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Stability and periodic solutions for a price model with delay

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We consider the delay differential equation:

$$x'(t) = a\left[x(t) - x(t-1)\right] - |x(t-\tau)|\, x(t-\tau), \tag{1}$$

with $a > 0$, $\tau > 0$. This is a modification of a model for exchange rates introduced by Brunovský, Erdélyi, Walther (2004) with $\tau = 0$. If $a \in (0,1)$ and $\tau = 0$ then $x = 0$ is globally attracting (Balázs, Krisztin, 2019). If $a > 1$ and $\tau = 0$ then there is a stable slowly oscillating periodic solution (Brunovský, Erdélyi, Walther, 2004).

If $\tau = \frac{1}{4n}$ for some $n \in \mathbb{N}$ then equation (1) has a $\frac{1}{n}$-periodic solution and global attractivity of $x = 0$ is not satisfied. We estimate the region of attraction

$$A(a,\tau) = \{\varphi \in C([-1,0],\mathbb{R}) :\ x^{\varphi}(t) \to 0 \text{ as } t \to \infty\}$$

of 0 in case $a \in (0,1)$, and show that $A(a,\tau)$ approaches $A(a,0) = C([-1,0],\mathbb{R})$ as $\tau \to 0^{+}$. Joint work with Tibor Krisztin.