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Macroeconomic Factors and the Thoroughbred Industry

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Abstract

A capitalization approach is used to estimate econometrically the effects of exchange rate, interest rate and tax law changes on thoroughbred yearling prices. The analysis found that exchange rate and tax law changes have significantly influenced yearling prices since the early 1980s. Another serious price-reducing event was the 1986 tax law change. Both of these factors have counteracted the positive impact of increased purse rates on yearling prices.

Key Words: exchange rate, macroeconomics, tax laws, purse rates, thoroughbreds

Agricultural economics research was tilted towards microeconomic analysis prior to the 1970s. However, these microeconomic analyses failed to explain the decline in competitiveness of U.S. agriculture in the world market. In spite of advanced technology and infrastructure and a well-established marketing system, U.S. competitiveness in agriculture declined. This prompted Schuh's 1974 article on the effects of the exchange rate on U.S. agriculture. He attributed lower U.S. agricultural prices to an overvalued currency. Schuh's work ushered a research initiative which concentrated on the impacts of the exchange rate on U.S. agriculture (Kost; Chambers and Just; Johnson, Grennes and Thursby). This literature has shown that exchange rate changes have significantly affected U.S. agriculture. Research efforts have broadened in recent years to incorporate the effects of macroeconomic variables -- interest rates, inflation and changes in money supply -- on U.S. agriculture.

This paper tests the hypothesis that macroeconomic variables, variables which are not

specific to the thoroughbred industry, have substantially affected the thoroughbred horse industry in recent years. The thoroughbred industry offers a unique opportunity to study the effects of macroeconomic variables. Thoroughbreds are capital assets whose values stem from expected future net returns from racing and breeding. Many thoroughbreds, especially yearlings¹, are sold at auctions which bring together foreign and domestic breeders. Thus, macroeconomic factors should play a major role in determining the health of the industry.

In the mid-1980s, the thoroughbred industry experienced an unprecedented economic boom. Foreign breeders invested heavily in American-bred yearlings and this boosted prices to historically high levels, especially at the major thoroughbred sale sites where foreigners purchase horses -- Keeneland (held in Lexington, Kentucky) and Saratoga (held in Saratoga, New York) sales. However, since 1985, the industry has undergone significant economic decline. In 1984, the average price of a selected yearling from the combined

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Keeneland and Saratoga summer sales was slightly over \$456,000 compared to an average of slightly over \$294,982 for 1990 (The Blood-Horse 1990).

The objective of this paper is to determine the macroeconomic factors that have contributed to this decline. Fundamental issues like the effects of exchange rates, interest rates, and the 1986 Tax Reform Act will be analyzed. Specifically, objectives are:

- 1) To test hypotheses that the exchange rate and the interest rate affect the price of thoroughbred yearlings.
- 2) To provide quantitative measures of the effects of these variables on yearling prices during the 1979-1990 period.

Literature Review

Chambers found a positive relationship between the money supply and agricultural exports. Orden expanded Chambers' analysis to include additional monetary variables (the money supply, real interest rate, exchange rate and general price level). He found that the exchange rate and real interest rate explained the largest proportion of the forecast-error variance for agricultural exports. Bessler analyzed Brazilian data and concluded that there was a one-way Granger-type causality from money supply to agricultural prices.

Devados and Meyers tested the hypothesis that farm output prices adjust faster than non-farm output prices to monetary changes. Their results confirmed that money supply increases (decreases) benefit (harm) farmers because farm product prices increase (decrease) relatively more than non-farm product prices.

Findings from commodity-specific models agree with findings from aggregated models that an overvalued currency contributes to export declines. Longmire and Morey, for example, concluded that

the appreciation of the exchange rate, approximately 20 percent during 1980-1982, caused the real value of U.S. wheat, corn, and soybean exports to decline by about \$3 billion (or 16 percent). They argued that this exchange rate effect accounted for approximately three-fourths of the total decline in the value of exports of these commodities during this period.

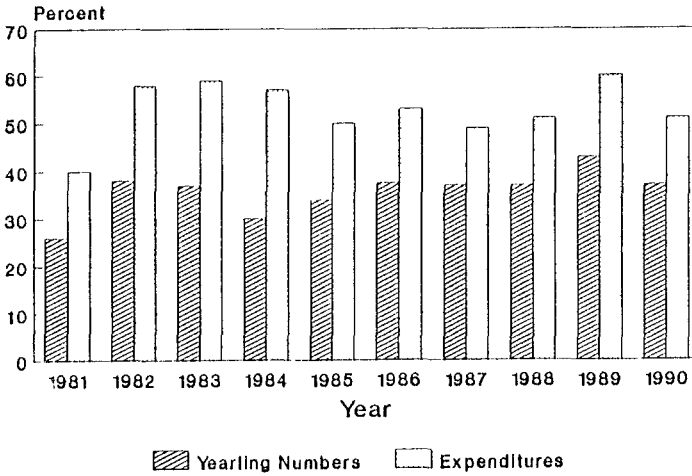
The Industry

The equine industry in the U.S., with over 5.25 million horses and 32 states participating in horse racing, is a multi-billion dollar industry contributing over \$15 billion annually to the gross domestic product (Lawrence). Between 1975 and 1988, the industry contributed on average \$600 million to the Federal government from its pari-mutual wagering activities (Thoroughbred Times). By 1988, 32 States had about 100 race tracks and a total attendance of about 69 million. The industry, through racing and breeding activities, contributes significantly to the economies of many states.

The most visible and business-oriented segment of the equine sector is the thoroughbred industry, whose major role is to breed high-quality horses for racing. Most offspring are auctioned as yearlings at various sites throughout the country. Sales at Keeneland and Saratoga are the most publicized and offer the highest quality yearlings.

Between 1981 and 1990, 35 percent of the total yearlings auctioned at Keeneland and Saratoga were purchased by foreign investors. This accounted for 53 percent of the total gross expenditure on yearling sales (The Blood-Horse). Figure 1 illustrates the percentage of selected yearlings that were purchased by foreign investors and the percentage of the gross expenditures on yearlings that accrued from the foreign market. Obviously, foreign buyers tend to purchase higher-priced yearlings.

Figure 1.



Source: The Blood Horse, 1990

With few government restrictions on thoroughbred purchasing and exporting (other than quarantine), foreign buyers participate directly in the auctions. Thus, the exchange rate influences thoroughbred auction prices directly. A stronger dollar relative to other currencies would raise yearling prices for foreign buyers, while a weaker dollar would generate demand for the high-quality U.S. bred-yearlings.

The 1986 Tax Reform Act affected the industry in three fundamental ways: 1) The Passive Activity Loss -- Prior to this Act, the thoroughbred industry benefitted from capital infusions by people who needed to shelter large sums of money, and these investments in the industry were tax-exempt. The Act put an end to these tax benefits. Newberry argues that there is no change in the Internal Revenue Code which has had such a profound impact on the thoroughbred industry as the passive loss provision. 2) The income tax from horses classified as capital assets (mainly the broodmares and stallions) rose from 20 percent to 28 percent, and 3) the Act lowered the depreciation rate for the industry.

Conceptual Framework

Because yearlings are purchased for future earnings, their price (value) can be modelled using a capitalization approach. In this model, yearling prices are demand-determined (i.e., from their value

to the buyer). The yearling price can be determined by discounting the value of the expected future earnings from racing and breeding.

Assume initially that all the expected income generated by the yearling comes from U.S. activities. The price of the yearling can be determined by discounting the nominal value of the expected net future earnings from racing and breeding in the U.S. Thus, applying an investment model, the present value of a yearling may be expressed as:

$$V_d = \sum_{t=1}^R \frac{(1-T) P_t}{(1+r)^t} + \sum_{R+1}^L \frac{(1-T) B_t}{(1+r)^t} \quad (1)$$

Where:

- V_d = price of the yearling
- P_t = expected net racing winnings in year t
- T = tax rate
- r = nominal interest rate
- R = number of years the horse can be expected to race
- B_t = expected net income from breeding in year t
- L = number of years the horse can be expected to breed

This model assumes constant risk premiums over time, no difference in tax rates between ordinary income and capital gains, and no salvage value for the thoroughbred. It abstracts

from variations in price due to phenotypic factors (genotypic and environmental factors) which produce detectable variations in horses. While the significance of the phenotypic factors cannot be overlooked, they require critical evaluation of an individual horse in regard to overall performance and pedigree. These phenotypic factors are not important for the present model due to the data analyzed.

In equation (1) the following conditions must hold:

$$\frac{\partial V_d}{\partial T} < 0; \frac{\partial V_d}{\partial r} < 0; \frac{\partial V_d}{\partial P_0} > 0; \frac{\partial V_d}{\partial B_0} > 0 \quad (2)$$

If the yearling is expected to earn all of its income stream from overseas activities, the variables from equation (1) would be:

$$V_f = \sum_{t=1}^R \frac{(1-T^*)P_t^*}{(1+r^*)^t} + \sum_{t=1}^L \frac{(1-T^*)B_t^*}{(1+r^*)^t} \quad (3)$$

Where:

- V_f = value of the yearling in foreign activities
- P_t^* = expected net racing winnings in year t
- T^* = tax rate for foreign countries
- r^* = nominal interest rate in foreign countries
- R = number of years the horse can be expected to race
- B_t^* = expected net income from breeding in year t
- L = number of years the horse can be expected to breed

To transform equation (3) into dollars, one divides the equation by E (denominated in foreign currency per dollar).

Many horses are purchased with the anticipation that they will be transported overseas for all or part of their career. Thus, yearling prices are a weighted average of equations (1) and (3):

$$V_y = w_d V_d + w_f \frac{V_f}{E} \quad (4)$$

V_y is the value of the yearling from all activities in all markets. Differentiating equation (4):

$$\frac{\partial V_y}{\partial E} = - w_f V_f E^{-2}$$

or

$$E_E = \frac{E}{V_y} \frac{\partial V_y}{\partial E} = - w_f V_f E^{-1} V_y^{-1} \quad (5)$$

If w_f is 1, V_y is V_f/E , and E_E is -1 . That is, if all horses were purchased for overseas activities (and there are no substitutes for American thoroughbreds), the elasticity of V_y with respect to E would be -1.0 . If w_f is 0, V_y is V_d , and E_E is 0. That is, if all horses were purchased for domestic activities, the elasticity of V_y with respect to E would be 0. If arbitrage equates thoroughbred prices between the U.S. and international markets,

$$\frac{V_f}{E} \sim V_y \quad \text{then} \quad E_E \sim -W_f \cdot$$

Since many horses are purchased for U.S. activity, the elasticity should fall between 0 and -1 .

Model Specification and Data

The model is fitted with data from 1979 to 1990. The price data were collected from Keeneland and Saratoga summer yearling sales (The Blood-Horse). Data from each individual horse transaction were placed into quartiles based on price, and the median price from each quartile was used as the dependent variable to eliminate phenotypic variation². Thus, there are four observations per year. The data on purse rate came from Keeneland and were for the average per race in their spring and fall meets.

Data for the exchange rate were obtained from the Citibank Data Base. Data on the interest rate were for intermediate loans from the Louisville Farm Credit Services office. The exchange rate for

each year was weighted by the proportion of sales accounted for by each country. These countries, in order of importance, are: England, Ireland, Canada, France and Japan. The sales to international customers were obtained from a data base kept by Keeneland (the purses are from Keeneland races). The exchange rate is trade-weighted with 1982 as the base³.

A dummy variable was used to identify the years after the passage of the 1986 Tax Reform Act. Another set of dummy variables identified the quartile of the observation. Data on breeding prices were not available.

Equation (4) cannot be transformed into a functional form which can be estimated econometrically. Instead equations (1-4) were used to identify the relevant right-hand-side variables. For estimation purposes, the model was specified in logarithmic form, which allows each right-hand-side variable to have a constant elasticity. The model, omitting dummy variables for the quartiles, is:

$$\ln P_y = b_0 + b_1 \ln i + b_2 \ln E + b_4 \ln P_{rate} + b_6 T + u \tag{6}$$

Where:

- P_y = yearling price,
- i = nominal interest rate,
- E = exchange rate,
- P_{rate} = purse rate for thoroughbred races,

- T = a variable measuring tax laws,
- u = error term.

The resulting regression model is a series of cross-sectional observations over time. Each yearling is sold only once, so there is only one time-series observation for an individual cross-sectional unit.

Results

Two estimates are obtained from the data - one for Keeneland and one for Saratoga. Separate parameter estimates for the two sales allow an analysis of differential variable effects that may prevail for Keeneland and Saratoga. Because the model is fitted in double logarithmic form, all estimates are elasticities except for the coefficient on dummy variables (e.g., T). The dummy variable coefficients are elasticities if evaluated where the dummy variable is unity.

The results of both analyses are reported in table 1. The Durbin-Watson statistic is 2.24 for the top quartile, indicating that autocorrelation is not a problem. All signs of the estimates conform to theoretical expectations (except the coefficient for the interest rate in the Keeneland model) and most slope estimates are significantly different from zero at the 10 percent level. Both models explain over 96 percent of the variation in thoroughbred prices.

Table 1. Coefficient Estimates for the Yearling Price Model for Keeneland and Saratoga

	Intercept	P_{rate}	E	i	T	D_1	D_2	D_3	R^2
Keeneland									
Coefficient	-.776**	1.28**	-1.75***	0.031*	-0.29***	-1.39***	-.92***	-.50***	.97
Standard Error	3.51	0.33	0.46	0.017*	0.09	.05	.05		
Saratoga									
Coefficient	-3.71	0.88*	-1.29**	-0.007	-0.17*	-1.43***	-.97***	-.53***	.96
Standard Error	3.93	0.36	0.48	0.024	0.09	.05	.05	.05	

One asterisk implies significance at the 10 percent level; two implies significance at the 5 percent level; three implies significance at the 1 percent level.

Keeneland

All coefficients for Keeneland data are significantly different from zero at the 10 percent level. The purse rate is an important determinant of yearling prices during the observation period. In the Keeneland model, a one percent increase in the purse rate increases yearling prices by 1.28 percent, though this coefficient estimate is not significantly different than unity. This sensitivity to purse rate changes could be capturing the expectation of future purse rate increases over time. Not only will a one percent increase in this year's purse rate affect yearling prices directly, but buyers might view this as an indication that purse rates will increase in the future.

The weighted exchange rate coefficient is -1.75, which is outside the expected range for the coefficient (though the coefficient is not significantly different from -1.0 at the 10 percent level). The magnitude of this coefficient shows the importance of foreigners in the pricing of yearling thoroughbreds -- essentially price trends are set by the foreign demand for yearlings. It is possible that the market overreacts to exchange rate changes because the demand by international buyers is so important in the higher-priced yearlings, which set the tone for the auction sales. A time-series approach could detect such an overreaction.

Yearling prices at Keeneland are less responsive to the interest rate than to other variables. The coefficient for the interest rate is actually positive and significantly different from zero at the 10 percent level. The interest rate variable may be picking up variation associated with an omitted variable which is positively linked to prices (e.g., international yearling supplies and inflation). Attempts to incorporate some of those other variables (particularly income and the foal crop size) into the regression model result in a negative relationship between thoroughbred prices and interest rates, but resulted in unexpected signs on other coefficients (particularly the impact of purse rates on thoroughbred prices). Obviously, the independent variables are correlated in some of these other models. Further, the intermediate term loan from the Farm Credit System (FCS) is much less volatile than many interest rates, such as government bonds. During 1990, the FCS

intermediate rate was still at 11.16 percent versus a three-month treasury bill interest rate at 7.50 percent. Thus, the FCS interest rate may not be picking up the true opportunity costs of funds. It is difficult to determine which interest rate is most relevant to the thoroughbred industry.

The dummy variable (which identifies years when the 1986 Tax Reform Act was in force) has a coefficient of -0.29, which means that the tax law resulted in a 29 percent reduction in yearling prices in 1986 (using 1986 values as a base). Obviously, the passage of that Act was a crushing blow to the industry. The elimination of tax shelters and non-taxable investment as "passive activities" have contributed substantially to the decline in the industry.

Saratoga

All coefficients for the Saratoga model have the expected signs, but all coefficients have lower *t*-values than for Keeneland. The absolute value of all coefficients are lower for Saratoga, implying that yearling prices tend to be less volatile. The quartile dummy variables explain more of the variation for the Saratoga observations.

The effect of increases in the purse rate is slightly smaller for the Saratoga model than the Keeneland model, but still increased purse rates have a large impact on thoroughbred prices. A one percent increase in the purse rate will increase Saratoga yearling prices by 0.88 percent. This coefficient estimate is significantly different from zero at the 10 percent level, but not significantly different from one.

The weighted exchange rate coefficient is smaller in absolute value for Saratoga than for Keeneland, -1.29 versus -1.75, but still outside the expected range (though, again, the -1.29 coefficient is not significantly different from -1.0). Foreign buyers are also quite important for the Saratoga sales. The larger magnitude in the Keeneland model is consistent with observations made by prominent industry members that there are more foreign buyers of yearlings at Keeneland than at Saratoga. However, both models are extremely sensitive to exchange rate changes.

The interest rate coefficient for Saratoga sales was negative, but not significantly different from zero at the 10 percent level. A one percent increase in the interest rate will only decrease yearling prices by .007 percent. The dummy variable for the Tax Reform Act of 1986 has a parameter estimate of -0.17 which is significant at the 10 percent level, implying that Saratoga yearling prices fell 17 percent due to the tax change -- almost ten percentage points lower than the effect on Keeneland prices.

Apportioning Changes to Exogenous Variables

Table 2 indicates the change in yearling prices for the highest-priced quartile at Keeneland between 1980 and 1984, and 1984 and 1990 into changes due to the four exogenous variables -- the purse rate, exchange rate, interest rate, and change in the tax laws⁴. Between 1980 and 1984, two relevant exogenous variables moved to increase yearling prices, while one (the interest rate) moved slightly to decrease yearling prices. The two effects dominated the one, with the stronger positive impact coming from the exchange rate depreciation. The total increase in median yearling prices between those early years was \$412,000 (or 154 percent), with the purse rate accounting for \$168,000 (or 41 percent of the change) and the exchange rate accounting for \$248,000 (or 60 percent of the change). The sum of the exchange rate and purse rate effect was greater than 100 percent because the interest rate moved slightly to reduce thoroughbred prices.

Table 2 shows that the tax law change in 1986 was a major negative factor influencing yearling prices, though the exchange rate also had a large negative impact. The 1986 tax change alone caused yearling prices to fall \$185,000 (or 27 percent). The exchange rate appreciation caused

prices to fall by \$135,000 (or 20 percent), while interest rate changes helped yearling prices fall by \$27,000 (or 4 percent).

Conclusion

The estimates for Keeneland and Saratoga provide evidence that macroeconomic factors, exchange rate and tax law changes, have significantly influenced the thoroughbred industry. A major factor which helped yearling prices increase in the early 1980s (the exchange rate) turned against the yearling market in the late 1980s. Another serious price-reducing event was the tax law change.

Phenotypic factors notwithstanding, the effects of these macroeconomic variables imply that the thoroughbred industry is influenced by monetary and fiscal policies. A weak dollar relative to currencies of leading buyers, lead to higher yearling prices. Higher levels of interest rate (for the Saratoga market) and the Tax Reform Act of 1986 have also had a negative effect on the industry. The Tax Reform Act of 1986, in particular, had a drastic negative effect on the industry. The tax law could be changed through future actions and there are moves to increase purse rates through state programs, but it appears that the thoroughbred industry will probably have to rely on a major dollar depreciation to turn yearling prices around.

The effect of the exchange rate on the thoroughbred industry enhances our understanding of its effect on a specific commodity or product. The yearling market presents a unique opportunity to study the impacts of an exchange rate change because of the obvious presence of foreign buyers at the auction. If a product relies heavily on foreign markets, the exchange rate can play a major role in product demand and price.

Table 2. Apportioned Change in Yearling Prices, Highest Quartile, 1980-84 and 1984-90, in Thousands of Dollars

Year	Total Effect ^a	Purse Rate	Exchange Rate	Interest Rate	Tax Change
1980 to 1984	\$412	\$168	\$248	-\$4	--
1984 to 1990	-\$209	\$137	-\$135	-\$27	-\$185

^aThe total effect measures the total predicted change in yearling prices by the model for the highest quartile horses. The purse rate, exchange rate, interest rate and tax change effects measure the predicted change in yearling prices from changes in those variables, respectively.

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Footnotes

¹ All thoroughbreds become yearlings on the first January 1 after they are foaled. Each thoroughbred has January 1 as its official birthday.

² Using quartiles increases the degrees of freedom (number of observations) available for analysis. An analysis of the top quartile alone doesn't have enough error degrees of freedom. The median price within a quartile will reduce the impact of phenotypic factors because variation among the high-priced horses associated with very specific sires will be eliminated. Some argue that yearling prices have fallen recently because there are no longer yearlings sired by Northern Dancer and Nijinsky II. This type of effect is reduced by using the median price.

³ The exchange rate index for each year is calculated using the following formula:

$$\sum_{i=1}^5 \frac{E_i}{E_0} W_i$$

where i is a country subscript, E_0 is the exchange rate in 1982 (the base year) and W_i is the weight of that country's exchange rate for the index. An indexing form is needed because the units of E_i vary by country. The weights for each year are determined by the percentage of yearlings purchased by the five leading thoroughbred importing countries.

⁴ 1984 is chosen for comparison because it is the year that thoroughbred prices peaked. Price changes for the other quartiles would be smaller absolute changes, but the relative effects of macroeconomic variables would be identical.