The covariation method for estimating the parameters of the Dynamic Energy Budget (DEB) theory provides a single-step method of accessing all the core DEB parameters from commonly available empirical data. In this study, we assess the robustness of this parameter estimation procedure and analyse the role of pseudo-data using elasticity coefficients. In particular, we compare the performance of Maximum Likelihood (ML) vs. Weighted Least Squares (WLS) approaches and find that the two approaches tend to converge in performance as the number of uni-variate data sets increases, but that WLS is more robust when data sets comprise single points (zero-variate data). The efficiency of the approach is shown to be high, and the prior parameter estimates (pseudo-data) have very little influence if the real data contain information about the parameter values. For instance, the effects of the pseudo-value for the allocation fraction $\kappa$ is reduced when there is information for both growth and reproduction, that for the energy conductance is reduced when information on age at birth and puberty is given, and the effects of the pseudo-value for the maturity maintenance rate coefficient are insignificant. The estimation of some parameters (e.g., the zoom factor and the shape coefficient) requires little information, while that of others (e.g., maturity maintenance rate, puberty threshold and reproduction efficiency) require data at several food levels. The generality of the standard DEB model, in combination with the estimation of all of its parameters, allows comparison of species on the basis of parameter values. We discuss a number of preliminary patterns emerging from the present collection of parameter estimates across a wide variety of taxa. We make the observation that the estimated value of the fraction $\kappa$ of mobilised reserve that is allocated to soma is far away from the value that maximizes reproduction. We recognise this as the reason why two very different parameter sets must exist that fit most data set reasonably well, and give arguments why, in most cases, the set with the large value of $\kappa$ should be preferred. The continued development of a parameter database through the estimation procedures described here will provide a strong basis for understanding evolutionary patterns in metabolic organisation across the diversity of life.