$$\sum_a v'_a = \sum_a \sum_b P_{ab} v_b = \sum_b v_b \sum_a P_{ab} = \sum_b v_b = 1 + \frac{1}{2}$$

Consider the system with Hamiltonian

$$\hat{H} = -\frac{\omega_0}{2}\hat{\sigma}_z + \omega_1 \cos(\omega t)\hat{\sigma}_x$$

$$e^{-i\omega t/2}\alpha(t) = \cos\left(\frac{\Omega t}{2}\right) - i\frac{\Delta}{\Omega}\sin\left(\frac{\Omega t}{2}\right),$$
$$e^{i\omega t/2}\beta(t) = -i\frac{\omega_1}{\Omega}\sin\left(\frac{\Omega t}{2}\right),$$

$$|\psi\rangle = \alpha(t)\,|0\rangle + \beta(t)\,|1\rangle$$

$$e^{i\omega t/2}\beta(t) = -i\frac{\omega_1}{\Omega}\sin\left(\frac{\Omega t}{2}\right)$$