ROSES OR LEMONS: ADVERSE SELECTION IN THE MARKET FOR THOROUGHBRED YEARLINGS

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Abstract—This paper tests for the presence of adverse selection in thoroughbred yearling auction markets. Thoroughbred auctions consist of two seller types: sellers who breed horses to race and sell (racers) and sellers who take all their yearlings to auction (breeders). If racers use private information, keeping those yearlings with a higher probability of on-track success, they are likely to receive a lower price for similar yearlings as compared to breeders. Using data from Keeneland’s 1994 September yearling sale, we find support for this hypothesis. We improve on previous studies by analyzing the distinction between seller types on a continuous scale.

I. Introduction

Many markets are characterized by goods with variable quality. Assuming perfect information, sellers of relatively high-quality goods command a higher price and the market yields an efficient outcome. However, when buyers are unable to discern the true quality of a good, or there is asymmetric information, markets may yield an inefficient outcome. In this paper we test the proposition that the thoroughbred yearling market is characterized by asymmetric information. In the thoroughbred industry, horses are bred for the purpose of racing. Each year a relatively large proportion of all yearlings bred is sold at one of several auctions. While buyers are able to visually inspect and study the pedigree of yearlings, sellers have the distinct advantage of having complete medical history, and generally identifies the yearling's temperament. While these factors do not perfectly predict the yearling's future on-track success, they do give the seller an informational advantage.

Akerloff (1970) shows that when sellers know the true quality of a good, but buyers know only the distribution of quality, markets may not exist. Essentially, a buyer’s best estimate of the quality of any individual seller’s good is the market average, and sellers of high-quality goods are unable to command a price consistent with the quality of their good. In the limit, low quality drives out high quality until no market exists.

Genesove (1993) extends this argument by allowing buyers to gain information concerning the “types” of sellers in the market. Genesove considers a buyer in search of a good apple. While only the seller is able to discern the true quality of apples, the buyer is able to distinguish between two distinct types of sellers: one who has a large orchard and hates apples and a second who has a small orchard and loves apples. From whom should he purchase? Obviously, the purchase should be made from the seller with the large orchard who hates apples. This seller takes all her apples to market, good and bad.

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REFERENCES


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NOTES
The seller who loves apples is unlikely to take good apples to the market. The buyer can improve on the estimate of the average apple by incorporating information on seller type. If the market incorporates this information, the seller who hates apples will receive a premium for the sale of her apples.

Several studies have examined markets where asymmetric information leads to price differentials based on seller type. Gibbons and Katz (1991) apply the model to postdisplacement wages, finding that individuals displaced by layoffs earn lower wages in their next job than do individuals displaced by plant closings. Greenwald and Glasspiegel (1983) examine historical data from pre–Civil War slave auctions in New Orleans. Because of the different types of crops grown in the new and old South, similar slaves have a higher marginal value in the new South. Sellers bringing slaves from the old South to the new South are found to receive a premium over similar slaves sold by locals. Genesove analyzes data from used-car (block) auctions. Genesove is able to identify two seller types in the auction, new-car dealers and used-car dealers. It is expected that used-car dealers prefer to keep their best used cars and take only their low-quality used cars to auction. New-car dealers are expected to receive a price premium for an otherwise similar used car. By regressing the final price of autos sold in the auction as a function of seller type and controls for the visible characteristics of the auto, limited support for the hypothesis is found.

We identify the determinants of a thoroughbred yearling’s price at auction, including price differentials based on seller type, for the 1994 Keeneland September yearling sale.1 The thoroughbred industry has two distinct aspects, the breeding end where breeders attempt to breed horses that will succeed on the track, and the racing end where the attempts of the breeders are implemented. In thoroughbred auctions, sellers from both ends of the market are represented to varying degrees. We consider “breeders” to be sellers who operate in the breeding end of the industry only and “racers” to be sellers that operate in both the breeding and the racing ends of the market. Much as the apple seller with the small orchard who loves apples, we expect racers to keep yearlings that appear to have the highest probability of on-track success and to cull the remainder. Breeders, having no interest in running horses themselves, will sell all of their yearlings. If buyers are able to identify a seller’s type, they will expect lower quality yearlings from racers. It follows that racers should receive a lower price for an otherwise similar yearling.2

The remainder of this paper is outlined as follows. Section II discusses the data and describes the empirical tests performed. We improve on previous studies by analyzing the distinction between seller types on a continuous scale. Section III presents the empirical results. We find that the market is characterized by adverse selection. Sellers operating relatively more intensively in racing receive lower results. We find that the market is characterized by adverse selection. Section IV concludes.

II. Data and Empirical Tests

To test for the presence of adverse selection in the market for thoroughbred yearlings, data from the 1994 Keeneland September yearling sale have been gathered. We believe this sale is representative of the industry because of its relatively large size (3492 horses were cataloged for sale) and because it includes horses that fall in the market’s middle in terms of price.3 In terms of quality, a broad range of yearlings are included in the sale: everything from eventual Kentucky Derby contenders to horses that will compete in low-grade claiming events.4

The initial sample includes 349 yearlings, approximately 10% of those cataloged for the auction, that were sampled by taking every tenth horse cataloged.5 Once observations with missing values are omitted, the sample includes 304 yearlings and is representative of the auction.6 The average hammer price for yearlings in our sample is $38,741, compared to $37,171 for the auction.7

The auction is a standard English or ascending-bid auction. Yearlings are nominated by the seller or their agent by filing a “nomination form” and paying a nonrefundable fee of $1000—$500 due with the application. Nominations for the September 1994 sales were due no later than May 16, 1994. Further, the “foal registration form” filed with the Jockey Club must be submitted no later than June 15, 1994. If these conditions are not met, the yearling is considered ineligible for sale in the auction. Upon filing the nomination form, the consignor agrees to the “conditions of the sale” and to the terms of the “consignor’s contract.”8 In addition to the $1000 nomination fee, the consignor agrees to pay Keeneland 5% of the hammer price above $20,000. Further, the consignor agrees that all yearlings nominated will be presented for sale, unless Keeneland accepts a valid veterinary certificate stating the reasons for withdrawal. In the event the yearling is withdrawn and interest in the yearling is subsequently sold, the seller agrees to pay 5% of the full market value of the yearling to Keeneland. These conditions presumably guarantee the reputation of the auction house by providing a disincentive for consignors to withdraw horses prior to the sale.

The sellers agree not to affect the sale of any yearling by making side payments, but do have the right to bid on their own yearlings.9 Presumably this aids in preventing the formation of bidding rings. The seller also has the right to set a reserve price, submitting a written request to Keeneland no later than 15 minutes prior to the sale of the

1 In the thoroughbred auction industry there are four auction houses that sell over 95% of all yearlings sold at auction. In order of size these are: Keeneland, Fasig-Tipton, Ocala Breeders, and Barretts. Keeneland officials estimate that they sell roughly 75% of all yearlings sold at auction, accounting for 90% of the dollar value. The highest valued yearlings are sold at the Keeneland July select sale.

2 A claiming race is defined as a race where all of the horses in the race may be purchased for a price specified prior to the race. These horses are generally of a lesser quality.

3 The horses are not sold in small groupings, so that sampling every tenth horse will not generate any systematic bias.

4 Information on the consignor’s contract is included in the nomination form, and the conditions of the sale are outlined in the Keeneland Sales Catalogues. These can be obtained from Keeneland Sales located in Lexington, Kentucky.

5 That a seller may bid on a horse he or she owns is law in the Commonwealth of Kentucky.
yearling. This allows sellers to gauge the market and update their reserves until the bidding begins. If the hammer price is less than the reserve, the buyer is notified and the sale of the horse is not affected. However, the seller remains liable for all fees as if the yearling were sold.

To test our hypothesis, data on the pedigree of the yearling, selling price of the yearling, and intensity of racing for the breeder were gathered. The primary source of data is the Thoroughbred Times Buyer’s Guide. This is a five-volume set that documents pedigree information for each yearling sold. For each entry, the listed information includes: the yearling’s sex, the dam or mare (the mother), the sire (the father), the quality of the genetic match, and identification of the breeder, who is the owner of the mare at the time of birth.10 For each mare, information on her success as a racehorse and success as a dam is included. Information on the foaling date of the yearling is found in the Keeneland Sales Catalogs published by Keeneland. A yearling’s hammer price is taken from the September 24 and the October 1, 1994, editions of the Thoroughbred Times. Finally, data distinguishing owners and breeders are taken from The American Racing Manual.

Genesove argues that the “test for adverse selection requires that each seller belong to one of at least two types and that a seller’s type be known to the market.”11 Although enlightening, this simple dichotomy masks much useful information available to buyers. We improve on previous work by accounting for the “intensity” of the distinction between racers and breeders. Some individuals sell all of the yearlings they breed—these are essentially our breeders. Racers may operate anywhere on a continuum. Some racers breed primarily for racing purposes while others will sell the majority of their yearlings, keeping only a few for racing.12 We expect all racers to be guilty of culling their herds. However, we expect the average quality of yearlings brought to market by sellers operating less intensively in racing to be higher than those who concentrate more heavily on racing. To measure the relative intensity of racing, the number of starts in 1993 for horses raced or bred by the listed breeder is gathered from the 1994 edition of The American Racing Manual.13 We define Racing Starts as the number of times that a yearling’s breeder was the owner of a horse that started a race in 1993. Similarly, Breeding Starts is defined as the number of races started by horses bred by the yearling’s breeder in 1993.14

We predict that as a breeder is more involved in the racing end of the industry, buyers expect lower quality yearlings and adjust their valuations accordingly. To measure an individual seller’s intensity of racing, we define \( \text{Racing Intensity} = \frac{\text{Racing Starts}}{\text{Breeding Starts} + 1} \).15 As sellers start horses in more races relative to their breeding operation, \( \text{Racing Intensity} \) increases. Buyers view this negatively, and we should observe a negative coefficient on this variable.

The sample mean of \( \text{Racing Intensity} \) is 2.194 with a standard deviation of 12.32. Of the 304 observations in the sample, 184 have a 0 for racing starts, not unexpectedly. Most of our breeders race very little or not at all. If we examine the remaining 120 observations, we find a mean of 5.632, a median of 0.2879, and a standard deviation of 19.332 for \( \text{Racing Intensity} \). The range is 0.0174 to 97. In the sample, the median hammer price is $27,000. Dividing the sample at this point, the mean \( \text{Racing Intensity} \) for observations with a hammer price above the median is 1.651, whereas the mean for \( \text{Racing Intensity} \) in the lower end is 2.776. Clearly a higher \( \text{Racing Intensity} \) is associated with a lower price for yearlings.

In order to establish the presence of adverse selection, other factors that affect the expected quality of a yearling must be held constant. To do so, we include information on the pedigree of the yearling. We control for the quality of the mare both at the track and in the breeding shed, the quality of the sire, the quality of the sire–mare match, the age and sex of the yearling, and the state where the yearling was born.

The quality of the mare is proxied by variables that measure the success of the mare at the track and of her foals at the track. The mare’s on-track success is measured by the Mare Standard Starts Index, which is increasing in the number and quality of races won by a racehorse and should be positively related to the price of a yearling. If like breeds like, then a mare that is successful at the track should have successful progeny. For a mare whose offspring have reached the track, the lifetime purse earnings per foal, Average Purse, has been calculated and should also be positively related to the price of the yearling. A dummy variable, New Mare, equal to 1 when the mare’s first yearling is the current yearling in the auction, is also included.

The quality of the sire is proxied by its 1994 Stud Fee. Stud fees reflect the market’s evaluation of the sire’s ability to beget successful offspring. This should be positively related to a yearling’s hammer price. As in the case of the mare, a dummy variable, Juvenile Sire, equal to 1 for sires whose first yearlings are represented in the current auction, is included.

The quality of the sire–mare match is held constant by including the percentage of horses with the same genetic pattern as a yearling that have won a stakes race (Sire–Mare Cross). For example, consider a yearling sired by Storm Bird, whose maternal grandsire is Secretariat. Sire–Mare Cross is calculated by taking the number of horses that have won a stakes race that were sired by Storm Bird and that have Secretariat as a maternal grandsire divided by the total number of horses with this genetic pattern. This variable is expected to have a positive effect on price.

Two indexes, the Dosage Index and the Center of Distribution, which are commonly followed in the industry, are also included. These indexes are calculated based on the presence of recognized successful

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10 A mare is commonly referred to as a dam when she is retired for breeding purposes.
11 Genesove (1993 p. 650). It is not clear that buyers in Genesove’s data could make any further distinction. Genesove is able to find this information in surveys of dealers, but is unable to match this with individual cars that are sold in the auction.
12 Sellers who also buy horses at auction may have a racing operation that is included. Information in surveys of dealers, but is unable to match this with individual cars that are sold in the auction.
13 Genesove (1993 p. 650). It is not clear that buyers in Genesove’s data could make any further distinction. Genesove is able to find this information in surveys of dealers, but is unable to match this with individual cars that are sold in the auction.
14 The American Racing Manual lists only breeders (racers) whose horses earned in excess of $50,000 ($30,000). When either variable is unobserved for an individual breeder, a zero is assigned. We expect to see zeros in the racing starts variable because of problems associated with adverse selection. Observations with Breeding Starts = 0 are expected for at least two reasons. First, some breeders in the sample have not been in the industry long enough for horses they have bred to reach the track. Second, many breeders only breed one or two mares. Given that a low proportion of all horses reach the track and that only a limited number of these win, it is likely that these breeders will not appear in The American Racing Manual data. Regressions including dummy variables indicating the assignment of zero are reported below.
15 The addition of 1 to the Breeder Starts variables is done to avoid division by 0. In the sample, 70 observations have a 0 in both breeding and racing starts. The addition of 1 to the denominator forces the ratio to 0 for these observations. For sellers that race a small amount, as discussed above, this may reorder the data. Our model predicts that when intensity is zero a high price should be observed. However, if the individual does race and the market knows this, then according to our model, a low price will result. Thus the reordering may create a bias, but this bias works against finding adverse selection.
sires in the yearling’s pedigree dating back four generations. A large Dosage Index and Center of Distribution are taken by the industry to indicate “inherent speed and early maturity.” The statistical likelihood that a thoroughbred will win a race at the classic distance of a mile and one-quarter, which is the distance of the Kentucky Derby, falls off greatly for a horse whose dosage index is greater than 4.00 and whose center of distribution is greater than 1.25. To capture this aspect, a dummy variable equal to 1 if the horse is Derby Eligible, that is, if the Dosage Index is less than 4.00 and the Center of Distribution is less than 1.25, is included.

Older yearlings, measured by days between foaling date and the first day of the auction (Age), are expected to have a greater chance to succeed as two- and three-year-olds and should therefore fetch a higher price at auction. Male horses seem to dominate most of the major events; only three fillies have won the Kentucky Derby. Further, if a colt is successful on the track, it will be more attractive to the market as a sire. Age and a dummy variable, Colt, equal to 1 if the yearling is male, are included in the study and are expected to yield positive coefficients. Of the horses in our sample, 75% were bred in Kentucky. A dummy variable, Kentucky, set equal to 1 if the yearling was foaled in Kentucky, is included in the regressions as well. Table 1 includes a brief description and summary statistics for the variables used.

### III. Empirical Results

Table 2 lists the results of the empirical model. The dependent variable in all specifications is the natural logarithm of the hammer price. The results for the control variables are generally consistent with our priors. As expected, the coefficients on Price, Stud Fee, Sire–Mare Cross, Age, Colt, and Derby are all positive and statistically significant. The Center of Distribution is positive and significant in all but one specification, whereas the Dosage Index is insignificant in all specifications. We also find that Juvenile Sire is estimated to be positive and significant, while First Mare is insignificant in all specifications. The variable Kentucky is found to be negative and significant. It appears that the market places a premium on out-of-state bred yearlings. Most out-of-state breeders have an opportunity to sell yearlings at auctions in their home states. The fact that they bring their thoroughbred yearlings. Most out-of-state breeders have an opportunity to sell yearlings to Kentucky provides a positive signal about the quality of the animal. We therefore observe a negative coefficient on Kentucky.

Columns 1 and 2 contain the results for the basic model. The results are consistent with our prediction that an increase in a seller’s intensity of racing is associated with a decrease in a yearling’s hammer price. In both specifications, Racing Intensity is negative and statistically significant at conventional levels. From column 1 we see that an increase in racing intensity of 1 causes the hammer price to fall by less than 1%. Evaluated at the mean hammer price, this translates into a hammer price decrease of $317. We conclude that the more intensively a seller operates in racing, the more heavily they are penalized by the market. Although the magnitude of the effect is small, it remains statistically significant. Column 2 gives the equation with the dummy variables Race Zero and Breed Zero included. These are defined as equaling 1 if Racing Starts and Breeding Starts are, respectively, equal to 0 and set to 0 otherwise. The inclusion of these variables does not appear to alter the magnitude or significance of the other variables substantially. Both of these dummies are negative and statistically significant at the 10% level.

Columns 3 and 4 of the table give the results of a double-log specification, where Racing Intensity is replaced by ln[Racing Intensity + 1]. The estimates are negative and significant in both specifications as in columns 1 and 2. The results indicate that the more intensively a seller races, the more the auction market penalizes them. Column 4 includes the Race Zero and Breed Zero dummy variables as in column 2. The dummy variables are again found to be negative and significant at conventional levels. Again, the result is found to be small in magnitude but statistically significant. This is consistent with the hypothesis that adverse selection is present in the market for thoroughbred yearlings.

The interpretation of the Racing Intensity variable is that, holding Breeding Starts constant, an increase in Racing Starts causes the ratio to increase, and this should be associated with a lower auction price. Alternatively, one might argue that, holding Racing Starts constant, an increase in Breeding Starts will lower the ratio, and this should be...

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**Table 1—Summary of Variables Used in Empirical Analysis**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price ($/100)</td>
<td>387.41</td>
<td>426.36</td>
</tr>
<tr>
<td>Racing starts</td>
<td>35.947</td>
<td>104.9</td>
</tr>
<tr>
<td>Breeding starts</td>
<td>203.51</td>
<td>438.6</td>
</tr>
<tr>
<td>Racing intensity</td>
<td>2.194</td>
<td>12.32</td>
</tr>
<tr>
<td>Mare standard starts index</td>
<td>2.690</td>
<td>3.838</td>
</tr>
<tr>
<td>Average purse</td>
<td>228.977</td>
<td>32.488</td>
</tr>
<tr>
<td>New mare</td>
<td>0.1316</td>
<td>0.3386</td>
</tr>
<tr>
<td>Stud fee ($/100)</td>
<td>152.84</td>
<td>179.50</td>
</tr>
<tr>
<td>Juvenile sire</td>
<td>0.1447</td>
<td>0.3524</td>
</tr>
<tr>
<td>Sire–mare cross</td>
<td>0.0495</td>
<td>0.1839</td>
</tr>
<tr>
<td>Dosage index</td>
<td>2.993</td>
<td>2.338</td>
</tr>
<tr>
<td>Center of distribution</td>
<td>0.6851</td>
<td>0.3858</td>
</tr>
<tr>
<td>Race zero</td>
<td>0.8026</td>
<td>0.3987</td>
</tr>
<tr>
<td>Age</td>
<td>531.02</td>
<td>37.93</td>
</tr>
<tr>
<td>Colt</td>
<td>0.5395</td>
<td>0.4992</td>
</tr>
<tr>
<td>Kentucky</td>
<td>0.7500</td>
<td>0.4337</td>
</tr>
<tr>
<td>Race zero</td>
<td>0.6118</td>
<td>0.4881</td>
</tr>
<tr>
<td>Breed zero</td>
<td>0.2599</td>
<td>0.4393</td>
</tr>
</tbody>
</table>

*Price = current bid when hammer falls and yearling is sold (includes those cases where reserve was not attained)*

*Evaluations of the specifications of columns 1 and 3 were calculated using the same variables as in column 1*

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16 Although the statistical accuracy of these indexes is questionable, the industry does place a great deal of weight on them, warranting their inclusion in this study. For a more complete description of the dosage index and the center of distribution see The American Racing Manual (p. 399).

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17 The addition of 1 is necessary to avoid taking the natural log of 0.

18 Estimates of the specifications of columns 1 and 3 were calculated omitting those observations with Race Zero and Breed Zero equal to 0. The results are very similar—the coefficient on Racing Intensity as in column 1 was found to be $-0.0078$ with a $t$-statistic of $-2.11$. Likewise, for column 3, the coefficient on $\ln$[Racing Intensity + 1] is found to be $-0.1051$ with a $t$-statistic of $-1.65$. 

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associated with higher prices. This is simply two sides of a similar story. However, it may also be argued that larger breeding operations might receive a higher price for their yearlings due possibly to a positive reputation effect or scale effect. The regression coefficient, as estimated, may incorporate the effects of both adverse selection and scale, if it exists.

To isolate possible scale effects consider the following transformation:

\[ \ln\left(\frac{R}{B} + 1\right) = \ln(R + B) - \ln B \]

where \( R = \text{Racing Starts} \) and \( B = (\text{Breeding Starts} + 1) \). Substituting into the estimating equation gives

\[ \ln \text{Hammer} = \alpha_0 + \alpha_1^* \ln(R + B) - \frac{\alpha_1^*}{1} \ln B + \cdots \]

Now the null hypothesis \( \alpha_1^* = \alpha_1^{**} \) corresponds to no scale effects. Estimates of this equation are presented in columns 5 and 6 of table 2. From column 3 we have that the coefficient on \( \ln(\text{Racing Intensity} + 1) \) is \(-0.1026\) while the coefficients on \( \ln(R + B) \) and \( -\ln(B) \) are \(-0.0638\) and \(-1.20\), respectively. Both coefficients are statistically significant. In the absence of scale effects, the latter two

\[ \begin{array}{l}
\text{TABLE 2.—DETERMINANT OF YEARLING PRICES} \\
\hline
\text{Dependent Variable: ln(Hammer Price)} \\
\hline
\text{Racing intensity} & -0.0082 & -0.0005 & -0.1026 & -0.1404 & -0.0638 & -0.1465 \\
(2.32) & (1.98) & (2.05) & & & (2.02) \\
\ln(\text{racing intensity} + 1) & - & - & -0.1026 & -0.1404 & -0.0638 & -0.1465 \\
(1.56) & (1.63) & (1.14) & (2.6) & (2.1) & (2.1) \\
\ln(R + B) & - & - & - & - & -0.1200 & -0.1340 \\
(2.01) & (1.84) & & & & & \\
-\ln(B) & - & - & - & - & -0.1200 & -0.1340 \\
(1.38) & (1.4) & & & & & \\
\text{Mare standard starts index} & 0.0002 & 0.0001 & 0.0002 & 0.0001 & 0.0001 & 0.0001 \\
(1.55) & (1.09) & (1.63) & (1.14) & (2.6) & (1.16) \\
\text{Average purse} & 0.0067 & 0.0058 & 0.0065 & 0.0057 & 0.0058 & 0.0057 \\
(4.81) & (4.19) & (4.70) & (4.11) & (4.21) & (4.11) \\
\text{First mare} & 0.1382 & 0.0893 & 0.1332 & 0.0989 & 0.1052 & 0.0993 \\
(1.02) & (0.66) & (0.73) & (0.77) & (0.73) & \\
\ln(\text{stud fee}) & 0.6278 & 0.6161 & 0.6280 & 0.6138 & 0.6266 & 0.6122 \\
(13.7) & (13.6) & (13.6) & (13.8) & \\
\text{Juvenile sire} & 0.2997 & 0.3033 & 0.3033 & 0.2993 & 0.3230 & 0.2980 \\
(2.44) & (2.48) & (2.48) & (2.65) & (2.44) & \\
\text{Sire–mare cross} & 0.7588 & 0.7870 & 0.7788 & 0.8033 & 0.7936 & 0.8016 \\
(3.2) & (3.37) & (3.45) & (3.39) & (3.43) & \\
\text{Dosage index} & -0.00004 & -0.00009 & -0.00003 & -0.00009 & -0.00006 & -0.00008 \\
(0.12) & (0.31) & (0.30) & (0.31) & (0.21) & (0.28) \\
\text{Center of distribution} & 0.0025 & 0.0029 & 0.0025 & 0.0030 & 0.0029 & 0.0030 \\
(1.7) & (1.67) & (1.72) & (1.67) & (1.69) & \\
\text{Derby eligible} & 0.3064 & 0.3092 & 0.3018 & 0.3094 & 0.3232 & 0.3089 \\
(1.99) & (2.04) & (2.05) & (2.13) & (2.04) & \\
\text{Age} & 0.0020 & 0.0023 & 0.0020 & 0.0023 & 0.0022 & 0.0023 \\
(1.74) & (2.03) & (2.05) & (2.05) & \\
\text{Colt} & 0.3368 & 0.3280 & 0.3424 & 0.3329 & 0.3402 & 0.3318 \\
(4.0) & (3.95) & (4.05) & (4.02) & (3.99) & \\
\text{Kentucky} & -0.1888 & -0.1957 & -0.1831 & -0.2024 & -0.2019 & -0.2008 \\
(1.91) & (2.02) & (1.84) & (2.08) & (2.06) & (2.05) \\
\text{Race zero} & - & -0.1831 & - & -0.2314 & - & -0.2457 \\
(1.87) & (2.17) & & (2.04) & & \\
\text{Breed zero} & - & -0.1942 & - & -0.1907 & - & -0.2447 \\
(1.79) & (1.76) & & (1.04) & & \\
\text{Constant} & 0.8419 & 0.9240 & 1.224 & 0.9636 & 0.5152 & 1.043 \\
0.5565 & 0.5734 & 0.5528 & 0.5738 & 0.5671 & 0.5739 \\
\text{R}^2 & & & & & & \\
\hline
\text{Note: Absolute values of t-statistics are in parentheses.}
\end{array} \]

19 We thank two anonymous referees for this point. The suggestions of one referee led to the specification that follows.

20 Further, the coefficients should equal the corresponding coefficient on \( \ln(\text{Racing Intensity} + 1) \).
coefficients should equal the first. We see that this is not true, but the estimates do surround the estimated effect of ln(Racing Intensity + 1). Similarly for columns 4 and 6 we have a coefficient for ln(Racing Intensity + 1) of -0.1404 compared to the coefficients on ln(R + B) and -ln(B) of -0.1465 and -0.1340, respectively. Again, both are statistically significant. Using the restricted and unrestricted equations of columns 3 and 5, we find \( F = 9.58 \), which indicates a statistically significant scale effect (the critical \( F \) is approximately 3.88). From columns 4 and 6 we calculate \( F = 0.068 \), clearly less than the critical \( F \).

The test for scale effects depends on the inclusion of the Race Zero and Breed Zero dummy variables. In the specification where we include these variables, we find that scale effects do not confuse our estimate of the effect of adverse selection. When they are not included, however, scale clouds the picture. The fact that we reject scale effects and find adverse selection, when holding constant for these observations, suggests adverse selection is present in the market for thoroughbred yearlings.

IV. Conclusions

In this paper we argue that the market for thoroughbred yearlings suffers from problems arising out of asymmetric information. Specifically, sellers know more about the true quality of a yearling than buyers do. However, buyers can identify the “type” of seller and use this information in forming their expectation of the value of a yearling. In the auction there are two types of sellers, racers who breed yearlings to race but sell some, and breeders who sell all of the yearlings they breed. We improve on previous studies by identifying the “intensity” of the distinction between racers and breeders. We argue that buyers discount the expected value of a yearling sold by a racer, and that this discounting is increasing with the racing intensity of a seller’s operation.

This proposition is tested by examining data from the 1994 Keeneland September yearling sale. We regress the yearling Hammer Price as a function of variables controlling for the pedigree and other characteristics of the yearling and the Racing Intensity of the seller. In all specifications, the effect of Racing Intensity is negative, although small in magnitude, and statistically significant. We test for the presence of scale effects and find that, in specifications omitting controls for small operations, these scale effects may cloud the coefficient on Racing Intensity. In regressions including controls for small breeding operations, the effects of scale on the coefficient for Racing Intensity are mitigated. The evidence leads us to conclude that adverse selection is a factor in determining the price of a thoroughbred yearling.

REFERENCES


\(^21\) Regressions omitting observations with Race Zero and Breed Zero equaling 1 were run as above. The results are comparable, with an \( F \)-Statistic of 1.77, indicating no scale effect.