Quadratic functions fulfilling an additional condition along hyperbolas or the unit circle

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Let S_1 denote the set of all pairs (x, y) of real numbers that fulfill the condition $x^2 - y^2 = 1$, and S_2 denote the set of all pairs (x, y) of real numbers that fulfill the condition $x^2 + y^2 = 1$.
In this talk we consider quadratic real functions f that satisfy the additional equation

$$y^2 f(x) = x^2 f(y)$$

under the condition $(x, y) \in S_j$ $(j = 1, 2)$.
We prove that each of these conditions implies $f(x) = f(1)x^2$ for all $x \in \mathbb{R}$.