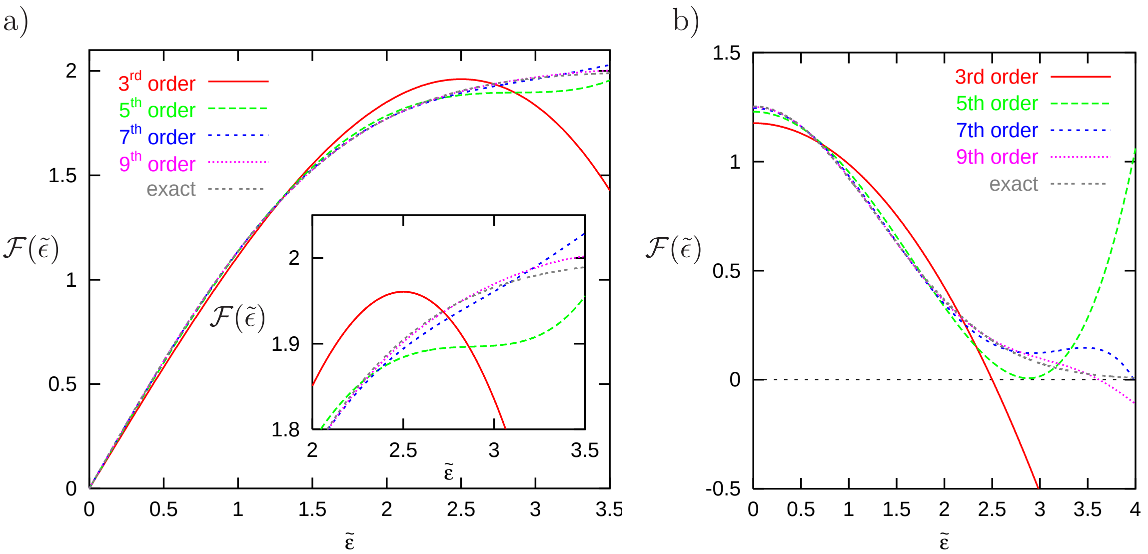

Figure 2.18: a) Transformation function $\epsilon = \mathcal{F}(\tilde{\epsilon})$ for the semi-elliptic Bethe DOS: approximations obtained by truncation of the hopping range in (2.52) to 3^{rd}, 5^{th}, 7^{th}, and 9^{th} neighbors (rescaled to unit variance) in comparison with the exact function. **b)** Derivative $\mathcal{F}'(\tilde{\epsilon})$; its zeros lead to singularities in the corresponding DOSs.

(Chung and Freericks, 1998*a*). Evidently, our result deviates even more strongly from a constant (having zero slope at the edges) than Freericks' form. The most important difference, however, is that our approach identifies (for the first time) a model with semi-elliptic DOS for which all transport properties are well-defined. Therefore, we can use DMFT calculations performed for a semi-elliptic DOS for the computation of an isotropic optical conductivity in chapter 4 without ignoring the energy dependence of $\langle|\boldsymbol{v_k}|^2\rangle(\epsilon)$ or resorting to heuristic approaches.

2.4.2 Truncating the Hopping Range

By construction, the DOS of our tight-binding model is exactly semi-elliptic when all hopping matrix elements are taken into account, i.e., when the full series (2.52) contributes to the dispersion. Since the limit of an infinite hopping range implies infinite dimensionality (cf. footnote 5 on page 30) we cannot directly study the effect of finite dimensionality on the full model. Instead, we will first discuss the effects of a truncated hopping range in $d = \infty$ before we present the DOS of a truncated model, evaluated in finite dimensions.

Figure 2.18 a shows approximations to the transformation function $\epsilon = \mathcal{F}(\tilde{\epsilon})$ in comparison with the exact form. The finite-order approximations represent truncations of (2.52) with $D \leq D_{\max}$ in which the hopping matrix elements, obtained from application of (2.55) to the numerically exact transformation function, have been rescaled to $\sum_{D=1}^{D_{\max}} |t_D^*|^2 = 1$. Since the effect of the transformation function $\mathcal{F}$ on the level of the DOS is to just shift the energy levels away from their position in the NN-hopping hypercubic case and since there is only exponentially small weight in