Taxes and Asset Prices: The Case of Thoroughbreds

Kim G. Key
Auburn University
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keykimb@auburn.edu

ABSTRACT

This study examines the thoroughbred auction market in order to assess the effect of taxes on prices. Yearlings purchased in the 2002 to 2004 time period are eligible for bonus depreciation, and the price of the yearlings is predicted to be bid up in this time period. The research design employs pricing models that have been published in economics and agri-business academic journals. Consistent with the prediction, prices are higher in the bonus time period than in other time periods. A control group of breeding horses, which are not eligible for bonus depreciation, does not exhibit the same time period price differential.

INTRODUCTION

This study investigates the effect of taxes on asset prices. Specifically, the study examines the extent to which bonus depreciation tax rules affect the price of thoroughbred yearlings. Yearlings purchased in the 2002 to 2004 bonus depreciation time period are eligible for bonus depreciation consistent with other assets classified as personalty. Compared to regular tax depreciation regimes, bonus depreciation accelerates the timing of deductions and related positive cash flows to earlier time periods in the asset's cost recovery period. Based on tax capitalization theory the pre-tax price of the horse is predicted to be bid up in the time periods of bonus depreciation compared to other time periods.

The research question, "How do taxes affect asset prices?" is a central question in accounting, finance, and economics. While there is ample theory to predict that taxes affect asset prices, it is not easy to find settings in which to test theory. Yearling auctions provide a large number of similar assets for sale in an information-rich environment. Further, price models with relatively high explanatory power exist so that the effect of non-tax variables on prices is measured well. Market characteristics and price models are consistent with a high degree of market efficiency so that "true" or "fundamental" prices can be predicted and tax effects, therefore, can be isolated and quantified.

This study extends Berger (1993), who examines the effect of research and development credits on the level of related investment activity and estimates the implicit tax created by the credit. The study also compliments prior research on the effect of taxes on prices paid in mergers and acquisitions (e.g., Weaver 2000) and the effect of taxes on investments in classes of particular assets (e.g., Goolsbee 1998). The study also extends yearling price research by Buzby and Jessup (1994) that includes a control variable to reflect taxes. This study also adds to recent research that has been conducted on the effect of the bonus depreciation tax rules.

The study uses well-established thoroughbred pricing models coupled with a dummy variable to represent time periods of bonus depreciation eligibility. The research design also makes use of an aspect of bonus depreciation that was an important issue in the equine industry: the original use of any asset eligible for bonus depreciation had to commence with the purchaser. This rule effectively eliminates bonus depreciation for most purchases of breeding horses, referred to as broodmares in the industry. The research design exploits this difference across horse type by predicting that yearling prices are affected by bonus depreciation but that broodmare prices are not affected. This design provides greater confidence that any yearling results consistent with predictions are due to taxes and not to a correlated omitted variable.

Results are consistent with bonus depreciation rules affecting yearling prices. In various model specifications, the coefficient on the bonus dummy variable is positive and statistically significant. The same dummy variable in broodmare models is not statistically different from zero. The regression coefficient on the bonus time period dummy can be used to estimate the effect of the bonus time period on yearling price. Doing so gives the result that the time period has a 22-25% price-increasing effect on price. This percentage is higher than net present value analysis suggests for expected price increases.

The paper proceeds by reviewing prior research on taxes, asset prices, and bonus depreciation. Then the equine institutional setting is described with emphasis on bonus depreciation rules applicable to thoroughbreds and industry characteristics that affect tax benefits associated with depreciation deductions. The research hypothesis is stated in this section. Next the price models and research design are described. Results are then reported followed by the conclusions from the study.

PRIOR RESEARCH ON TAXES, ASSET PRICES, AND BONUS DEPRECIATION

Shackelford and Shevlin (2001) describe asset price formation in light of taxes as a fundamental issue in accounting, finance, and economics. They state that the research focuses on the questions, "Do taxes matter?" and "If so, how much?" and that, further, the contracting perspective of considering both parties to a transaction is important. The research in this study is directly related to these issues. Shackelford and Shevlin (2001) review several lines of related research in accounting, of which implicit tax and merger and acquisition research are particularly relevant. Economics researchers have studied these questions with respect to bonus depreciation.

Berger (1993) investigates the effect of the 1981 Research and Development (R&D) tax credit on the level of R&D investment spending and then estimates the magnitude of the implicit tax created by the credit. The model controls for non-tax factors that affect R&D spending and then specifies a credit usability variable. With respect to implicit taxes, he does not investigate prices of assets but uses differential stock price reactions between two types of firms. He finds significantly positive share price reactions to the tax law enactment for firms that will receive the credits compared to firms that will not receive the credits. Firms receiving no credit pay implicit taxes because they compete in the market where credit-using firms bid down pre-tax returns, i.e., prices are bid up.

Weaver (2000) and Ayers et al. (2000) use a change in intangible asset amortization tax rules under IRC §197 to examine the effect of taxes on acquisition/divestiture structure and prices paid in those transactions. Dummy variables (sometimes specified in an interaction term) are used to measure the pre- and post-tax law change time periods. Weaver (2000) finds that the change allowing goodwill amortization increases the likelihood that transactions are structured to take advantage of the deduction. The study does not examine price effects. Ayers et al. (2000) concludes that, while there was not a statistically significant increase in the number of transactions after the tax law change that were eligible for goodwill amortization deductions, there was a statistically significant increase in acquisition premiums associated with purchased goodwill for qualifying transactions, i.e., the data are consistent with price effects due to taxes. This study is similar to the two studies described in that depreciation and amortization are similar deductions; however, the setting of this study is not as complex because the price of a single asset rather than a firm's entire set of assets is considered, and transaction structure issues are not present.

Goolsbee (1998) uses Bureau of Economic Analysis data to investigate the effect of investment tax credits (ITC) on the price of capital goods and concludes that much of the benefit of the credits goes to suppliers rather than to the firms making the investments. Estimates indicate that a 10% ITC increases prices by 3.5% to 7% overall, with prices increases largest where there are capacity constraints, and on average, 60% of investment subsidies go to buyers with 40% going to capital suppliers (Goolsbee 1998). The author points out that the result is consistent with tax incidence in that having a tax deduction and receiving the benefit of the deduction are not the same thing. Tax incidence is consistent with the implicit tax description used by Berger (1993) and others.

This study has the benefit of being able to use asset prices to quantify implicit taxes. The price in the bonus depreciation time period is expected to be bid up, shifting tax benefits away from the purchaser and to the seller. The setting is one in which bidding up of price can reasonably be expected because the supply of thoroughbreds is "quite" inelastic with respect to price (Robbins and Kennedy 2001). Supply cannot be altered on a short-term basis because of the lengthy time of gestation and growth of the foal to the age of yearling. Expected prices differentials for yearlings given the two different tax depreciation regimes, no bonus and bonus, are compared to the actual differences based on regression results.

The influence of taxes on yearling prices is considered by Buzby and Jessup (1994) who included a binary variable for the Tax Reform Act of 1986 (TRA 86) because that Act's slower depreciation rates, passive loss limits, and accounting method changes were unfavorable to the industry. Data are consistent with lower prices in the post TRA 86 time period. This study extends Buzby and Jessup (1994) by examining a single aspect of a tax law rather than general effects and by quantifying the expected price effect from the bonus depreciation and any actual tax effects on price by interpreting the tax variable regression coefficient. In addition, this study's tax regime change has a prediction period (2002 through 2004) that is in the middle of two non-prediction periods (2001 and 2005), which makes it less likely than in Buzby and Jessup (1994) that the time period dummy variable is capturing unspecified structural shifts in pricing.

Recent research has considered the 2002- 2004 bonus depreciation tax laws. Desai and Goolsbee (2004) analyze industry- and firm-level capital expenditures. They conclude the changes did not have much effect on expenditures and attribute some of lack of findings to the fact that the tax depreciation system is already accelerated. They also state that while the tax cuts were effective in changing incentives, the cuts were not large enough to counteract declines in investment rates observed in the 2000s (Desai and Goolsbee 2004). House and Shapiro (2005) also examine the effect of the bonus depreciation rules. Their results are consistent with the prediction that investment in capital that qualified for the tax subsidy was substantially higher than capital that did not. The differences in results between the two studies could be a result of different data and different measures of investment in capital goods. In contrast to the thoroughbred setting, both of these studies are broad, macroeconomic analyses. Huston (2006) conducts a firm level investigation of capital expenditures for tax-favored versus non-tax-favored assets and finds an increase in the former and decrease in the latter. The study does not investigate asset prices.

House and Shapiro (2005) go on to show that the magnitude of increased investment in assets they find is greater the longer the useful life of the personalty because the 30% and 50% bonus amounts shift the timing of depreciation deductions relatively more for longer-life versus shorter-life assets. When House and Shapiro (2005) test for predicted asset price increases, they do not find a relationship between the tax rate of depreciation and investment. Overall, this study complements existing research on the bonus depreciation tax law by singling out a particular asset, focusing on price effects, and making use of empirically validated expected price models.

EQUINE INDUSTRY: DEPRECIATION AND OTHER APPLICABLE TAX RULES

Horses are subject to the election for immediate expensing under IRC §179 and tax depreciation under IRC §167 and §168. Two useful life categories are applicable to horses. 3-year property includes race horses greater than 2 years old and breeding horses greater than 12 years old. All other horses are 7-year property. If a horse is used outside the United States more than 50% of the time, the alternative depreciation system (ADS) applies such that all breeding horses are depreciated straight-line over 10 years and all other horses straight-line over 12 years. Age is determined by the actual birth date of the horse, not the industry standard whereby a horse's first birthday is measured on January 1 following the year of birth.

Additional first year depreciation of 30%, commonly referred to as bonus depreciation, was added to the tax law by the Job Creation and Worker Assistance Act of 2002 signed into law on March 9, 2002. Bonus depreciation applied retroactively to asset purchases after September 10, 2001. The provision was schedule to expire for purchases after September 11, 2004, but the Jobs and Growth Tax Relief Reconciliation Act of 2003 (2003 Act) increased the bonus depreciation percentage to 50% for purchase dates after May 5, 2003, and before January 1, 2005. Bonus depreciation is allowed for alternative minimum tax purposes.

Table 1 provides schedules of effective 7-year depreciation rates without bonus depreciation and with 50% bonus depreciation. Panel A shows the depreciation rates. The first year depreciation rate is much higher with bonus depreciation, 57.15% versus 14.29% without. Over time, of course, the percentages will sum to 100%, so the bonus rules affect cash flows from a time value of money perspective. Panel B uses a 10% discount rate and 35% marginal tax rate and shows that the after-tax cost of 7-year property would be 5% lower if the pre-tax price did not change. Panel C shows that for a $100,000 pre-tax purchase price, a buyer could pay $105,268 in the bonus period and have the same after-tax cost. Thus, with a 10% discount rate, pre-tax prices are expected to be bid up as much as 5.268%. At 5.268% the seller would be securing all the benefits of the bonus depreciation. If the discount rate is 5% or 15%, the resulting pre-tax purchase prices are $103,020 and $106,990, respectively [not shown in table].

This study tests the following hypothesis:

> Yearling prices are higher in time periods of bonus depreciation compared to other time periods.

There is anecdotal evidence consistent with the hypothesis. The *Louisville Courier-Journal* reports on the upcoming Keeneland yearling sale stating it “could get a boost” from the new 30% bonus rules (Haukebo 2002). The article goes on to quote a CPA dealing with buyers and helping to figure out how much more they can spend because of the tax law. Reports about upcoming 2003 Keeneland sales following the change to 50% bonus rules are similar. The director of sales states that "the market for yearlings in September got a boost from the new tax depreciation schedules" (Hickman 2003). *The Wall Street Journal* reports "If you want to see investment tax breaks in action, head to the local racetrack," and that "the thoroughbred market turns out to be a huge beneficiary of the tax incentives" (Murray 2003). One owner is quoted as saying, "The economic model changed drastically when the depreciation schedule changed," while one attorney warns "don't let the tax incentive influence you to the degree you overlook the fundamentals of the horse" (Murray 2003). Other industry periodicals reported similar information. Whether these tax motivations affect prices after controlling for yearling fundamentals is an empirical question.

An important aspect of bonus depreciation in the equine industry is that the original use of the property must commence with the taxpayer. This provision caused uncertainty in the industry for awhile. It was clear that a horse purchased for racing that had never raced would qualify for bonus depreciation (e.g., yearlings) and that a horse purchased to race after being raced by a different owner would not qualify. However, it was unclear whether a horse raced but never bred would qualify if purchased for breeding (Bloodhorse.com news posting March 12, 2002). Final regulations issued by the IRS on September 8, 2003, resolve the issue in an example that shows no bonus depreciation may be taken on a horse purchased for breeding when the horse was previously raced (IRC Reg. §1.168(k)-1T(a)(3)(v) Example 3). Therefore, broodmares are used as a control group with the expectation that there is no price effect in time periods of bonus depreciation compared to other time periods.

Some aspects of depreciation tax law changes will bias against detecting predicted price differentials. First, bonus depreciation rules do not apply to property depreciated under the ADS system. To the extent buyers intend to use the horses outside the U.S., there is no change in depreciation for yearlings across time periods nor between yearlings and broodmares, which makes it less likely that price effects will be detected. Second, the 2003 Act increased §179 immediate expensing to $100,000 per year with phase-out of that amount when total asset purchases exceed $400,000. Effective dates are January 1, 2003, (retroactive to the 2003 Act) through December 31, 2005. Both types of horses are eligible for the §179 immediate expensing. To the extent buyers are motivated by this tax provision more than bonus depreciation rules, it is less likely that a pricing differential will be detected. However, this potential effect is mitigated by the assets placed in service cap of § 179 because many horse buyers will place in service a dollar amount of assets such that the election cannot be made.

The 2003 Act included a reduction in both the ordinary income tax rate and the maximum net long-term capital gain tax rate applicable to individuals. Many thoroughbred owners are individuals or pass-through entities with individuals who are owners. All else equal, the change in the top statutory rate from 39.6% to 35% makes depreciation deductions less valuable, which would make a buyer willing to pay less for a horse. The change in rates works against detecting price increases for the yearlings. However, the tax rate change affects yearling and broodmare buyers in the same manner, so the tax rate is not a confounding factor that affects the usefulness of the broodmare control group.

To the extent a yearling is held as an investment asset, gains on sales would not be subject to the favorable rate because there is a 2-year holding period requirement for long-term classification. If yearlings are held as inventory, the preferential rate rules do not apply. With respect to breeding horses, many horses are likely to be held as trade/business assets with gains first subject to depreciation recapture and then trade/business classification. Whether the preferential rate ultimately applies to a trade/business gain on the sale of a breeding horse depends on an individual's netting process for trade/business and capital asset gains and losses. To the extent the change in the net long-term capital gain rate affects the seller of a breeding horse, the seller would be willing to take a lower pre-tax price for the horse. An underlying assumption in using this control group is that the preferential capital gain rate does not, on average, affect the price of the broodmares. Finally, no other tax law changes during the bonus depreciation era were identified that would affect either the direct pricing of thoroughbreds or the relative pricing of yearlings and broodmares.

There are other long-standing tax laws that affect horse owners such that this study is less likely to find predicted price effects. Hobby loss limits and passive activity loss rules are important and relevant issues for horse owners. Both issues are covered in American Horse Council publications (e.g., Davis 2006). Although tax depreciation can potentially be deducted on a carryforward basis despite hobby loss rules (i.e., the hobby eventually generates a profit) and despite passive activity loss rules (i.e., the suspended loss offsets a gain on the sale of the activity), the present value of the tax depreciation is greatly reduced.

THOROUGHBRED PRICE MODEL SPECIFICATIONS

This section specifies and explains the yearling price model first and the broodmare price model second. There are similarities across the models, but there are also a few important differences because of the different natures and functions of the two types of horses.

Yearling Model

The yearling model is specified as follows:

$$PRICE_{i,t} = a_{i,t} + ß_1\ STUDFEE_{i,t} + ß_2\ AGE_{i,t} + ß_3\ GENDER_{i,t} + ß_4\ DAMWIN_{i,t}$$

$$+ ß_5\ SIBWIN_{i,t} + ß_6\ BONUS_{i,t} + e_{i,t}$$

where:
PRICE = logged hammer price (final bid) for yearling,
STUDFEE = logged stud fee of yearling's sire,
AGE = 1 if month foaled is January through March and = 0 if April through June,
GENDER = 1 if colt and = 0 if filly,
DAMWIN = 1 if the yearling's dam is a high-quality winner and = 0 otherwise,
SIBWIN = 1 if the yearling's siblings on the dam's side are high quality winners and = 0 otherwise,
BONUS = 1 if year is 2002, 2003, or 2004 and = 0 if year is 2001 or 2005,
i = hip number of yearling, and t = year.

Several prior studies investigate the determinants of yearling prices. Buzby and Jessup (1994) examine 3,027 sales from Keeneland auctions between 1980 and 1990 and include a model with both yearling-specific and macroeconomic variables. The adjusted R^2 of their models is as high as .25. Robbins and Kennedy (2001) examine a regional yearling market, British Columbia, over the 1985 to 1997 time period and pay particular attention to assessing model variables given the range of variables used in prior research. The adjusted R^2 of their models is as high as .56. Prior research is consistent in using a log linear model such that all model variables that are not binary are logged. Other studies use yearling price models to assess possible asymmetric information in the market (e.g., Chezum and Wimmer [1997] and Vickner and Koch [2001]). Results of those studies are inconsistent. Although the research question in those studies is different from this study, some model characteristics are relevant.

Yearling-specific variables measure the quality of the yearling's lineage (sire and dam characteristics) and also information about the yearling itself. Robbins and Kennedy (2001) conclude that the sire stud fee at the time of the auction by itself adequately represents the role of the sire. Although they investigate more than one measure of sire quality, Buzby and Jessup (1994) find that stud fee at the time of the auction is statistically significant and positively related to yearling price. This study uses the stud fee at the yearling sale date to measure sire quality.

Measuring the quality of the dam is more difficult because there is not a single measure that appears to be representative of her quality. Dam information provided in auction sale catalogs includes the dam's race history and also the race history of the dam's progeny. Race results include North American dollars earned, number of races won, and quality of the races in which the horse won. Quality of races is captured by the distinction of a horse being a stakes winner, stakes placed, or Black-type winner. All race horses can be classified as a stakes winner, stakes placed, or neither. Black-type refers to wins at certain prestigious races; a horse could have no, one, or up to several black-type wins. Wins do not include just first place. This study takes the approach of counting all listed finishes as wins, consistent with catalog descriptions.

Robbins and Kennedy (2001) conclude that a major contribution of their study is determining the effect of the dam on yearling price, a role they state no other study has identified with confidence. With respect to the dam, they test race results of the dam itself as well as the dam's progeny. They conclude that the role of the dam in affecting yearling prices comes from progeny racing performance and not from dam racing performance. Buzby and Jessup (1994) find that dam quality measured with a binary variable for Black-type winner is statistically significant and positively related to yearling price. This study uses data for both dam and dam progeny race history. Dam progeny are siblings of the yearling that is for sale. The regression variable, SIBWIN, is defined with respect to the yearling. This reference is consistent with the broodmare model, where more relationships are defined. Dummy variables are constructed to measure the dam quality and sibling quality such that a horse that is either a stakes winner, stakes placed, or black-type winner is considered high quality with a dummy set equal to 1. Otherwise, these dummies are set equal to zero.

The month in which the horse is foaled is included because older yearlings are more developed and expected to sell for a higher price. Results in Robbins and Kennedy (2001) and Buzby and Jessup (1994) are consistent with this prediction. This study adopts the approach of Buzby and Jessup (1004) by defining older horses as born in months January through March. Horse gender is included as a binary variable in most prior research although results are not consistent. The expectation is that colts will sell for a higher price than fillies all else equal.

Alternative model specifications use earnings information with total earnings scaled by number of wins for both the dam and siblings, consistent with Robbins and Kennedy (2001). In addition, a dummy is incorporated to indicate whether the horses ever raced. The dummy captures the difference between horses that raced and did not win versus a horse that never raced. Only North American earnings are disclosed in the sales catalog. However, in some cases overseas wins are listed. When using earnings information, a dummy variable is included to indicate the horse has won overseas. In addition, specifications take into account the day of sale. Vickner and Koch (2001) explain that well-bred thoroughbreds are sequenced early in the sale with one purpose being to group like horses within the sale. The Keeneland webpage does not specifically describe this process or that it occurs. However, posted sale information is consistent with declining daily average prices. Consistent with Vickner and Koch (2001), a dummy is set equal to 1 for the first four days of the yearling auctions.

A variety of macroeconomic variables have been used in prior research. Variables reflect characteristics of particular sale markets and time periods studied. No clear and consistent set of variables has been identified, and Robbins and Kennedy (2000) state that the influence of these variables remains an open question. This study does not include macroeconomic variables, in part because of the conclusion by Robbins and Kennedy (2000). Further, macroeconomic factors affecting the industry are likely to affect yearling and broodmare prices in a similar manner. The use of the broodmare model mitigates the importance of considering macroeconomic variables that might differ across the five years examined in this study.

Broodmare Model

The broodmare model is specified as follows:

$$PRICE_{i,t} = a_{i,t} + ß_1\ STUDFEE_{i,t} + ß_2\ COVERFEE_{i,t} + ß_3\ PREGNANT_{i,t} + ß_4\ AGE_{i,t}$$

$$+\ ß_5\ BMAREWIN_{i,t} + ß_6\ DAMWIN_{i,t} + ß_7\ PROGWIN_{i,t} + ß_8\ SIBWIN_{i,t} + ß_6\ BONUS_{i,t} + e_{i,t}$$

where:
PRICE = logged hammer price (final bid) for broodmare,
STUDFEE = logged stud fee of broodmare's sire,
COVERFEE = logged stud fee of covering sire if broodmare is pregnant,
PREGNANT = 1 if broodmare is pregnant and = 0 otherwise,
AGE = logged age of broodmare in years,
BMAREWIN = 1 if the broodmare is a high quality winner and = 0 otherwise,
DAMWIN = 1 if the broodmare's dam is a high quality winner and = 0 otherwise,
PROGWIN = 1 if the broodmare's progeny are high quality winners and = 0 otherwise,
SIBWIN = 1 if the broodmare's siblings on the dam's side are high quality winners and = 0 otherwise,
BONUS = 1 if year is 2002, 2003, or 2004 and = 0 if year is 2001 or 2005,
i = hip number of broodmare, and t = year.

Neibergs (2001) examines the broodmare market. Many model variables are essentially the same as the yearling model, but there are also important differences. This study uses the following variables from Neibergs (2001): a dummy variable for pregnancy status, covering sire stud fee if the broodmare is pregnant, and age measured in years. Neibergs (2001) constructs a variable to represent the broodmare's sire quality. Consistent with the yearling model, this study uses the sire's stud fee at the time of the sale of the broodmare. Like Niebergs (2001), this study also uses race result variables to measure the quality of the broodmare itself, the quality of any progeny of the broodmare, the quality of the broodmare's dam including the dam's own performance as well as that of progeny of the dam (i.e., siblings of the broodmare that is for sale). Status as a stakes winner or stakes placed and Black-type wins are used in the same manner as the yearling quality variable, which is very similar to the approach used in Neibergs (2001). Neibergs (2001) uses a log linear model. Alternative specifications for the quality measures use earnings data in the same manner as the yearling model.

DATA SOURCES AND TIME PERIOD OF ANALYSIS

This study uses data from Keeneland auctions. Keeneland is located in Lexington, Kentucky, the heart of the thoroughbred industry. Keeneland is considered to be the world's leading thoroughbred auction facility, and the September yearling auction is the world's largest single offering of thoroughbred yearlings (Vickner and Koch 2001). Sale results are published on-line and provide the dependent price variable. The sale catalog is also available on-line, and each horse has one page of information, which provides the rest of the data except for stud fees. Stud fees for respective years are obtained from annual issues of *Market Watch*, a publication of The Bloodhorse.

Data from September yearling sales and November breeding stock sales are analyzed. Only yearlings are sold in September. Although the November sale is called the breeding stock sale, other horses are offered for sale as well. The primary type of horse for sale other than broodmares is weanlings, horses born in the same year as the sale. The weanlings are excluded from the analysis. No yearlings are sold at the November auction.

Sale outcome is "sold," "out," or "RNA." Out means the horse was withdrawn from the sale after the sale catalog was published and posted. RNA stands for reserve not attained. This designation means the bidding did not reach the minimum price the seller would take for the horse. When RNA is indicated in sale results, the dollar amount of the last bid is also listed. This final bid is to some degree the market's valuation of the horse. Three prior studies that use Keeneland data explicitly include RNA observations in their samples (i.e., Neibergs [2001], Vickner and Koch [2001], and Chezum and Wimmer [1997]). Buzby and Jessup (1994) do not state whether these observations are included. This study uses RNA observations in main tests and examines alternative specifications with only horses that are actually sold.

The 30% rules were passed on March 9, 2002, so participants in late 2001 auctions were not aware that bonus depreciation would apply to those yearlings. Thus, the following yearling sale periods are identified as bonus periods: 2002, 2003, and 2004. 2001 and 2005 sales are non-bonus periods. The Keeneland webpage does not include sale catalog information prior to 2001.

Each horse in a sale is identified by a number placed on its hip, and the sale catalog is in hip order starting with 1. Samples are constructed by selecting for each year every 50th horse starting with 50. This approach is consistent with Chezum and Wimmer (1997) who explain that the horses are not sold in small groupings and so no systematic bias occurs in such sampling.

Table 2 provides information on the original sample sizes for the yearlings and broodmares and then reconciles to the sample sizes available for the main tests. Panel A shows that approximately 11% of cataloged horses are out. The only other reason sample size is reduced is for missing stud fees. Broodmare data are presented in Panels B and C. Panel B first removes missing sire stud fees, and Panel C first removes missing covering sire stud fees. The final reconciliation to 76 observations is the same because it reflects that at least one of the stud fees is missing. There is a greater proportion of missing stud fees for broodmares compared to yearlings because the older the broodmare, the less likely it is that her sire is still in service. If a sire is not in service, *Market Watch* cannot list a stud fee.

DESCRIPTIVE DATA AND RESULTS

Yearling Models

Table 3 provides descriptive data for the yearling sample. Panel A shows price data by year. Panel B provides descriptive data for the continuous variables, price and stud fee. These amounts are not logged in order to compare price to Panel A data and for ease of understanding. Mean price is $79,759, and the mean stud fee is $34,921. Panel C shows information with respect to the binary variables used in the main regression analysis. In no case does a binary variable appear to have a very high or very low number of 1s and 0s.

Table 4 reports correlations between the variables as specified for regressions (i.e., non-binary variables are logged). All correlations with PRICE are positive, as expected. The highest correlation with PRICE is for STUDFEE (correlation = .60 and p-value < .0001). Other model variables except for AGE are positively correlated with PRICE and statistically significant. The BONUS dummy variable representing the years of eligibility for bonus depreciation is positively correlated with PRICE (p < .07). The correlations do not control for the influence of any other variables on PRICE, so no conclusion about the research hypothesis can be made. Some correlations among the independent variables are noteworthy. STUDFEE is positively correlated with a high quality dam, DAMWIN, and the dam producing high-quality progeny, SIBWIN. This result is consistent with high quality dams breeding with high quality sires. No correlation between the BONUS dummy and any other independent variable is statistically significant.

Table 5 reports regression results for two models, both with and without the RNA horses. Model 1 measures DAMWIN and SIBWIN with dummy variables. Model 2 measures SIBWIN with logged race earnings scaled by number of wins. The correlation between the Model 1 and Model 2 measures of SIBWIN is .56 (p< .0001). Model 2 also includes binary variables to indicate whether the yearling's siblings raced or had overseas winnings. Results of the two models are consistent whether the regression is specified for the full sample or only for the sold horses (i.e., without RNA). The results are fairly consistent across the four specifications. Adjusted R^2 amounts range from .39 to .42. Parameter estimates for STUDFEE, GENDER, DAMWIN, and SIBWIN are positive and statistically significant, as expected. AGE is not statistically significant. In Model 2 the dummy indicating the siblings had overseas winnings, SIBOVER, is positive and statistically significant. This dummy captures success by the progeny that is not captured in earnings amounts because only North American earnings are reported. The dummy variable indicating whether sibling have raced or not, SIBRACE, is not statistically significant.

The parameter estimate on BONUS is positive and statistically significant, consistent with the hypothesis that yearling prices are higher in favorable tax regimes all else being equal. Results with respect to BONUS are robust to several alternative specifications run on Model 1 for the full sample [not reported]. A regression is specified using separate dummy variables for the three years in the bonus period and for 2005. Results show that the coefficients for the bonus time period are positive and statistically significant ($p < .10$ for 2002, and $p < .05$ for 2003 and 2004) and that the coefficient on the 2005 dummy is not different from zero. A regression is also specified with two dummies, one for 2002 (30% bonus period) and one for 2004 and 2005 (50% bonus period). The coefficient estimate and statistical significance for the 50% period are higher than for the 30% period, but an F-test does not show a statistical difference.

If AGE is specified to include April birthdates as older horses, AGE is statistically significant. When DAMWIN is measured with earnings scaled by number of wins, it is not statistically significant nor is a dummy variable indicating the dam raced overseas. A dummy variable for days one through four of the sale is positive and statistically significant. In these alternative specifications, the BONUS dummy is positive and statistically significant ($p < .05$).

Tests are conducted to determine the effect of outliers on the results. Price is scaled by stud fees with neither logged, and results are re-estimated without the two largest observations. There is no change to conclusions reached in the main tests. In addition, influence diagnostics are used to identify potential regression equation outliers. For the yearling data, one Rstudent measure is greater than the absolute value of 3 and 17 are greater than the absolute value of 2. Regressions are estimated omitting these observations with conclusions remaining the same.

Broodmare Models

In order to rule out the alternative explanation that BONUS is measuring some unspecified characteristic of that time period, the broodmare sample serves as a control group. Table 6 reports descriptive data for this sample. Panel A shows price data by year. Mean prices for 2002 and 2005 are higher than for other years due in part to each year having a large sale price, $1,750,000 and $2,100,000, respectively. The next highest price in any year is $700,000. Panel B reports descriptive data for continuous variables in the sample. The mean price is $84,909. The mean and median stud fees for the broodmare sires are $61,495 and $30,000, respectively, with the mean and median covering sire stud fees equal to $25,128 and $15,000 respectively. The binary variables reported in Panel C do not appear to have an unusually high number of 1s or 0s, but more than 80% of the broodmares are pregnant.

Table 7 reports correlation coefficients for the broodmare sample. The correlation between PRICE and BONUS is not statistically significant; it is not predicted to be. BONUS correlations with other independent variables are not statistically significant. Correlations between PRICE and all other independent variables are consistent with predictions, positive, and statistically significant except that AGE is negative as predicted. Age for the broodmare is in years unlike the month foaled for yearlings, which is why the prediction is negative. Like in the case of yearlings, high-quality dams appear to breed with high-quality sires; the correlation between COVERFEE and BMAREWIN is .192 (p-value < .02). The older the broodmare, measured by AGE, the more likely the broodmare and its offspring are winners (correlations between AGE and both BMAREWIN and PROGWIN are positive and statistically significant). A broodmare that is a winner appears to come from a line of winners; the correlation between BMAREWIN and SIBWIN is .272 (p < .0001).

Table 8 reports regression results for the broodmare model. The four models differ based on missing data for sire stud fees, STUDFEE, and covering sire stud fees, COVERFEE. Calculations of the various sample sizes are shown in Panels B and C of Table 2.   When COVERFEE is included in the regression, Models 1 and 3, the PREGNANT variable cannot be used because the model is not full rank due to all PREGNANT observations = 1. Model 1 with both sets of stud fees is theoretically the best of the four models, but it has the smallest sample size. Nonetheless, the adjusted R^2 = .68 is the highest of the four models. The high explanatory power is consistent with adjusted R^2 = .74 in Neibergs (2001). Results for independent variables are consistent across the four models and statistically significant in predicted directions except that progeny racing success, PROGWIN, is not statistically significant in Model 1. The importance of covering sire stud fee, COVERFEE, can be seen by noting that when it is not included in Models 2 and 4, the adjusted R^2 amounts are much lower, .43 and .30, respectively. In all four models, BONUS is not statistically different from zero. When the four models are estimated without RNA observations, the results are consistent [not reported]. These results help rule out the alternative explanation in the yearling model results that all horse prices were higher in the bonus time period.

The effect of outliers is assessed in the same manner as for yearlings. Price is scaled by stud fees with neither logged, and results for the models are re-estimated without the largest observation. There is no change to conclusions reached using Table 8 data. Influence diagnostics show no Rstudent measure greater than the absolute value of 3. Reductions in sample size range from 3 to10 observations when using the absolute value of 2 as a cut off. For all four models, the coefficient on BONUS remains statistically indistinguishable from zero.

Economic Significance

One way to assess the economic effect of the bonus depreciation is with the coefficient on the BONUS time period dummy variable. Because the model uses logged data, a direct interpretation cannot be done. Halverson and Palmquist (1980) show how to measure the effect in percentage terms using the dummy coefficient estimate. Table 4 shows BONUS coefficients that range from .222 to .245. For small values of relative effects, the coefficient is approximately equal to the percentage (Halverson and Palmquist 1980); for example, that study's Table 1 shows a .25 coefficient has a 28% relative effect. Based on regression results, yearling prices are 22% to 25% higher in the bonus time period. These percentages are higher than suggested by the net present value analysis in Table 1, which warrants further investigation.

CONCLUSION

This study examines market prices in the equine industry given time periods of bonus or no bonus depreciation. Results are consistent with yearling prices being higher in bonus time periods as predicted. A control group of broodmare sales do not exhibit the same result. The results are robust to alternative specifications and sensitivity analysis. The magnitude of yearling price increases in the bonus time period is higher than expected when using net present value analysis.

Future research could focus on the tax status of buyers and sellers in order to examine tax sharing between the two parties. Additional data on buyers could also potentially be used to test for effects of IRC § 179 immediate expensing. Some buyer and seller information is disclosed in the Keeneland sale catalog and sale results, but it would be necessary to obtain more details regarding the tax status of the two parties in order to conduct research on tax clienteles. Future research could also investigate whether tax motivations in auction markets generalize to the other market settings. Non-tax extensions of this work could examine market characteristics in greater detail.

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Table 1
Depreciation Calculations with and without Bonus

Panel A: Depreciation Rates

Year	7-year property without bonus	7-year property with bonus	Difference
1	.1429	.5715	.4286
2	.2449	.1225	(.1224)
3	.1749	.0875	(.0874)
4	.1249	.0625	(.0624)
5	.0893	.0446	(.0447)
6	.0892	.0446	(.0446)
7	.0893	.0446	(.0447)
8	.0446	.0222	(.0224)
Sum	1.000	1.000	0

Panel B: Example of Present Value of Cash Flows from Tax Savings

Assumptions:
7-year property; Asset placed in service = 100,000; Marginal tax rate = .35; Discount rate = .10

Year	Tax Savings without bonus	Present value of tax savings without bonus*	Tax savings with bonus	Present value of tax savings with bonus*
1	5,002	5,002	20,003	20,003
2	8,572	7,792	4,288	3,898
3	6,122	5,059	3,063	2,531
4	4,372	3,284	2,188	1,644
5	3,126	2,135	1,561	1,066
6	3,122	1,939	1,561	969
7	3,126	1,764	1,561	881
8	1,561	801	777	399
Sum	35,000	27,776	35,000	31,390
After-tax Cost		72,224		68,610

* No discount calculated for Year 1

Panel C: Pre-Tax Price with Bonus that Generates Same After-Tax Cost without Bonus
Solving for that Price Gives Price = 105,268

Year	Tax savings with bonus	Present value of tax savings with bonus*
1	21,056	21,056
2	4,513	4,103
3	3,224	2,664
4	2,303	1,730
5	1,643	1,122
6	1,643	1,020
7	1,643	928
8	818	420
Sum	36,844	33,044
After-tax Cost		72,224

* No discount calculated for Year 1

Table 2
Sample Information

Panel A: Yearlings

Original sample size	460
Out	(52)
Subtotal	408
Stud fee data not available	(48)
Sample size*	360

* Descriptive data are computed for this sample

Panel B: Broodmares
Missing Sire Stud Fees Removed First

Original sample size	411
Weanlings	(166)
Horses age 3 or older	245
Out	(30)
Subtotal*	215
Sire stud fee data not available	(118)
Subtotal*	97
Covering sire stud fee data not available	(21)
Sample size for full sample*	76

* Regressions are estimated on these samples.

Panel C: Broodmares
Missing Covering Sire Fees Removed First

Original sample size	411
Weanlings	(166)
Horses age 3 or older	245
Out	(30)
Subtotal*	215
Covering sire stud fee not available	(47)
Subtotal*	168
Sire stud fee data not available	(92)
Sample size for full sample*	76

* Regressions are estimated on these samples.

Table 3
Descriptive Data for Yearlings

Panel A: Mean and Median Sale Price by Year

	2001	2002	2003	2004	2005
Sample					
Mean	63,035	73,995	87,789	85,987	86,175
Median	24,000	40,000	40,000	50,000	32,500
	(n= 71)	(n= 63)	(n= 71)	(n= 75)	(n= 80)

Panel B: Continuous Variables (n=360)

	Price	Stud Fee
Mean	79,759	34,921
Std. dev.	123,155	51,102
Median	40,000	20,000
Maximum	1,100,000	500,000
Minimum	1,000	2,500

Panel C: Binary Variables (n=360)

Age (1 = January through March)	1= 209 0 = 151
Gender (1 = colt)	1 = 191 0 = 169
Dam is a high quality winner (1= yes)	1 = 117 0 = 243
Siblings of the yearling on the dam's side are high quality winners (1= yes)	1 = 110 0 = 250
Bonus (1 = 2002, 2003, 2004 and 0 = 2001 and 2005)	1 = 209 0 = 151

Table 4
Yearling Variable Correlation Coefficients

Pearson correlations with p-values indicated below.
All independent variables are predicted to be positively related to PRICE with one-sided p-values reported. P-values for correlations between independent variables are two-sided.
n= 360

	STUDFEE	AGE	GENDER	DAMWIN	SIBWIN	BONUS
PRICE	.598 (p<.0001)	.030 (p<.29)	.118 (p<.02)	.265 (p<.0001)	.251 (p<.0001)	.081 (p<.07)
STUDFEE		-.001 (p<.99)	-.007 (p<.90)	.214 (p<.0001)	.128 (p<.02)	-.005 (p<.93)
AGE			-.078 (p<.14)	.121 (p<.03)	-.084 (p<.12)	-.061 (p<.25)
GENDER				.035 (p<.52)	.080 (p<.13)	.069 (p<.20)
DAMWIN					.080 (p<.13)	.049 (p<.36)
SIBWIN						-.035 (p<.51)

PRICE = logged sale price of yearling
STUDFEE = logged stud fee of yearling's sire
AGE = 1 if yearling is foaled in months January through March and 0 otherwise
DAMWIN = the quality of the yearling's dam measured by stakes winner, stakes placed, or black-type winner distinctions with high quality = 1,
SIBWIN = the quality of the yearling's siblings on the dam side measured by stakes winner, stakes placed, or black-type winner distinctions with high quality = 1,
BONUS = 1 if time period of bonus depreciation, auctions in Years 2002, 2003, and 2004, and 0 otherwise

Table 5
Yearling Regression Results

Model 1 measures dam and sibling quality with binary variables.
Model 2 measures sibling quality with logged earnings scaled by number of wins, a dummy variable = 1 if any siblings won overseas, and a dummy variable = 1 if any siblings have raced.

Parameter estimates reported with standard errors in parantheses.

Dependent variable = PRICE	Model 1 Full sample n= 360	Model 1 Sold horses only n= 281	Model 2 Full sample n= 360	Model 2 Sold horses only n= 281
Intercept	1.937*** (.602)	1.618** (.760)	1.677** (.612)	1.263 (.763)
STUDFEE (+)	.794*** (.060)	.820*** (.076)	.819*** (.060)	.858*** (.076)
AGE (+)	.119 (.116)	.134 (.140)	.174 (.116)	.178 (.140)
GENDER (+)	.284** (.113)	.278* (.135)	.337** (.114)	.325** (.135)
DAMWIN (+)	.356** (.124)	.456** (.151)		
SIBWIN (+)	.501*** (.124)	.542** (.148)	.058** (.021)	.084** (.024)
SIBOVER (+)			.628** (.192)	.837*** (.236)
SIBRACE (?)			-.343 (.243)	-.605* (.285)
BONUS (+)	.222* (.114)	.237* (.139)	.223* (.115)	.245* (.139)
F-statistic	43.21 p< .0001	30.62 p< .0001	35.88 p< .0001	26.51 p< .0001
Adjusted R^2	.42	.39	.40	.39

*** statistically significant with p-value < .0001
** statistically significant with p-value < .01
* statistically significant with p-value < .05

Table 6
Descriptive Data for Broodmares

Panel A: Mean and Median Sale Price by Year

	2001	2002	2003	2004	2005
Sample					
Mean	63,473	105,600	63,637	69,987	118,740
Median	22,000	29,000	40,000	35,000	25,000
	(n=40)	(n=37)	(n=43)	(n=45)	(n=50)

Panel B: Continuous Variables

	Price (n=215)	Broodmare's Sire Stud Fee (n= 97)	Covering Sire Stud Fee (n=168)	Broodmare Age (n=215)
Mean	84,909	61,495	25,128	7.78
Std. dev.	208,036	91,167	28,168	4.00
Median	30,000	30,000	15,000	7.00
Maximum	2,100,000	500,000	200,000	24.0
Minimum	1,200	2,500	2,500	3.00

Panel C: Binary Variables (n=215)

Pregnant (1 = yes)	1=180 0= 35
Broodmare is a high quality winner (1 = yes)	1= 46 0 = 169
Broodmare's dam is a high quality winner (1= yes)	1=90 0=125
Broodmare's progeny are high quality winners (1 = yes)	1 = 32 0 = 183
Broodmare's siblings on the dam side are high quality winners (1 = yes)	1=162 0=53
Bonus (1 = 2002, 2003, 2004 and 0 = 2001 and 2005)	1=125 0=90

Table 7
Broodmare Variable Correlation Coefficients

Pearson correlations with p-values indicated below.
All independent variables except AGE and BONUS are predicted to be positively related to PRICE with one-sided reported p-values.
Age is predicted to be negatively related to PRICE with one-sided reported p-value.
No prediction is made for the correlation between PRICE and BONUS.
P-values for correlations between independent variables are two-sided.

	SIREFEE	COVERFEE	AGE	PREGNANT	BMAREWIN	PROGWIN	DAMWIN	SIBWIN	BONUS
PRICE	.389 (p<.0001) n=97	.746 (p<.0001) n=168	-.224 (p<.0005) n=215	.212 (p<.001) n=215	.201 (p<.0001) n=215	.093 (p<.09) n=215	.203 (p<.002) n=215	.161 (p<.01) n=215	.050 (p<.48) n=215
SIREFEE		.21 (p<.08) n=76	-.001 (p<.94) n=97	.054 (p<.60) n=97	-.118 (p<.25) n=97	.030 (p<.78) n=97	.277 (p<.006) n=97	-.094 (p<.35) n=97	.084 (p<.42) n=97
COVERFEE			-.128 (p<.10) n=168	*	.192 (p<.02) n=168	.083 (p<.29) n=168	-.001 (p<.99) n=168	.113 (p<.15) n=168	.006 (p<.94) n=168
AGE				.271 (p<.0001) n=215	.152 (p<.03) n=215	.486 (p<.0001) n=215	-.027 (p<.70) n=215	.138 (p<.05) n=215	-.016 (p<.82) n=215
PREGNANT					-.016 (p<.82) n=215	.078 (p<.26) n=215	.068 (p<.32) n=215	.010 (p<.15) n=215	.034 (p<.62) n=215
BMAREWIN						.037 (p<.59) n=215	-.121 (p<.08) n=215	.272 (p<.0001) n=215	.052 (p<.45) n=215
PROGWIN							.043 (p<.54) n=215	-.004 (p<.97) n=215	.116 (p<.09) n=215
DAMWIN								-.083 (p<.23) n=215	.032 (p<.65) n=215
SIBWIN									.083 (p<.23) n=215

*No correlation can be computed because for any covering sire stud fee, the broodmare is pregnant (i.e., pregnant = 1 for all observations).

PRICE = logged sale price of broodmare
SIREFEE = logged stud fee of broodmare's sire
COVERFEE = logged stud fee of the covering sire when broodmare is pregnant
AGE = logged age in years of broodmare
BMAREWIN = the quality of the broodmare for sale measured by 1= stakes winner, stakes placed, or black-type winner and otherwise = 0
PROGWIN = the quality of the progeny of the broodmare for sale measured by 1 = stakes winner, stakes placed, or black-type winner and otherwise = 0
DAMWIN = the quality of the broodmare's dam measured by 1 = stakes winner, stakes placed, or black-type winner and otherwise = 0
SIBWIN = the quality of the broodmare's siblings (on the dam side) measured by stakes winner, stakes placed, or black-type winner and otherwise = 0
BONUS = 1 if time period of bonus depreciation, auctions in Years 2002, 2003, and 2004 and otherwise = 0

Table 8
Broodmare Regression Results

Parameter estimates reported with standard errors in parantheses.

Dependent variable = PRICE	Model 1 n= 76	Model 2 n= 97	Model 3 n= 168	Model 4 n= 215
Intercept	-.012 (1.177)	6.72*** (.884)	2.043* (.832)	11.129*** (.381)
STUDFEE (+)	.262*** (.064)	.372*** (.077)		
COVERFEE (+)	.869*** (.109)		1.00*** (.075)	
PREGNANT		.810** (.263)		1.139*** (.226)
AGE (-)	-.540** (.218)	-.714** (.264)	-.906*** (.146)	-1.38*** (.189)
BMAREWIN (+)	.782** (.234)	1.322*** (.286)	.430* (.156)	.870*** (.204)
DAMWIN (+)	.307* (.165)	.383* (.201)	.380** (.122)	.565** (.163)
PROGWIN (+)	.441 (.312)	1.13** (.379)	.702** (.189)	1.189*** (.260)
SIBWIN (+)	.345* (.190)	.525** (.223)	.294* (.150)	.487* (.194)
BONUS (no prediction)	-.103 (.167)	-.238 (.205)	-.186 (.123)	-.108 (.164)
F-statistic	21.03 (p< .0001)	10.23 (p< .0001)	45.49 (p< .0001)	14.01 (p< .0001)
Adjusted R^2	.68	.43	.65	.30

*** statistically significant with p-value < .0001
** statistically significant with p-value < .01
* statistically significant with p-value < .05