore lower prices. Yet, they find no statistically significant difference between prices observed during estate and voluntary sales. Secondly, they suggest an alternative explanation for the difference in the prices of imported versus local slaves. If a fixed transportation cost is applied to an imported slave, irrespective of its quality, and if prices are positively related to quality, then clearly the relative prices of the high-quality slave decrease with respect to that of the inferior one. Slave buyers would therefore have responded to this fall in the relative price of high-quality slaves by demanding more of them (Pritchett and Freudenberger, 1992; Pritchett and Chamberlain, 1993). That imported slaves to the New Orleans market would fetch higher prices simply reflected the fact that they were of higher quality compared to local slaves, instead of being the result of an adverse selection discount applied against local sellers.

Hence, the debate on the presence of adverse selection on slave markets remains unresolved. Whether or not adverse selection was indeed present is of importance to the extent that *not* taking it into account may bias evaluations of the profitability of slavery. In particular, it would prove hazardous to infer the productive capacity of the general slave population from market prices of slaves if these were actually inferior ones culled by their owners (e.g Greenwald and Glasspiegel, 1983; Choo and Eid, 2004, among others). In light of these elements, this paper's objectives are to propose another look at whether or not adverse selection affected slave markets. We depart from previous analysis in at least three important ways. First, we focus on a slave market which has received comparatively less attention: that of early Nineteenth century Mauritius. Second, we analyze adverse selection from a different perspective drawing from an auction–theoretic background. Finally, we resort to a rigorous estimation and inference framework to gauge the importance of adverse selection. The proposed methodology should be useful to the analysis of residual asymmetric information in different applications of English auctions and possibly others.

1.2 Methodology and results overview

Although Mauritius remained an important slave colony of the French, and, beginning in 1810, of the British, until slavery was finally abolished in 1835, Mauritian slavery has not been as extensively studied as its American counterparts.[2] Despite distance, Chenny et al. (2003) show that Mauritian slavery displayed remarkable parallels with its better–known counterparts elsewhere. Valuation of physical strength, skills, and reproductive capacities were just as prevalent as those found in the Americas (Mancall et al., 2001; Bergad et al., 1995; Newland and San Segundo, 1996; Kotlikoff, 1979, 1992, among others). On the other hand, compared to the New Orleans market, the Mauritian slave market can safely be regarded as purely local. A small island of 720 square miles, slave imports were effectively banned by the British. The implications are that difference in prices between slaves could not be attributed to differences in quality induced by transportation costs, thereby addressing the critique by Pritchett and Chamberlain (1993).

The problem of adverse selection should be market–, and not location–specific. If the characteristics of the slave market are such as to give rise to adverse selection, and if those characteristics are similar across geographical locations, then adverse selection should also be prevalent in the Mauritian market. In order to study this question, we augment and complement the database introduced by Chenny et al. (2003). This database initially consisted of detailed no-

[2]It is estimated that 85% of its population of 78,000 were slaves in 1807. See Burroughs (1976), Benedict (1980), Nwulia (1981) Barker (1996), Teelock (1998), Scarr (1998), Valentine (2000), and Allen (1999, 2001) for historical and sociological discussions and bibliographies on Mauritian slavery in particular. See Clarence-Smith (1989); Scarr (1998) for discussions of the Indian Ocean slave trade in general.

tarial acts on auction sales of slaves over the period 1825–1827. In Section 2 we extend the period covered to include the years up to 1835, for a total of 580 auctions involving over 4,200 slaves. Our database includes detailed information on slaves' characteristics (ethnicity, gender, age, skills, bundle composition). Importantly, it also contains transactional data on the motivation for the sale, as well as on the identities of the seller and buyer. This allows us to differentiate between voluntary and involuntary (i.e. succession, bankruptcy) sales. Moreover, a careful analysis of the notarial acts allows us to gauge the degree of parental relationship between the seller and buyer. This variable is a key ingredient of our empirical evaluation of adverse selection.

Heuristically, it may be argued that close parental (or business) relationship with the owner could lead to more and better information on the slave's characteristics. Furthermore, if we take into account the fact that the Mauritian market was local, and that auctions were publicized well in advance, it appears reasonable to suppose that these seller–bidder ties would have been public information. Observing that someone who was related to the original owner was bidding for a slave at the auction could signal to the market that this particular slave was of high quality. Clearly, a related bidder could also try to acquire the slaves for other, more personal reasons that are unrelated to a slave's productive characteristics (e.g, personal attachment, manumission purposes, . . .). In the former case, competitive bidding should have been more aggressive, in the latter, it should not have been affected by the related bidder's participation. Put differently, the informational asymmetry with respect to a slave characteristic valued by all bidders (common value) should have been reflected in a slave's price. Information asymmetry related to a slave's characteristic valued only by a particular bidder (private value) should not.

In light of these elements, this paper departs from standard literature in resorting to a demand–related, instead of supply–related (i.e. through marginal propensity to sell) empirical characterization of adverse selection. We use the interdependence of bidding behavior in public auctions where information is asymmetric, and where the good being auctioned has a common and private value to construct our empirical test. In this setup, the bidding behavior of certain bidders considered to be better informed affects that of others who infer the quality of the good from the actions of the formers. The auctions literature described in Section 3.1 has long recognized that this environment is well suited for the analysis of adverse selection (e.g Milgrom, 2004; Maskin, 2004, among others).

We consequently resort to a well-known theoretical model of English auctions in Section 3.2. The framework, developed by Wilson (1998) and extended by Hong and Shum (2003), considers open–bid ascending auctions with informational asymmetries among bidders, private and common valuation, and is particularly appropriate for the analysis of slave markets. Importantly, the Wilson (1998) model derives closed–form solutions for the Bayesian–Nash equilibrium bids under log-normal distributions for values and signals. We can adapt this model to our particular setting by characterizing an informed (related) bidder as one with a perfect signal on the slave's common value, but nonetheless valuing the slave for personal motives as well. In the Wilson (1998) model, individual signals and valuations are not observed, but distributional assumptions governing those are public information. This means that the identity of the informed bidder would be known, as was likely the case in our setting.

Although analytical expressions for the equilibrium bidding strategies are derived, the exact role of the informed–bidder assumption is difficult to extract. We therefore resort to numerical analysis in Section 3.3. Using Monte–Carlo experiments, we compute the ex-post distribution of equilibrium bids for a large parameter space and taking into account parametric uncertainty. Our results indicate a clear and intuitively–appealing outcome: the presence of the informed bidder leads to systematically more aggressive bidding (Claim 1). When the informed bidder exits the auction, the market interprets this as a bad signal on the auctioned good's common value, and bids fall accordingly, until this effect is eventually subsumed by the additional information revealed in subsequent bidding rounds. As we increase the uncertainty regarding the share of total valuation of the informed bidder attributed to personal motives, the bid premium is reduced, but remains nonetheless positive. Hence the auction–theoretical model result reveal that bids (and consequently) prices should be higher when an informed bidder is present. Importantly, the informed bidder ends up paying a higher equilibrium price in those instances where he does win the auction (Claim 2).

In our case, we attribute more information to personal seller–bidder ties and associate an informed bidder with a related bidder. Our data set does not contain information on *all* instances where related bidders participated in slave auctions. However, we observe cases where related bidders *made the winning bid*, and subsequently recorded the sale with the notary. It is thus unlikely that these sales were motivated by market manipulation objectives from those entitled to the proceeds of the auction. Hence, testing Claim 2 is tantamount to testing whether slave prices were effectively higher when a related buyer ended up buying the slave. Consequently, in Section 4.1 we specify an hedonic pricing econometric model of log prices, with slave characteristics (ethnicity, age, skills, presence of children in bundle, and gender) as well as seasonal and time dummies as control variables. We augment the specification with a binary variable for the buyer being related to the original owner. We interpret a positive premium on this variable as indicating the presence of informational asymmetries in general, and adverse selection in particular.

The estimated parameters presented in Section 4.2 all have the desired signs: prices are higher for ethnic groups considered more productive, are bell-shaped in age, increase in skills and presence of children and in peak sugar cane production seasons and years. Whether or not we control for potential endogeneity in the related–buyer variable, or the fact that it is a discrete variable confirms our theoretical result: the premium on the related buyer is positive, indicating that the null hypothesis of no adverse selection is rejected. Moreover, we draw from the literature on testing for adverse selection in insurance markets to verify the robustness of our results. Adapting a result from Chiappori and Salanié (2000) amounts to testing for conditional covariances between prices and decision of related buyers to purchase the slave. Once again, our empirical results confirm that the null of no adverse selection is rejected. Finally, we consider a parametric implementation suggested by Dionne et al. (2001) controlling for potential misspecification of the econometric model. Again we reject the null of no adverse selection. Overall, our tests consistently indicate that adverse selection was present in Mauritian slave markets.

2 Data

The information on the sale of Mauritian slaves is obtained from the notarial acts in the General Inventory of Notaries (group NA), from the Mauritius Archives located in Coromandel, Mauritius. Under Mauritian colonial law, notaries played a key role in the public auctions of slaves (Government of Mauritius, 1824, Proclamation of July 16, pp 122–125). In particular, notaries certified the ownership titles of the sellers, recorded the list of slave characteristics, as well as the motivation for the sale. They subsequently publicized and organized the public auction. Finally, the notaries recorded transactional information between the seller and the buyer of the slave, including the price and observable characteristics of the slave, as well as the name of the buyer. In what follows, we focus exclusively on sales conducted through public auctions, and abstract from private person–to–person sales for which we have no information.

We build on the database first introduced by Chenny et al. (2003) who used the notarial acts for 1825 to 1827. They considered a sample of 152 auctions involving the sale of close to 1,300 slaves. We extend the period covered up to January 1835, for a total of 580 auctions involving 4,286 slaves. Even though other auctions were also held over that period, slaves were actually sold only during those auctions in our sample. These sales were recorded in the notarial acts of fifteen notaries described in Table 1. Most were operating from the capital, Port-Louis. One notary, Alexandre Bonnefin, accounts for 26% of all auctions and 20% of all slaves sold during the whole period. Three notaries were active up to 1829 and we found no record of sales which they would have performed afterwards.

The slave's gender was recorded either explicitly or implicitly. For example, the acts written in French distinguish between *vendu* (male) and *vendue* (female). Moreover, a slave's age, and ethnicity were also reported. Following contemporaneous descriptions, slaves' ethnic groups were classified as Creoles (born on the island), Malagasy, Mozambiques, and Indians (including Malays). Table 2 verifies our sample's representativeness of the slave population in Mauritius by comparing it with the 1826 partial census data from the *Greffe de l'Enregistrement des Esclaves* in the Mauritius Archives Teelock (1998); Valentine (2000). Overall, gender, ethnic, as well as the average age distributions by ethnic group in our sample are quite close to those obtained from the census. We therefore conclude that our sample is reasonably representative of the general slave population.

We use the occupational classification of Telfair (1830) to characterize a slave's work. We aggregate the slaves' occupations into three categories: laborers, agriculture and sea-related; household slaves; and skilled slaves (see the notes to Table 3 for a more complete description). Table 3 reports the average prices across gender, occupation and ethnic group. Our main findings may be summarized as follows: (i) female slaves consistently fetched lower prices; (ii) price differences across ethnic groups are significant, with Creoles fetching the highest prices; and (iii) premiums are associated with skilled occupations. These findings are consistent with those of Chenny et al. (2003) for the period 1825–1827.

Slaves on the secondary market were either sold voluntarily by their masters, or sold involuntarily following their owner's bankruptcy or death (succession sales). Under the French Civil Code (adapted for Mauritius under Code Decaen, 1804), following a bankruptcy, all the assets (including slaves) of the individual or company had to be liquidated through an auction. Succession laws (also specified in the Civil Code) prescribed that the succession should be divided among heirs following the death of the owner(s). Complete liquidation of assets through an auction was automatic whenever a heir was minor, absent or legally ineligible. Similarly, auction sales would have been organized whenever heirs failed to reach an agreement concerning the valuation and distribution of the assets among themselves. In this case, the value of the proceeds from the auction would have been divided among the heirs.

When the reason for the auction could not be obtained from the notarial acts, either because it was not documented or the reason was illegible because of the poor quality of some documents, the motivation for the sale was classified as unknown. In Table 4, the vast majority (77%) of auctions took place to liquidate the estate of a deceased person, while only 9% were because a slave owner voluntarily wanted to sell his or her slaves. The remainder auctions occurred because of bankruptcy.

Table 5 uses the motivation for sales to compare the prices of succession versus voluntary sales. To ensure homogeneity of the slaves, we focus on a sub-sample of males, and prime-aged field hands. The results indicate a substantial and significant 45% premium for the latter when sold in succession rather than in voluntary sales. This premium could be interpreted as *prima facie* evidence of adverse selection.[3] However, it could also be related to the different types of buyers involved in both type of sales, an issue to which we now turn.

[3] Pritchett and Chamberlain (1993) argue that it is unlikely that succession sales were motivated by hidden defects of the slaves. The death of the owner is a random event, uncorrelated with the quality of his slaves. As such, succession sales would probably be the least subject to adverse selection, and the price would be more closely aligned with the productive capacities inferred from the slave's observable characteristics. In comparison, slave owners should be inclined to voluntarily sell slaves with unobservable defects (propensity to flee, to illness, low work intensity, ...). Contrary to a succession, voluntary sales did not involve the forced liquidation of all assets. Only slaves with bad qualities might therefore have been brought to the auction, with better ones retained by the owners. This suggests that adverse selection would have been the most severe in voluntary sales and the least severe in succession sales. Consequently, slaves sold voluntarily should fetch lower prices than those who are sold during succession sales.

Finally, our data allows us to determine whether or not buyers and sellers are related. Each notarial act gives the name of the person who initiated the sale, the name of the original owner, and the name(s) of the buyer(s). In the case of succession sales, each notarial act also lists the name of all the heirs, as well as any other individual who is entitled to some part of the proceeds of the sale.[4] For example, on July 2^{nd} 1826, notary Dubor (NA 63) auctioned the estate of deceased sieur Deville, a police commissioner (*Commissaire civil et de police*) in the town of Pamplemousses located to the North of Mauritius. Sylvain Chauveau, the testament executor, is recorded as the seller. The estate consisted of 12 slaves: 2 mothers with their children (1 and 3 in each case), 2 skilled males (cook and carpenter), 2 female laundresses, 1 female seamstress, and 1 female domestic worker. All the slaves, except the cook Caramouche and the female domestic worker Zaize, were purchased by the wife of the deceased sieur Deville. The widow is obviously related with the original slave owner. Caramouche was purchased by Hypolite Dupery for whom we could not find any link with either sieur Deville or anyone else mentioned in the notarial act. As for Zaize, she was purchased by G. Deville. Although the latter has the same last name as the deceased, he is not mentioned anywhere in the notarial archive as being related to the deceased slave owner. We code such a sale as the buyer and sellers having the same names and being possibly related.[5]

We repeated the above procedure for each slave. Given that mothers were sold together with their younger children under *Code Noir*, and that we exclude voluntary bundling of slaves, we are left with 3,307 sales. The distribution of the potential link between the buyer and seller is reported in Table 6. We find a link between buyers and sellers for 1,003 slaves. In the case of succession sales, conditional on having a relationship with the deceased person, the widow(er) is the modal buyer. The second group of related buyers is composed of the former owner's

[4]This would be the case for example if there was any creditor.

[5]For robustness reasons, we also assumed that individuals with the same last name were unrelated, without any qualitative change in our results.

children. The share of related buyers is lower in the case of bankruptcies (4.6%) or voluntary sales (12.6%) than succession sales (38.5%). In the case of voluntary sales, the modal related buyer is the original owner himself (15 purchases).[6] Overall, this confirms our earlier conjecture that the type of buyers involved in voluntary versus involuntary slave auctions differed. We now address the issue of how these differences might have affected the bidding process and eventually the sale price.

3 Theoretical analysis

As mentioned in Section 2, we can distinguish two types of buyers: related and unrelated. Regarding the formers, we make the following two assumptions:

Assumption 1 *Compared to other bidders, a related bidder has superior information on unobservable characteristic(s) of a slave correlated with the slave's common value.*

Assumption 2 *A related bidder's identity is known by other bidders.*

The first assumption appears realistic. We saw in Table 6 that the vast majority of related buyers were either the spouse or children of the deceased owner in succession sales. It would seem natural to suppose that these bidders would have had sufficient time to acquire privileged information on the slave being auctioned. The second assumption is also reasonable. The small size of the Mauritian market, both in the limited number of participants, and geographical concentration would make it likely that bidders would have known each other.

Observing that a related buyer remains active in the bidding process signals to others that this slave has value. On the one hand, if this value is purely private, it is useless to others, and their bidding strategy should remain unaffected. On the other, if this value is common,

[6] Note that, as was the case in New Orleans (Freudenberger and Pritchett, 1991), the original owner could buy back his own slaves. These owners may have decided to buy back the slave given that the proposed bid was less than their reservation value.

the related bidder's actions are useful to the others; they revise upwards their conditional beliefs as long as the related bidder remains active in the bidding process. If at the end of the bidding process the related buyer acquires the slave, and if other bidders believe his actions are motivated by a high common value, then the price paid by the related buyer will be higher, reflecting the informational asymmetry, and adverse selection risk. Clearly if information is perfectly symmetric across bidders, and/or if the slave's value to the related bidder is purely private, the latter's actions should be inconsequential.[7] In order to characterize better how these effects impact the equilibrium bidding process, we now turn to auction models. One setting which is particularly well-suited for our analysis is the open–bid, ascending English auction model with private and common value, and informational asymmetry across bidders.

3.1 Auctions models

An auction is characterized by a group of potential bidders that compete for the acquisition of goods. We limit the discussion to a single good auction because we analyze such auction in the empirical part of the article. An auction of interest for our purpose is the English or ascending auction with a sequential bidding game where the highest bid wins. When there is a single good, this auction with only private values generates an efficient allocation in the sense that the bidder with the highest type always win. As shown by Vickrey (1961), the English and the second price auction yield the same payoffs under the above assumptions.

One limitation of this environment with only private values is that the payoffs of potential bidders are not dependent of other bidders' presence. In other words, the assumption of private values does not consider that others' information can influence a participant ranking of values or does not allow for interdependent (or common) values. An environment with interdepen-

[7] Note that the relationship between a seller and a related bidder raises a possibility of market manipulation. For instance, a group of heirs might collude to simulate interest in a particular slave so as to raise prices, dropping out of the auction process at the last moment. In our setting however, the market manipulation argument does not apply since the related buyer *actually ended up* purchasing the slave.

dence is often identified as containing potential adverse selection (or asymmetric information) because the final outcome may be function of the information of certain bidders that affects the information of other bidders. In other words, bidders can learn something about the quality of the good during the bidding period that can change their reservation prices (Milgrom, 2004; Maskin, 2004). It is natural to believe that oral English auctions may introduce interdependence in individual values.

In presence of interdependent or common values, the analysis of efficiency is more complicated. However, Maskin (1992) and Krishna (2003) show that an equilibrium, with one-dimensional signals, can still be efficient in ascending auctions with interdependent values and asymmetric bidders (different value functions) if interpersonal crossing conditions hold. When signals are multidimensional, efficiency is no longer possible (for a general proof of inefficiency see Jehiel and Moldovanu (2001)).

Krishna (2003), as for many authors in this literature, considers a specific case of English auctions. This version of the English auction is labelled as the Japanese auction or the button auction (Milgrom and Weber, 1982). In this auction, when a bidder decides to drop out, his decision is both public and irrevocable. We shall consider this auction type in the reminder of the discussion. One important contribution for empirical studies on auctions with private and common components is that of Wilson (1998). He assumes that values are distributed log normally and asymmetric bidders have multiplicative value functions. In that setting the equilibrium strategies are log-linear and can be computed in function of the chosen parameters. Krishna (2003) shows that Wilson model satisfy the crossing conditions with N bidders, so the obtained sequential equilibria are efficient even in asymmetric auctions. Finally, Hong and Shum (2003) extend the Wilson model by relaxing the perfectly diffuse prior assumption for the common value. They also allow the bidders to observe only a single signal that corresponds to the product of the private component and the noisy estimate of the common component.

As already mentioned, in this article, we analyze the selling of slaves in small communities where potential buyers know other buyers and where one bidder can be a family member of the past owner of the slave in the auction. The auction model that corresponds to our empirical test is related to open ascending auctions. The monetary value of the item is the sum of two components: A common component having a common value to all bidders and a private component having an idiosyncratic value. For our purpose the common component can be interpreted as the productivity of the slave and the private component corresponds to any other quality of the slave that matters for a potential buyer such as his personality. The two values are independent random variables.

The theoretical setting allows for asymmetric auctions where all bidders differ in the precision of their signals on private and common values. What we test for is a special case of that asymmetry in which one related bidder (the insider) has better information on the common value. We label this case as asymmetric information.

In our framework, the common value is assumed to be better known by only one bidder identified as the insider who may be a member of the family that owned the slave before the auction. The auctioneer does not know the common value so she cannot reveal it to the outsiders or all other bidders. The insider can be identified and other bidders know that the insider has private information about the common component of the slave.

Two information cases are of interest for the empirical test. The first one, common knowledge, is when none of the bidders has better information on the common value. The second case will be identified as the residual asymmetric information one. By definition, this case occurs when the observable insider does not want to or cannot credibly reveal his perfect information about the common value of the slave during the auction. This case is possible in small communities where all bidders know each other as in our application.[8]

One prediction from the model presented in the next section is that the expected price conditional on the insider winning the auction in the residual asymmetric information case is higher than in the case where the insider does not win the auction. When there is no residual asymmetric information, such as in the common knowledge case, there should not be any correlation between the winning price and the fact that the insider wins the auction. By symmetry, this last result should be the same when no participant knows the common value (hidden knowledge) because the analytical models are very similar (Hernando-Veciana and Tröge, 2004).

Our empirical proposition for the presence of residual asymmetric information means that when the insider remains in the dynamic auction, this increases some outsiders' incentives to do so. These outsiders are willing to outbid any insider's bid, even bids above their expected value. The reason is that such outsiders may find it profitable to win at any price at which the insider does so. This situation is a consequence of the interplay between the winner's and the loser's curse.

To see intuitively the effect of presence of asymmetric information, consider Figure 1 borrowed from an example in Hernando-Veciana and Tröge (2004). The figure compares the outsiders' bid function b_i in the common knowledge (CK) structure for a given realization of the common value (v) to that in the residual asymmetric information one (AI). The bid functions are increasing in the private values a_i. In this auction the insider has an incentive to remain active as long as the price has not reached his true value. In the common knowledge case, the outsider with type a_i leaves the auction at price $(a_i + v)/2$. Under residual asymmetric

[8] It is also probable in auctions of fine arts or in auctions for the selling of fishes when experts are present. Of course an art collector or a fish expert can be represented by an anonymous bidder but such substitution is less possible in slaves auctions that are regulated and where all transactions have to be registered with notary acts.

information, the behavior of the outsider is function of the insider's behavior. One can show that the outsider will leave the auction at price a_i if the insider has not leaved the auction yet and at $(a_i + v)/2$ if the insider has left the auction at price v.

We observe in Figure 1 that if the insider remains in the auction, the outsiders with high types or high private values continue to bid at higher values in the asymmetric information case than in the common knowledge case. The opposite situation is observed for outsiders with low types. So when outsiders have high private values, the probability to have a winner's curse ("the insider knows that the common value is less than what the outsider thought") is low and that to have a loser's curse ("the insider knows that the common value is larger than what the outsider thought") is high. Consequently, when the number of bidders is sufficiently large to have bidders with high private values in the auction, outsiders with high private values will have higher incentives to remain active in the auction under asymmetric information than in the auction with common knowledge because they bid as they have good news about the common value to protect themselves against the loser's curse.

In this environment with residual asymmetric information, if the insider has high private and common values and wants to buy the slave, the observed winning price will be higher when the insider wins than when he does not win. In the common knowledge case however, the fact that the insider wins is independent of the common value. We now present a more formal discussion of the above conclusion.

3.2 Closed-form Bayesian-Nash equilibrium bids

The structure of the Wilson (1998), and Hong and Shum (2003) model of English auctions is the following. Agents denoted $i = 1, \ldots, N$ are characterized by a valuation (common and private) V_i and a signal (valuation plus noise) X_i concerning an object sold at an ascending, open–bid auction. Each round of auction consists in agents submitting bids, with the lowest bid being dropped out and a new round being started. At each round k, agents can observe the signal of the exiting bidder, but need to infer that of the $N-k$ other bidders who remain active. Given price P, the equilibrium bidding strategy of agent i at bid round k, β_i^k, must satisfy:

$$P = \mathrm{E}[V_i \mid X_1 = (\beta_1^k)^{-1}(P), \dots, X_{N-k} = (\beta_{N-k}^k)^{-1}(P), X_{N-k+1}, \dots, X_N], \tag{1}$$

for $i = 1, \dots N-k$. Under general monotonicity conditions, it can be shown that such an equilibrium exists and is obtained by solving (1) for the $N-k$ inverse bidding functions $(\beta_{N-k}^k)^{-1}(P)$ (Hong and Shum, 2003, Proposition 1, p. 331).

Importantly, Wilson (1998) and Hong and Shum (2003) derive closed-form expressions for the Bayesian-Nash equilibrium bidding functions when the stochastic process is log-normal. In particular, assume that (log) valuation $v_i \equiv \log(V_i)$ and (log) signal $x_i \equiv \log(X_i)$ are distributed as follows:

$$v_i = a_i + v \tag{2}$$

$$a_i = \bar{a}_i + \epsilon_{a_i}, \quad \epsilon_{a_i} \sim N.I.D.(0, t_i^2) \tag{3}$$

$$v = m + \epsilon_v, \quad \epsilon_v \sim N.I.D.(0, r_0^2) \tag{4}$$

$$x_i = v_i + \epsilon_{x_i}, \quad \epsilon_{x_i} \sim N.I.D.(0, s_i^2). \tag{5}$$

The valuation for each agent v_i is the sum of an idiosyncratic private value a_i and a common value v; t_i is the standard error of the private value, and r_0 that of the common value. The idiosyncratic signal x_i is given by the individual value plus an idiosyncratic noise term ϵ_{x_i} with standard error s_i varying across agents.

Under the log-normal assumptions, the equilibrium bid of agent i at round k satisfies:

$$b_i^k \equiv \log(\beta_i^k) = 1/A_i^k(x_i + D_i^k x_d^k + C_i^k), \tag{6}$$

where x_d^k is the ex-post observable vector of signals from exited bidders, and where A_i^k, D_i^k, C_i^k are functions of the distributional parameters $\bar{a}_i, t_i, m, r_0, s_i$ (Hong and Shum, 2003, eq. (12), p. 334).[9] The main difference between Wilson (1998) and Hong and Shum (2003) is that the former assumes a perfectly diffuse prior on the common value corresponding to $r_0 = \infty$, whereas the latter do not.

This model is well-suited to analyze the impact of the presence of an informed bidder on equilibrium bids. In particular, we can rewrite the signal function (5) as:

$$x_i = (\bar{a}_i + \epsilon_{a_i}) + (v + s_i \xi_i), \quad \xi_i \sim N.I.D.(0,1). \tag{7}$$

Hence, the signal is the sum of a noisy private component $(\bar{a}_i + \epsilon_{a_i})$, and a noisy estimate of the common value $(v + s_i \xi_i)$. In this light, an informed bidder, $i = I$, could be thought of as one whose signal on the common value is precise compared to others:[10]

$$s_i = \begin{cases} 0, & \text{if } i = I, \\ > 0 & \text{otherwise.} \end{cases} \tag{8}$$

Hence, the signal on the common value to an informed bidder is the common value itself. The overall signal x_I in (7) however remains noisy since it incorporates a noisy private signal as well.

[9] For completeness, we reproduce the closed-form expressions for A_i^k, D_i^k, C_i^k in the Appendix.

[10] Recall that because the distributional parameters $\bar{a}_i, t_i, m, r_0, s_i$ are known, this implies that the identity of the informed bidder is also known by other bidders

An analytical evaluation of the effect of restriction (8) is complicated by the nonlinearities in the distributional parameters found in A_i^k, D_i^k, C_i^k. Alternatively, we may resort to numerical approaches to which we now turn.

3.3 A Monte-Carlo Experiment

We conduct a Monte-Carlo experiment to analyze the impact of the informed bidder restriction (8) on the equilibrium bids (6). Specifically, we select a number of participants ($N = 30$); distribution laws for the fixed parameters ($U(0,1)$); and a number of iterations ($T = 5000$). In accordance with the model, the error terms are drawn from Gaussian distributions. Then, at each iteration $j = 1, \dots T$ we:

1. generate the fixed parameters $\bar{a}_i, t_i, m, r_0, s_i$ from $U(0,1)$;

2. generate the errors process $\epsilon_{a_i}, \epsilon_v, \epsilon_{x_i}$ from a Gaussian distribution corresponding to the generated scedastic structure in step 1;

3. use (6) to compute the equilibrium bids for each bidder i, at each round k, and for each iteration j, first without $b^0(i,k,j)$, and then with an informed bidder $b^1(i,k,j)$.

Finally, we compute the informed bidder premium π defined as difference between all agents' bids with and without informed bidder:

$$\pi(i,k,j) \equiv b^1(i,k,j) - b^0(i,k,j), \quad \forall i,k = 1, \dots N \tag{9}$$

In what follows, we focus on the median premium $\hat{\pi}(i,k) \equiv \text{Median}(\pi(i,k,:))$ to obtain the desired prediction for the empirical part of our study.

The number of participants is set at 30, a reasonable figure for Mauritian slave auctions. Moreover, the parameters of the model are generated at each iteration. This ensures that our results are not dependent on a specific parameter set, but are robust to very general parametric specifications. In addition, we resort to variance reduction techniques (antithetic variates) to augment precision, such that our results actually correspond to a much larger than the (already large) number of replications. Also, the identity of the informed bidder is arbitrarily chosen such that he sometimes wins the auction, and sometimes doesn't. Finally, we check for the robustness of our results by sequentially changing the number of participants, and the distributional laws for the fixed distribution parameters.

Figure 2 plots the median premium $\hat{\pi}(i,k)$ in function of the bidder's number $i = 1, \ldots 30$ and round number k. The identities for some bidders are indicated.[11] Moreover, we identify the median retirement bid for the informed bidder which was evaluated at round 18 out of 30. We observe that, *for all* agents, the median informed bidder premium is positive until the informed bidder retires from the bidding process. Specifically,

Claim 1 *Bidding is more agressive when the informed bidder is actively participating in the auction.*

For high-value bidders remaining after I has left, the premia is negative and becomes negligible as we approach the end of the process; for median- and low-value bidders, the premium is positive until they retire. Furthermore, the premium for the highest bidders are similar in shape and decline in the intensity of the bids. In addition, for median- and low-value bidders, the premia increases until they retire. Finally, the premia is largest for the lowest bids who retire early on in the bidding process (located to the left of the graph).

These results are intuitively appealing. The fact that the informed bidder remains active is interpreted as a good signal on the common value. Consequently, *all* the participants bid

[11]Recall that bids are re-sorted at each round in descending order. The bidder's identity should be interpreted as his position in the sorted bids. Hence, for example, bidder $i = 17$ at round $k = 5$ is the 17^{th} highest bid of the remaining $N - k = 25$ bidders.

more aggressively than if he had not been present. However, when the informed bidder exits, high-value bidders interpret this negatively and the bid is lower than it would have been otherwise. Eventually, the information from the informed bidder's decision is subsumed by the new information as other bidders exit and the two bids become identical. The fact that the informed bidder premium is highest for low-value-signal bidders is also intuitive. Since valuation is the sum of a common and private value term, a low value on average corresponds to a low private value. Since these agents comparatively value more the common component, any information revealed by the informed bidder's action is very valuable. The longer the informed agent remains in the bidding process, the more it confirms that the common value might be high.

Next, in Figure 3, we consider comparative statics exercises where we successively change the assumptions generating the fixed parameters. For this analysis we focus exclusively on the maximum bid. Since bids are ordered in descending order, this correspond to $\pi(1,k,j) \equiv b^1(1,k,j) - b^0(1,k,j)$.

First, in panel A we increase $\bar{a}_i \rightarrow 5 \times \bar{a}_i, \forall i$. This implies that the mean *private* value component of total value becomes more important relative to the *common* value, and that mean total value and signal are also higher. Conversely, the variances of both value and signal remain unaffected. The impact is to shift outwards the informed bidder premium which becomes more important. Second, in panel B we increase $m \rightarrow 5 \times m$. This results in an increase in the mean *common* value, with variances again unaffected. This variable has no apparent impact on our benchmark results. An increase in $\bar{a}_i$ raises the mean levels of high-value bidders more than those of low-value bidders. In comparison, an increase in m has a uniform effect on all bidders' mean valuation. Consequently, the effect on the highest value bidder is more important than in the second case.

Third, in panel C, we increase $t_i \to 2 \times t_i, \forall i$ thereby increasing the variance of the private component of total value, and signal, while means remain unchanged. This results in lowering the premium, which nonetheless remains positive. Bidders become more uncertain regarding the informed bidder's private value; the latter could remain active because of a large private value which is irrelevant to other bidders, i.e. the winner's curse risk is more important. Fourth, in panel D we increase $r_0 \to 2 \times r_0$. This raises the standard error on the common value. This also has a positive impact on the premium since agents are more uncertain concerning the mean common value. Any signal inferred from the informed bidder's action is therefore more valuable.

Fifth, in panel E we increase $s_i \to 2 \times s_i, \forall i$ so as to increase the overall variance of the signals on common value without affecting the means. This implies that the signals agents receive becomes less informative. Consequently the information revealed by the informed bidder's decision become more important and the premium increases strongly. Finally, in panel F we increase $N \to 1.5N$. Augmenting the number of participants from 30 to 45 shifts the informed bidder outwards. It might have been argued that the informed bidder effect could have been diluted by having more bidders. Our results show that this is not the case.

Overall, our Monte–Carlo results convey the following message. As long as the informed bidder I remains active, the informed bidder premium is positive, i.e. all active bidders bid more aggressively than otherwise. This result comes about from the interaction of the winner's and loser's curse. The fact that I remains active could be because of a high common value. Then, an outsider retiring from the auction incurs a loser's curse. However, I could remain active because of a high private value; remaining active therefore implies a winner's curse risk. Our results indicate that for a wide set of parametric specifications, the loser's curse effect is more important, such that bidders are willing to bid more aggressively knowing that the informed bidder remains active.

A corollary of this observation is that, if I remains active until the end, then the $(N-1)^{th}$ bidder will also bid more aggressively and I will end up paying a higher price. To verify this claim, we therefore compute the informed bidder premium conditional on I winning the auction, i.e. $\pi(i = I, k = N, j)$.[12] This corresponds to the difference in price the informed bidder would have to pay given that he ended up winning the auction. Figure 4 plots the distribution of premia. It clearly indicates that the premium is on average positive, with a median of 0.0984. This last observation forms the basis of our empirical tests. We may state our main hypothesis to be tested as follows:

Claim 2 *The winning bid is higher when the informed bidder wins the auction.*

In the subsequent econometric analysis, we formally test Claim 2 using our Mauritian slave auctions data discussed in Section 2.

4 Empirical analysis

4.1 Methodology

Let w_s denote whether winner of the auction for slave s is related ($w_s = 1$), or not ($w_s = 0$). We are interested in testing if w_s has some predicting power for the winning bid $p_s \equiv \log(P_s)$.[13] If f denotes some probability function and $\boldsymbol{X}_s$ a vector of exogenous variables which explain the winning bid, then we say there is no residual information asymmetry if w_s has no prediction power for p_s:

$$f\left(p_s \mid \boldsymbol{X}_s, w_s\right) = f(p_s \mid \boldsymbol{X}_s). \tag{10}$$

[12] In our Monte-Carlo experiment, the informed bidder won the auction 395 times out of 5,000 replications.

[13] Note that the notarial acts document the winner of the auction but not the sequence of bids.

Assuming a simple hedonic price function we have that:

$$p_s = \boldsymbol{X}_s\boldsymbol{\beta} + w_s\,\gamma + \varepsilon_s. \tag{11}$$

where $\boldsymbol{\beta}$ and γ are parameters, and ε_s is an error term. A test of the null hypothesis of no residual adverse selection is then simply a test of $H_0 : \gamma = 0$.

However, w_s is potentially correlated with the unobservable characteristics of the slave, and ordinary least square estimates of the parameters in (11) could be biased. One approach is to find a valid instrument for w_s which is not correlated with the error term ε_s. Letting $\boldsymbol{Z}_s$ denote the vector of explanatory variables which determine whether the winner of the auction s is a related buyer and ν_s a mean-zero normally distributed random error term, we have that:

$$w_s = \begin{cases} 1 & \text{if } \nu_s > -\boldsymbol{Z}_s\boldsymbol{\theta} \\ 0 & \text{if } \nu_s < -\boldsymbol{Z}_s\boldsymbol{\theta} \end{cases} \tag{12}$$

In other words, a related buyer wins the auction if there are net positive benefits for him or her.

The vector of explanatory variables $\boldsymbol{Z}_s$ must contain at least one identifying variable which is correlated with w_s but is not correlated with the error term in (11). Assume the winning bid should reflect the expected lifetime productivity of the slave. In this case, variables which do not measure the slave's productivity and which appear in the notarial act should not influence the value of the winning bid. One such candidate identifying variable is the number of heirs: ceteris paribus observing more or less heirs should not affect a slave's productivity. However, if there are more heirs, there are reasons to believe that one of them would be willing, or have the financial means, to buy the slave. As a result we use the number of heirs to identify whether the winner of the bid is a related buyer.

For robustness reasons we extend the tests for residual information asymmetry proposed by Chiappori and Salanié (2000) and Dionne et al. (2001) in the context of insurance markets. While these tests are for either moral hazard or adverse selection, our results have a pure adverse selection interpretation since the private action of a participant to the auction does not matter. An adaptation of the Chiappori and Salanié (2000) test means we have to simultaneously estimate (12) and

$$p_s = \boldsymbol{X}_s \boldsymbol{\beta} + \eta_s. \tag{13}$$

A correlation between w_s and p_s given, $\boldsymbol{X}_s$, is equivalent to ν_s and η_s being correlated.

Dionne et al. (2001) point out that (10) is equivalent to:

$$f\left(w_s, p_s \mid \boldsymbol{X}_s\right) = f\left(w_s \mid \boldsymbol{X}_s\right) f\left(p_s \mid \boldsymbol{X}_s\right). \tag{14}$$

This additional relationship shows the symmetry in w_s and p_s of the conditional independence in our context. In a parametric formulation of winning auction prices distribution, as given by (11), the conditional independence between w_s and p_s given $\boldsymbol{X}_s$, is obtained when $\gamma = 0$ in (11). However, the null hypothesis of no residual information asymmetry can be rejected because (11) is misspecified. Dionne et al. (2001) show that one way to avoid this problem is to add the conditional expectation of w_s as an explanatory variable in (11). In our case, using (11) this means we should estimate:

$$p_s = \boldsymbol{X}_s \boldsymbol{\beta} + w_s \gamma + \mathrm{E}(w_s | \boldsymbol{Z}_s)\delta + \varepsilon_s, \tag{15}$$

where E is expectation operator and δ is a parameter. Again, a test of the null hypothesis of no adverse selection can be devised as a test for $H_0 : \gamma = 0$.

The control variables in $\boldsymbol{X}_s$ that we include are mainly determined by the availability of the data, existing literature, and likely relevance. They can be separated between slave–specific characteristics, sale–specific components, and timing elements:

- Slave–specific characteristics:
  - Age: We expect the usual concave relationship between age and prices that is well documented in the literature;
  - Gender: As shown in the primary statistics, there appears to be a significant premium for male slaves;
  - Ethnicity: Chenny et al. (2003) showed that the ethnicity of the slave had a strong influence on prices, most likely through its impact on resistance to illness, physical strength, . . . ;
  - Occupation: As a sizeable share of slaves were employed in skilled work, we expect a premium on this variable;
- Sale–specific characteristics:
  - Presence of children: Children, who under *Code Noir* had to be sold with their mother, should increase the price. As found by Chenny et al. (2003), we expect a different impact depending on the age of children involved.
- Timing elements:
  - Years: As can be see in Figure 5, prices displayed considerable medium-term movements across years, peaking at about 1830. We plan to capture those movements through time dummies.
  - Semesters: As most slaves were involved in agricultural activities, a strong seasonal component to slave demand is expected.

4.2 Results

The results of the multivariate tests for information asymmetry are reported in Table 7. For the sake of comparison with the literature we start with the OLS estimates of the price equation without conditioning on the information of the buyer. We then augment that equation with a dummy variable which captures the identity of the buyer (related or unrelated).

As discussed in Section 4.1, observing that a related individual is the buyer is likely correlated with the unobserved characteristics of the slave. Indeed, the Durbin-Wu-Haussman test strongly rejects the null hypothesis that the related buyer is exogenous with value of 10.76 and a p-value of 0.001. We therefore estimate the price equation by two–stage least squares (2SLS) where the number of heirs is used as the instrument. Once again, a related buyer pays a significantly positive premium. However, given that relatedness between the buyer and the seller is measured by a dummy variable, it may be inappropriate to use 2SLS. We therefore estimate the system of equation by full information maximum likelihood (FIML) without any qualitative change in the results. Both sets of estimates strongly reject the hypothesis that related buyers pay the same price as unrelated ones.

The tests drawn from Chiappori and Salanié (2000) and Dionne et al. (2001) also support residual adverse selection on that market. The correlation of the residuals between the error term of the probit equation for whether the buyer is related or unrelated and the error term of the price equation equals 0.098 with a p-value of 0.001. The results obtained by using the specification advocated by Dionne et al. (2001), equation (15), which are reported in the last column of Table 7 (DGV), indicate that related buyers (insiders) pay a statistically significant premium compared to unrelated ones. Hence, all the tests strongly reject the null hypothesis that a related buyer does not pay a premium when buying a slave. In other words, a related buyer with superior information leads to higher equilibrium prices, consistent with Claim 2.

It is of interest to note that the other determinants of the price of a slave are consistent with the literature. First we find the usual concave relation between age and price. A slave reached its highest price at age 24.4, which is very close to the estimates reported in the literature for the U.S. Kotlikoff (1979) and Peru Newland and San Segundo (1996). Second, a male slave fetched a premium of 10% compared to a female one. This estimate confirms findings that Mauritian female slaves were sold at a discount, reflecting lower labor productivity rather than reproductive potential (Scarr, 1998, p. 161). Interestingly, our estimated male premium is the same as the one found for the Southern US Kotlikoff (1979), very close to that for Jamaica (12% in 1817, (Higman, 1976, p. 192)), and close to the lower estimates for the West Indies (10% to 25%, (Ward, 1988, fn. 60, p. 34)).

Our estimates also confirm that children purchased with their mother were highly valued. Kotlikoff (1979) also finds that slave bundle prices increase with the age of children for the New Orleans market. Low birth rates, and high mortality at birth (Benedict, 1980; Valentine, 2000) are possible explanations of this high child premium. Moreover, the premium for children who are older than five is higher than for those who are at most five. This difference may reflect the high mortality rates of younger children and output lost when a female care for a young infant (Barker, 1996, p. 95). Finally, human capital was valued positively: skilled slaves fetched a premium of 17% compared to agricultural slaves and of 13% compared to household slaves. These premia are lower than US and Peru ones, but similar to those for Cuban slaves.[14]

5 Conclusion

Existing tests for adverse selection in the market for slaves remain inconclusive. To re–address this question, we took advantage of unique information in the notarial acts which document

[14] Kotlikoff (1979) for the US and Newland and San Segundo (1996) for Peru find a skill premium varying between 43 and 46%. (Bergad et al., 1995, pp. 72–77) report that a 1819 Cuban field hand sold for 467 Spanish pesos, whereas a carpenter sold for 525.

the auction sales of slaves on the secondary market in Mauritius between 1825 and 1835. We used the fact that buyers and sellers were often related to test the presence of adverse selection. Such buyers would likely have had privileged information about unobservable characteristics of the slave correlated with its common value. Moreover, given that the size of the Mauritian slave market was relatively small, it was likely that the identity of related bidders was known by other bidders.

Under these two assumptions of informational asymmetry and public identities, we used a benchmark auction–theoretic model of English auctions that is well–adapted to our setting. This model predicted more aggressive bidding by all participants as long as a related bidder remained active in the auction. Importantly, the model predicted that the related bidder would have ended up paying a higher price in instances where he would win the auction.

We tested this conjecture controlling for slave characteristics (gender, age, ethnicity, occupation), as well as timing. Addressing potential nonlinearities, endogeneity and bounded variable issues, our result consistently validate the model's prediction. Drawing from the empirical adverse selection literature in insurance markets only confirmed these results.

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Appendix

A Closed-form equilibrium bids

For completeness, we reproduce the closed-form expressions for the Bayesian-Nash equilibrium bids from Hong and Shum (2003). The distributional assumptions governing value and signals can be written as:

$$\begin{pmatrix} v_i \\ \boldsymbol{x} \end{pmatrix} \sim N.I.D. \left[\begin{pmatrix} \mu_i \\ \boldsymbol{\mu}^* \end{pmatrix}, \begin{pmatrix} \sigma_i^2 & \boldsymbol{\sigma}^{*\prime}_i \\ \boldsymbol{\sigma}_i^* & \boldsymbol{\Sigma}^* \end{pmatrix} \right] \tag{16}$$

where $\boldsymbol{x}$ is the $N \times 1$ signal vector, with:

- $\boldsymbol{x}_r^k$ is the $(N-k) \times 1$ vector of unobserved signals after k bids have occurred and k bidders have exited, and $\boldsymbol{x}_d^k$ is the $k \times 1$ vector of observed signals;
- $\boldsymbol{\Sigma}_{k,1}^{*-1}$ is the $(N-k) \times N$ partition of the inverse of the covariance matrix in (16) corresponding to the $N-k$ remaining bidders. $\boldsymbol{\Sigma}_{k,2}^{*-1}$ is the $k \times N$ partition corresponding to the k bidders who have exited;
- $\boldsymbol{l}_k$ is the $N-k$ unit vector, $\boldsymbol{\mu}_k \equiv (u_1, \ldots u_{N-k})'$, $\boldsymbol{\Gamma}_k \equiv (\sigma_1^2, \ldots \sigma_{N-k}^2)'$, and $\boldsymbol{\Lambda}_k \equiv (\boldsymbol{\sigma}_1^*, \ldots \boldsymbol{\sigma}_{N-k}^*)$.

Define:

$$\boldsymbol{A}^k \equiv (\boldsymbol{\Lambda}_k \boldsymbol{\Sigma}_{k,1}^{*-1})^{-1} \boldsymbol{l}_k; \tag{17}$$

$$\boldsymbol{C}^k \equiv 1/2 (\boldsymbol{\Lambda}_k \boldsymbol{\Sigma}_{k,1}^{*-1})^{-1} (\boldsymbol{\Gamma}_k - \text{Diag}(\boldsymbol{\Lambda}_k \boldsymbol{\Sigma}^{*-1} \boldsymbol{\Lambda}_k') + 2\boldsymbol{\mu}_k - 2\boldsymbol{\Lambda}_k \boldsymbol{\Sigma}^{*-1} \boldsymbol{\mu}^*); \tag{18}$$

$$\boldsymbol{D}^k \equiv (\boldsymbol{\Lambda}_k \boldsymbol{\Sigma}_{k,1}^{*-1})^{-1} (\boldsymbol{\Lambda}_k \boldsymbol{\Sigma}_{k,2}^{*-1}). \tag{19}$$

Take the i^{th} row of each and substitute in (6) to obtain the optimal bids.

B Figures

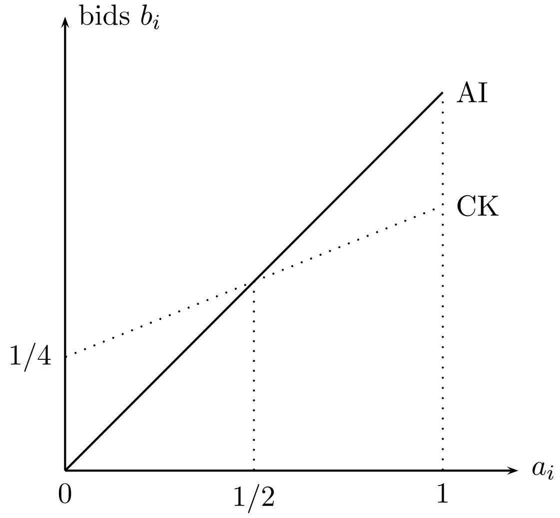

Figure 1: Hernando-Veciana and Tröge (2004) example

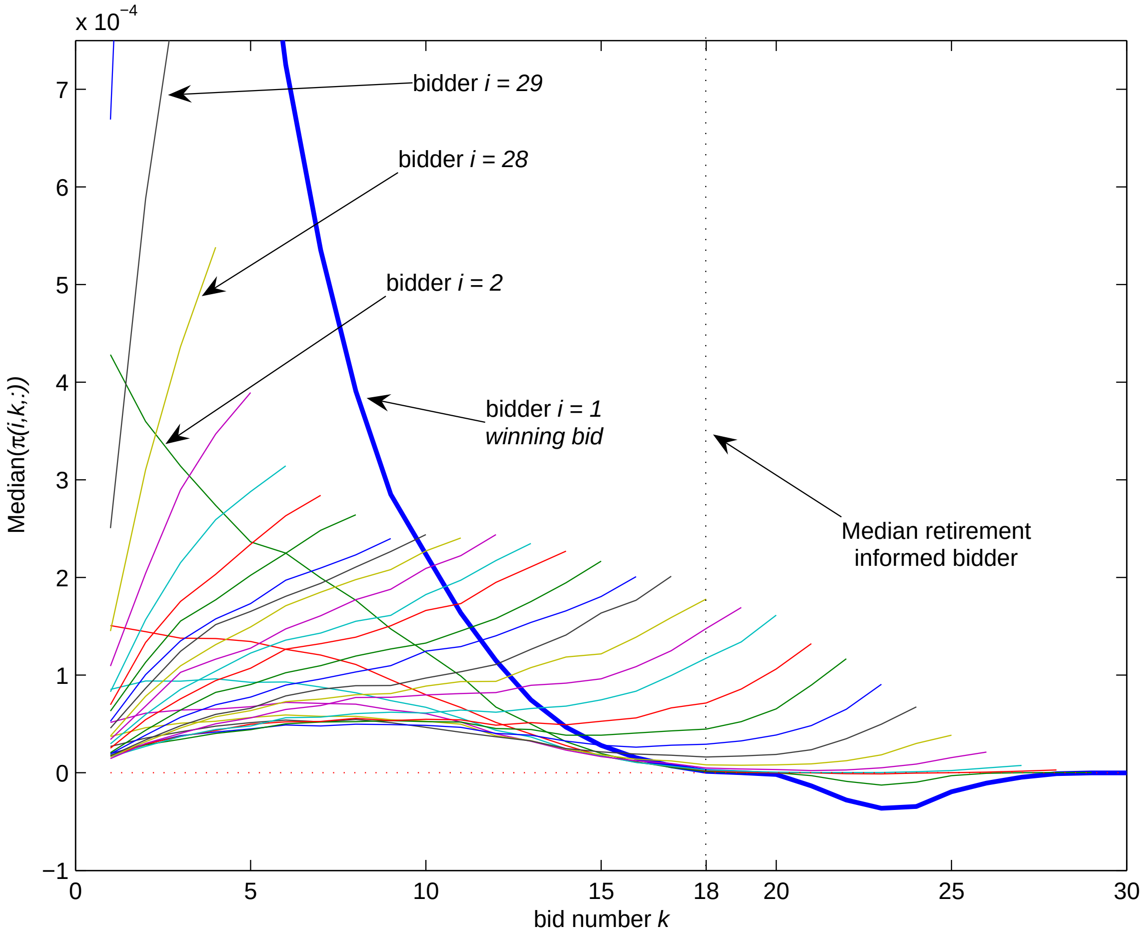

Figure 2: Median Informed Bidder Premium

Note: Each line corresponds to the median informed bidder premium Median($\pi(i, k, :)$), where $\pi(i, k, j)$ is given in (9), and the premium is calculated for each agent $i = 1, \ldots, 30$, and at each round k. The thick line corresponds to the maximum bid $i = 1$ and defines our benchmark case used in the subsequent comparative robustness analysis.

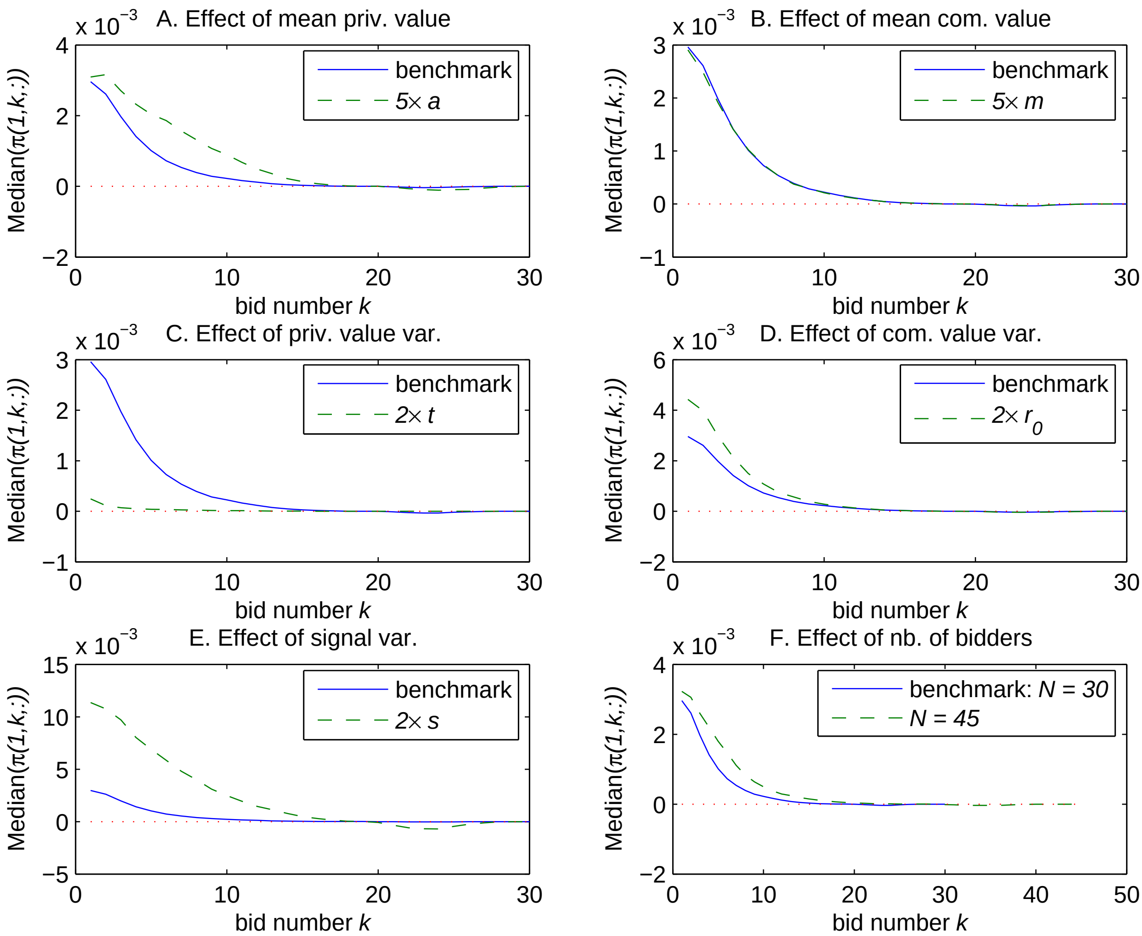

Figure 3: Median Informed Bidder Premium: Effects of Parameters

Note: The median informed bidder premium is Median$(\pi(i, k, :))$, where $\pi(i, k, j)$ is given in (9), and the premium is calculated for the maximum bid $i = 1$, and at each round k. The solid line corresponds to our benchmark specification while the dashed line varies one parameter in turn.

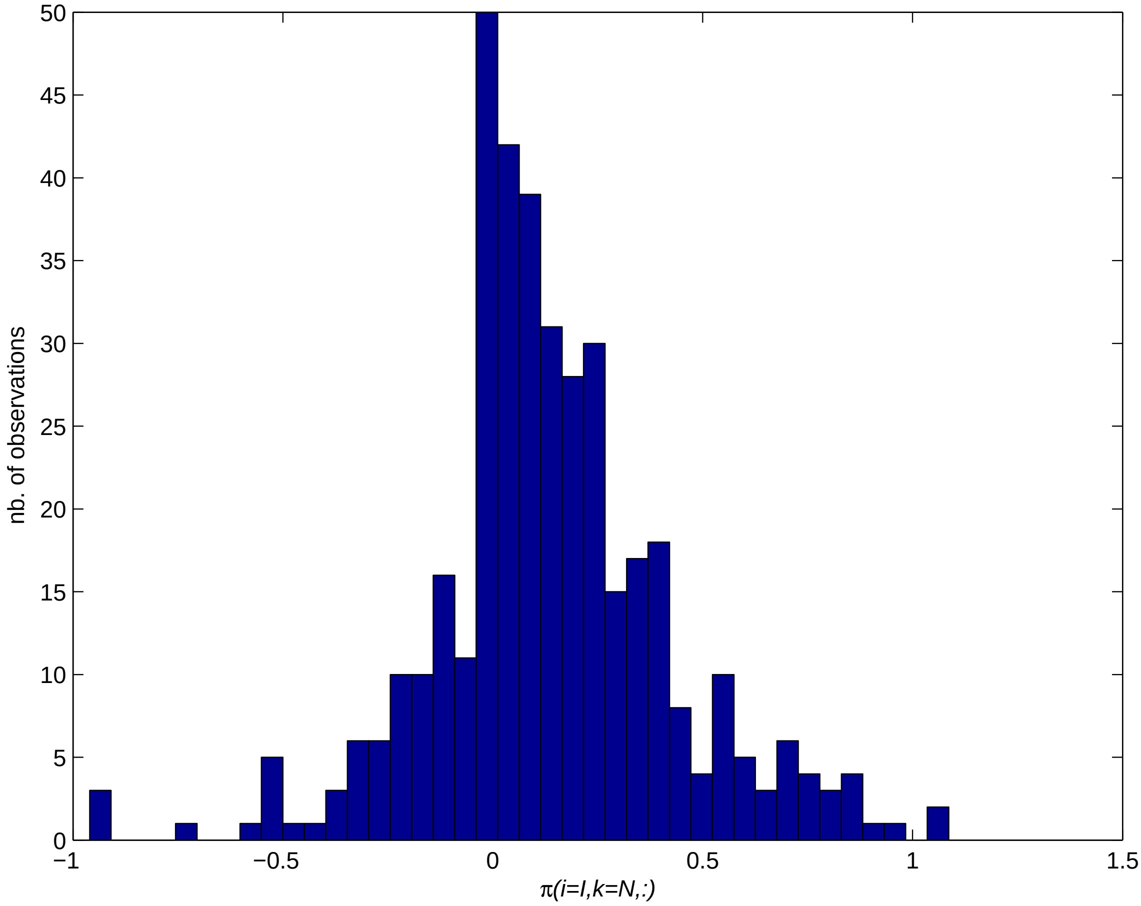

Figure 4: Distribution of Informed Bidder Premium Conditional on I winning the Auction

Note: The informed bidder premium is $\pi(i,k,j)$ given in (9). It is calculated conditional on the informed bidder winning the auction, i.e. $i = I$, when $k = N$.

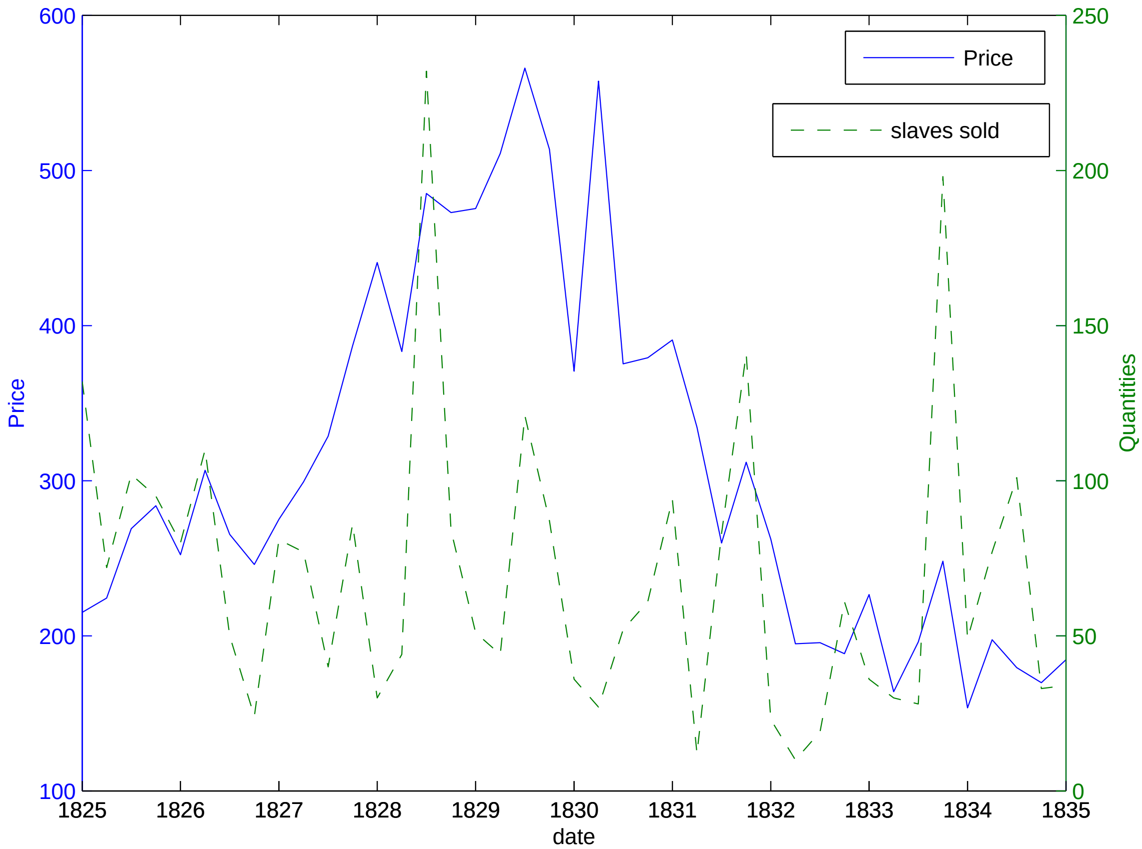

Figure 5: Average quarterly slave prices, quantity sold, Mauritius 1825–1835

Note: Solid line is mean quarterly slave prices (left-hand scale). Dashed line is number of slaves sold during public auctions (right-hand scale).

C Tables

Table 1: Distribution of sales by notaries

Archive Num.	Notary	District	Active	Nb. of auctions 25-29	30-35	25-35	Nb. of slaves sold 25-29	30-35	25-35
NA 42	TOUSSAINT	Grand Port	1791-1831	13		13	125		125
NA 63	DUBOR, Louis-Joseph Senoni	Port Louis	1819-1830	37	3	40	269	34	303
NA 66	MONTOCCHIO, Jean Charles	Flacq	1822-1874	10	6	16	140	78	218
NA 67	JOLLIVET, Yves Isidore	Port-Louis	1822-1857	35	43	78	183	511	694
NA 68	BUSSIÉ, Jean-Paul	Port-Louis	1823-1832	38	24	62	221	182	403
NA 69	ARNAUD, Charles	Port-Louis	1823-1833	24	8	32	444	129	573
NA 71	BELIN, Jean	Port-Louis	1824-1827	5		5	33		33
NA 72	BONNEFIN, Alexandre	Port-Louis	1825-1833	110	41	151	703	142	845
NA 73	BONSERGENT, Théodore	Port-Louis	1825-1828	17		17	43		43
NA 74	DEROULLEDE, L. E.	Port-Louis	1828-1837	12	33	45	141	148	289
NA 75	GIBLOT-DUCRAY, J. M. R.	See note 1	1829-1873	1	14	15	29	85	114
NA 76	MAIGNARD, Louis Charlemagne	Port Louis	1830-1839		34	34		197	197
NA 77	ERNY, Amédée	See note 2	1831-1837		24	24		271	271
NA 78	BOUIC, Jules	Port Louis	1833-1839		41	41		151	151
NA 79	TREBUCHET, Louis Antoine	Port Louis	1833-1842		7	7		27	27
		Total		302	278	580	2,331	1,955	4,286

Notes

NA Notary Archive number refers to the classification used at the Mauritius Archives.

1. Giblot-Ducray was based in Pamplemousses & Rivière du Rempart from 1829 to 1831 and then in Grand Port & Savanne between 1832 and 1842. He remained active until 1873 but the district after 1842 is not documented
2. Erny was based in Pamplemousses & Rivière du Rempart in 1831 and 1832. He then moved to Port Louis

Table 2: Comparison with the 1826 partial census

	Number of slaves				Average age			
	1826 Census		Notarial acts		1826 Census		Notarial Acts	
	Nb.	%	Nb.	%	Avg.	Std. Dev.	Avg.	Std. Dev.
All sample	20,467		4,013		25	14.3	28	15.0
Gender								
Male	11,671	57	2,724	64	26	14.0	30	14.5
Female	8,762	43	1,521	36	23	14.5	24	15.2
Missing			33					
Ethnic group								
Creole	10,364	51	2,015	52	17	12.1	19	12.9
Mozambique	5,581	28	995	26	34	10.8	38	9.7
Malagasy	3,666	18	717	19	31	11.3	34	9.9
Indian	669	3	135	3	44	12.6	47	10.4
Missing			424					

Note: See Valentine (2000) for a description of the partial 1826 census.

Table 3: Occupation and Ethnicity. Individual slave sales

1825 - 1835		**Ethnic group**										**All ethnic groups**	
Gender	Occupation	Creole		Mozambique		Malagasy		Indian		Unknown			
		Price	Num.	Price	Num.	Price	Num.	Price	Num.	Price	Num.	Price	Num.
Female	Skilled	108	2			229	8	106	1			196	11
	Laborer	378	64	188	49	298	19	109	13	126	5	274	150
	Household	345	203	243	36	354	63	197	23	313	20	325	345
	Unknown	246	69	149	17	216	16	111	11	219	14	214	127
	All	330	338	201	102	313	106	152	48	255	39	288	633
Male	Skilled	427	167	349	155	371	152	131	10	411	59	382	543
	Laborer	397	196	298	495	315	237	194	22	238	25	318	975
	Household	373	210	305	65	405	71	188	33	311	17	350	396
	Unknown	305	70	271	93	310	47	261	12	314	58	294	280
	All	387	643	305	808	344	507	193	77	337	159	337	2,194
All	Skilled	423	169	349	155	364	160	128	11	411	59	378	554
	Laborer	392	260	289	544	314	256	163	35	219	30	313	1,125
	Household	360	413	283	101	381	134	191	56	312	37	338	741
	Unknown	276	139	252	110	286	63	189	23	295	72	269	407
	All	367	981	294	910	339	613	177	125	321	198	326	2,827

Notes Average prices are in current piastres (5 piastres = £1 = \$4.94US in 1827, Officer (2001)). The sample is restricted to individual slaves whose gender is known. We exclude heterogenous groups and mother-child bundles. The following occupations are recorded in the notarial acts are:

- Skilled slaves: Assistant blacksmith, blacksmith, barrel maker, carpenter, carpentry trainee, carter, commander, locksmith, mason, master carpenter, master mason, mattress maker, nailer, roofer, sack-maker, sawyer, shoemaker, squarer, stone cutter, stone cutter trainee, sugar-maker.
- Agriculture slaves: Chief gardener, gardener, laborer, marketman, stable-boy, watchman and sea-related activities: caulker, fisherman, sailor.
- Household slaves: Baker, cook, innkeeper, laundress, maid, messenger, nurse, seamstress, shoe polisher, tailor.

Table 4: Motivations for the sales

Year	Reasons for the aution				All
	Voluntary	Bankruptcy	Succession	Unknown	
1825	9	1	42	1	53
1826	9		37	1	47
1827	6	1	45	3	55
1828			57	11	66
1829			65	14	76
1830		2	41	1	42
1831		1	46	8	55
1832			35	7	41
1833	6	5	29	3	43
1834	19	10	36	15	80
1835	2	3	8	1	14
1825-35	51	23	441	65	572
Year	**Number of slaves sold by reason**				
1825	118	51	377	4	550
1826	58		309	6	373
1827	37	28	349	3	417
1828			459	66	525
1829			410	56	466
1830		3	234	53	290
1831		7	454	33	494
1832			168	24	192
1833	12	155	228	43	438
1834	53	124	226	96	499
1835	7	14	17	4	42
1825-35	256	382	3,231	388	4,286

Note Unknown means either the reason is not documented or the condition of the notarial act did not allow us to identify the reason for the sale.

Table 5: Differences in slave prices, succession vs voluntary sales

Succession & voluntary sales	**Succession sales**		**Voluntary sales**		**T-test**	**Premium**
	Avg. price	Nb. of obs	Avg. price	Nb. of obs		
All males						
1825-1835	355	1,598	247	146	9.22	44%
1825-1830	400	1,080	267	117	9.81	50%
1831-1835	259	518	163	29	5.90	59%
Prime-aged field slaves	334	687	231	61	6.58	45%

Note: A prime-aged field slave is a male of age 15 to 35 who works in agriculture (*pioche* or other agricultural related tasks). Price is in piastres. The T-test is for the null hypothesis that prices for related and unrelated buyers (top panel), succession and voluntary sales (bottom panel), are equal.

Table 6: Related and Unrelated Buyers

Link between the owner and the buyer	**Reasons for the sale**					
	Voluntary	**Bankruptcy**	**Sucession**	**Unknown**	**Total**	**Share**
Family						25.7%
Wife			286		286	
Husband	9		189		191	
Son	1		177		178	
Son in law	1		76		77	
Daughter			69		69	
Grand children			9		9	
Nephew and niece			9		9	
Brother		3	5		8	
Father			8		8	
Sister			7		7	
Brother in law			2		2	
Cousin			2		2	
Minor children			2		2	
Father in law			1		1	
Mother			1		1	
Buy back						1.0%
Original slave owner	14	7		7	28	
The slave		2	4		6	
						0.3%
Tenant			3		3	
Business partner			7		7	
						3.3%
Same last name	3	3	97	2	105	
Other			4		4	
						69.7%
No apparent link	200	314	1,530	260	2,304	
Total	221	329	2,488		3,307	

Notes

* Children sold with their mother are coded as one sale because they could not be sold, or bought, separately. We exclude group sales of slaves, i.e. heterogenous bundling of adult slaves.

** Other informed buyers include: a creditor, husband of the niece of the deceased, the notary, the testament executor (*fondé des pouvoirs*)

Table 7: Determinants of slave prices: Succession sales only

	OLS		2SLS		FIML		DGV
	Log of price		log price	Buyer	log price	Buyer	log price
Related buyer		0.056**	0.617**		0.373***		0.064**
		2.41	2.354		3.784		2.27
Exp. value of the informed dummy							0.594***
							2.93
Number of heirs				0.022***		0.072***	
				4.329		5.164	
Attributes							
Age	0.048***	0.050***	0.056***	-0.012**	0.053***	-0.035**	0.056***
	10.931	11.139	7.885	2.196	9.071	2.262	6.725
Age squared	-0.001***	-0.001***	-0.001***	0.000*	-0.001***	0.000*	-0.001***
	16.731	16.836	11.617	1.791	13.34	1.83	8.776
Male slave	0.093***	0.094***	0.096**	0.013	0.097***	0.04	0.096**
	3.353	3.378	2.385	0.383	2.676	0.414	2.437
Handicapped	-0.537***	-0.538***	-1.036***	-0.305	-1.112***	-5.808	
	4.421	4.436	2.639	0.908	3.18	0	
Ethnicity							
Mozambique	-0.058*	-0.067**	-0.124**	0.148***	-0.088**	0.443***	-0.130**
	1.852	2.126	2.053	3.639	1.975	3.866	2.345
Malagasy	-0.041	-0.045	-0.076*	0.053	-0.066	0.153	-0.078**
	1.39	1.506	1.667	1.374	1.628	1.39	2.06
Indian	-0.413***	-0.421***	-0.412***	0.08	-0.396***	0.223	-0.414***
	7.006	7.048	4.781	1.086	5.153	1.083	4.037
Mother-child bundling							
Num. of children not older than 5	0.242***	0.242***	0.269***	-0.048	0.257***	-0.136	0.272***
	8.217	8.218	5.483	1.157	5.95	1.136	6.789
Num. of children older than 5	0.389***	0.388***	0.356***	0.034	0.362***	0.086	0.355***
	9.044	9.039	5.567	0.613	6.286	0.552	6.112
Occupation							
Laborer and agriculture	-0.188***	-0.183***	-0.121**	-0.099**	-0.143***	-0.283**	-0.114**
	5.98	5.82	2.256	2.36	3.225	2.417	2.421
Household	-0.133***	-0.142***	-0.152**	0.108**	-0.124**	0.297**	-0.155***
	3.802	4.031	2.493	2.33	2.51	2.305	2.806
1826	0.054	0.046	0.045	0.011	0.047	0.074	0.036
	1.117	0.951	0.614	0.179	0.704	0.395	0.523
1827	0.380***	0.375***	0.242***	0.126**	0.269***	0.408**	0.234***
	8.536	8.443	3.21	2.055	4.194	2.369	4.031
1828	0.731***	0.708***	0.649***	0.121**	0.680***	0.375**	0.639***
	17.806	16.758	8.952	2.151	11.385	2.309	10.678
1829	0.842***	0.828***	0.790***	0.076	0.820***	0.251	0.779***
	20.118	19.668	11.088	1.349	14.006	1.557	13.536
1830	0.587***	0.578***	0.549***	0.106	0.580***	0.32	0.538***
	11.117	10.9	6.163	1.452	7.611	1.547	7.803
1831	0.313***	0.290***	0.195**	0.215***	0.251***	0.622***	0.179**
	7.735	7.012	2.277	4.008	4.187	4.003	2.457
1832	0.04	0.021	0.056	-0.002	0.062	0.105	0.05
	0.73	0.368	0.668	0.026	0.817	0.507	0.49
1833	-0.159***	-0.163***	-0.099	-0.170**	-0.133*	-0.563**	-0.099
	2.839	2.899	1.074	2.28	1.705	2.39	1.137
1834	-0.191***	-0.211***	-0.314***	0.200**	-0.251***	0.569**	-0.327***
	2.792	3.068	2.7	2.39	2.806	2.43	3.174
2nd Quarter	-0.072*	-0.068*	-0.045	-0.065	-0.061	-0.134	-0.048
	1.961	1.848	0.785	1.355	1.202	0.976	0.978
3rd Quarter	-0.005	-0.003	0.006	-0.044	-0.009	-0.078	0.004
	0.143	0.083	0.112	0.977	0.19	0.613	0.088
4th Quarter	0.034	0.029	-0.004	0.04	0.005	0.136	-0.008
	1.072	0.908	0.082	0.941	0.113	1.146	0.178
Constant	5.120***	5.090***	4.787***	0.390***	4.905***	-0.393	4.772***
	59.286	58.323	26.751	3.462	39.539	1.249	28.305
Number of observations	1812	1797	1212	1212	1212		1210
R-squared	0.579	0.58	0.421	0.097			

Notes *Related buyer* is a dummy variable which equals 1 if the buyer and the orignal slave owner are related, and zero otherwise (see Table 4). The reference categories are: skilled workers for occupation (see Table 3 for the full list of occupations); creoles for ethnicity, 1825 for the year and the first quarter for semester. We use only succession sales from 1825 to 1834 in estimating the model. The lack of data prevents us from using sales for 1835.

The Durbin-Wu-Hausman Chi-Squared statistic for the null hypothesis that *Buyer is informed* is exogenous equals 10.76 and the corresponding P-Value is 0.001. Absolute value of T-ratios corrected for heteroscedasticity are reported under the point estimate; * denotes the parameter is significantly different from zero at 10%; ** significant at 5% and *** significant at 1%.

DGV denotes the specification based on Dionne, Gourieroux and Vanasse 2001