On the existence of invariant Gibbs measure and balanced shifts

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It is well known that if f is a Hölder continuous function from a mixing shift of finite type X to $\mathbb{R}$, then there exists a unique equilibrium state which is a Gibbs measure for the potential f. Recently, Baker and Ghenciu showed that there exists a (non-invariant) Gibbs measures for the potential 0 if and only if X is (right-)balanced. By defining f-balancedness condition, we extend this result and show that there exists an invariant Gibbs measures on X for the real-valued continuous potential f if and only if X is bi-balanced with respect to f. Using this result, we construct a class of subshifts which have a Gibbs measure but do not have invariant Gibbs measures for the potential 0, answering a question raised by Baker and Ghenciu.