hypotheses regarding the deterministic terms. These tests are obvious choices because the ML estimators and, hence, the corresponding maxima of the likelihood functions are easy to compute for various different deterministic terms (see Section 7.2.4).

Apart from dummy variables, a linear trend

$$\mu_0 + \mu_1 t \tag{8.2.20}$$

is the most general deterministic term considered in the foregoing. A possible pair of hypotheses of interest related to this term when $\mu_1 \neq 0$ is

$$H_0 : \beta' \mu_1 = 0 \quad \text{versus} \quad H_1 : \beta' \mu_1 \neq 0. \tag{8.2.21}$$

Hence, there is a deterministic linear trend in the variables and the test checks whether the trend is orthogonal to the cointegration relations. In other words, the test checks the model (8.2.14) against (8.2.16). The corresponding LR test has a standard χ^2 limiting distribution under the null hypothesis, as we have seen in Section 7.2.4. If the underlying VECM has cointegrating rank r and, thus, β is a $(K \times r)$ matrix, r zero restrictions are specified in H_0. Therefore we have r degrees of freedom, that is, the LR test statistic has an asymptotic $\chi^2(r)$-distribution.

Another pair of hypotheses of interest is

$$H_0 : \mu_1 = 0 \quad \text{versus} \quad H_1 : \mu_1 \neq 0, \beta' \mu_1 = 0. \tag{8.2.22}$$

In this case, a model with an unrestricted intercept, (8.2.16), is tested against one where no linear trend is present and, thus, the constant can be absorbed into the cointegration relations as in (8.2.11). Again, the LR test has standard asymptotic properties, that is, for a VECM of dimension K and with cointegration rank r, it has a $\chi^2(K - r)$ limiting distribution.

If these tests are used for deciding on the deterministic term in a VECM, it may be worth keeping in mind that they introduce additional uncertainty into the modelling procedure. The tests are performed for a model with a specific cointegrating rank. Thus, ideally the cointegrating rank has to be determined before the deterministic terms are tested, whereas one motivation for them was that cointegrating rank tests may have better power if the deterministic term is specified properly. Thus, the tests present only a partial solution to the problem. Proceeding as in the example and checking the robustness of the rank tests with respect to different specifications of the deterministic terms is a useful strategy.

8.2.9 Other Approaches to Testing for the Cointegrating Rank

The literature on cointegration rank tests has grown rapidly in recent years. Many related issues have been discussed and investigated. Examples are non-normal processes (Lucas (1997, 1998), Boswijk & Lucas (2002), Caner (1998)),