Nondegenerate bilinear forms

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Let V, W be finite dimensional vector spaces. Suppose $B : V \times W \to F$ is a bilinear form, which is non-degenerate in its left argument. That is, if $B(v, w) = 0$ for all $w \in W$, then $v = 0$.

Define $R : V \to W^*$ by $R(v)(w) = B(v, w)$. Then R is injective, since