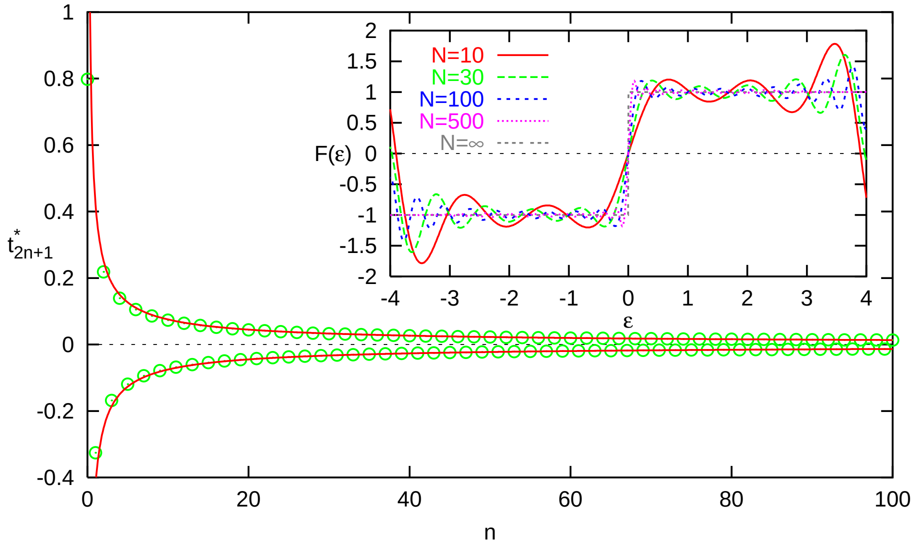

Figure 2.15: Hopping matrix elements corresponding to a flat DOS as given by (2.65). Solid lines: asymptotic form (2.67). Inset: transformation function as obtained from the truncated series with $D \le D_{\max} = 2N + 1$.

2.4 Redefinition of the Bethe Lattice

In this section, we will apply the new formalism developed in Sec. 2.3 to the Bethe semi-elliptic DOS as given by (2.24) in order to determine a corresponding tight-binding Hamiltonian defined on the hypercubic lattice with the same local properties as the Bethe lattice (with NN hopping) in the limit $d \to \infty$. For the purpose of DMFT calculations, we can regard the new model as a redefinition of the Bethe lattice, since all properties which could rigorously be defined and calculated on the original Bethe tree are unaffected. In addition, properties which are not well-defined on the Bethe lattice such as transport properties are well-defined for the new model which has the full hypercubic symmetry.[25] Furthermore, these transport properties can be computed analogously to the hypercubic case which is the only case for which rigorous derivations have been previously published.

In the following, we will first derive and briefly characterize the new model Hamiltonian with semi-elliptic DOS and then discuss the behavior of the Fermi velocity in this model, a central result of this section. This will enable us to compute the corresponding optical conductivity in Sec. 4.4. Having demonstrated the usefulness of our approach, we will critically review possible shortcomings by studying the effects of truncation of the hopping range and of finite dimensionality in the context of its application to the Bethe DOS. The application of the method to the asymmetric model DOS (2.27) will illustrate the effects of asymmetry and allow us to make

[25] We note that in a simpler general scheme, transport properties can be defined and computed for arbitrary lattice models in $d = \infty$ when these are periodically stacked in one extra dimension (see Sec. 4.4). This procedure, however, leads to a highly anisotropic model.