We consider the orbital effect of an in-plane magnetic field on electrons in bilayer graphene, deriving linear-in- field contributions to the low-energy Hamiltonian arising from the presence of either skew interlayer coupling or interlayer potential asymmetry, the latter being tunable by an external metallic gate. To illustrate the relevance of such terms, we consider the ratchet effect in which a dc current results from the application of an alternating electric field in the presence of an in-plane magnetic field and inversion-symmetry breaking. By comparison with recent experimental observations in monolayer graphene [C. Drexler et al, Nature Nanotech. 8, 104 (2013)], we estimate that the effect in bilayer graphene can be two orders of magnitude greater than that in monolayer, illustrating that the bilayer is an ideal material for the realization of optoelectronic effects that rely on inversion-symmetry breaking.