Abstract. Let Γ be a torsion-free cocompact lattice in $\mathrm{Aut}(\mathcal{T}_1) \times \mathrm{Aut}(\mathcal{T}_2)$, where $\mathcal{T}_1$, $\mathcal{T}_2$ are trees whose vertices all have degree at least three. The group $H_2(\Gamma, \mathbb{Z})$ is determined explicitly in terms of an associated 2-dimensional tiling system. It follows that under appropriate conditions the crossed product C^*-algebra $\mathcal{A}$ associated with the action of Γ on the boundary of $\mathcal{T}_1 \times \mathcal{T}_2$ satisfies $\operatorname{rank} K_0(\mathcal{A}) = 2 \cdot \operatorname{rank} H_2(\Gamma, \mathbb{Z})$.