abstract We explore the connection between halo concentration and the dark matter power spectrum using the halo model. We fit halo model parameters to non-linear power spectra over a large range of cosmological models. We find that the non-linear evolution of the power spectrum generically prefers the concentration at non-linear mass scale to decrease with the effective slope of the linear power spectrum, in agreement with the direct analysis of the halo structure in different cosmological models. Using these analyses, we compute the predictions for non-linear power spectrum beyond the current resolution of N-body simulations. We find that the halo model predictions are generically below the analytical non-linear models, suggesting that the latter may overestimate the amount of power on small scales.