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„Trade Imbalances in the European Monetary Union. An Analysis of the Demand for Intra- and Extra-European Imports and Exports with Special Focus on Austria and the Netherlands."

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1 Introduction

Despite the worldwide economic downturn in the course of the world economic crisis, with the exception of the time period between 2008-2009, the total trade volume of the European Monetary Union (EMU) has been constantly growing since its creation in 1998. However, while some EMU-member countries were the driving forces behind this constant growth of total trade, others contributed little to these developments. While the imports and exports of the economically stronger countries (for example France, Germany, Italy, Spain, the Netherlands and Austria) increased significantly, that of the economically weaker countries (for example Greece or Portugal) or of those countries which joined the EMU later (Slovenia, Slovakia, Cyprus or Malta) lagged far behind.
Which are the causes of these imbalances and huge divergences in the external sectors of the EMU-countries? The answer to this question can be found by looking on the demand-side of imports and exports. Finding the driving factors of the demand for imports and exports of all 17 EMU-member countries is the starting point of a large-scale analysis, conducted by the Macroeconomic Policy Institute (IMK, in Dsseldorf). Thereby, the demand for intra- and extra-EMU imports and exports is analyzed separately.
In my thesis, I want to examine the causes of these trade imbalances among the EMU-countries, in particular from the perspective of Austria and the Netherlands. Therefore, I will analyze the determinants of intra- and extra-EMU import and export demand for Austria and the Netherlands. Thus, the thesis is thus only a fractional contribution to the large-scale project of the IMK.
For the analysis, I will in particular look at the two main demand factors of import and export demand, namely prices and income. To asess the price and income effects empirically, I estimate import and export demand models for Austrian and Dutch intra- and extra-EMU trade separately. With this analysis, I want to learn more about the price competitiveness and responsiveness of import and export demand. In addition, I want find out which income factors, be it industrial production or private consumption, are the driving forces behind the demand for Austrian and Dutch imports and exports. Knowing more about these two main demand factors of demand for the entire EMU could help a lot to solve the puzzle finding the causes for the huge divergences in the external sectors of all EMU-countries.

The number of empirical studies analyzing the export and import demand of the EMU-area, or of a group of EMU member countries, is rather scarce. In most of these studies, *total* EMU exports and imports are used for the estimation of EMU-import and -export demand, without discriminating between intra-and extra-EMU trade. Often, only the demand for (intra- and/or extra-EMU) exports, and not for imports, is estimated and only

the biggest EMU-countries are used in order to approximate the entire EMU-area. No attempt has been done so far to analyze the export and/or import demand of the (biggest) EMU-countries separately.

Despite the rather small number of empirical studies analyzing the export and - import demand of the EMU, the list of studies introduced in this section is not exhaustive[1]. Most of these empirical studies use price and and income variables for the estimation of import and/or export demand. Their results are rather inconclusive. Some of these studies find significant effects of these variables, in particular of the price variables. While other studies do not produce significant results, or even lead to contradicting findings. In addition, there seems to be empirical evidence that other factors besides prices and income have an significant effect on export (and thus also on import) demand. All in all, no explicit conclusion of the effect of prices and income on the demand for (intra- and/or extra-) EMU imports or exports can be drawn. Since the creation of the EMU, no large-scale study has analyzed the import and export demand of all or at least the majority of all member countries.

In a comparative analysis conducted by the Banco de Espana (2003), the determinants of export demand for manufactured goods of the EMU-countries and the causes of the divergences in the external sectors within the EMU-area countries are examined. In addition, the responsiveness of EMU-export demand should be tested with respect to these determinants. Thereby, usual price and income measures are used as determinants to conduct this sensitivity test. The results of the study show, that the explanatory variables used for the estimation of export demand do not satisfactorily explain the differences in export growth. Thus, no conclusion about the price or income responsiveness of exports can be made. This result is in line with that of a later study conducted by Allard et al. (2005). They find that traditional factors used for the estimation of import and export demand, namely price and income variables, go a long way in explaining differences in the external sector performances of the biggest EMU-countries. On the contrary, di Mauro and Maurin (2005) find that world demand, used as income variable, is an important factor to explain the export growth of the biggest EMU-countries. In addition, they find a significant effect of the price variables used for the estimation of EMU-trade. Their results show that the EMU-area can be divided into a group of countries which profited from the introduction of the Euro, and the associated depreciation of their product prices (increased price competitiveness), and a group of countries which lost competitiveness, due to an appreciation of their product prices relative to the time before the introduction of the Euro (decreased price competitiveness).

A different study conducted by Anderton et al. (2005) analyzes the effect of price and

[1]No claim for the completeness of the list of empirical studies analyzing the export and import demand of the EMU-area introduced here is made.

income variables on intra- and extra-EMU imports. They find significant substitution effects between intra- and extra-EMU imports due to changes in their relative prices and thus confirm the explanatory power of the price variables[2].

Ca'Zorzi and Schnatz (2007) compare different price measures, trying to find which of these measures explains the intra- and extra-EMU export demand (for the EMU-aggregate) best and helps to forecast the export developments of the EMU-area. They find that no indicator outperforms the others in terms of explaining and forecasting aggregate EMU-exports. On the contrary, Bayoumi, Harmsen and Turunen (2011) discover that there is a significant difference in the performance of the relative price measures used for the estimation of EMU import and export demand. They analyze the price competitiveness of the EMU-area and find that there are wide divergences between the different relative price measures used in their study. Even if the price data indicates a steady loss in intra- (and extra-) Euro-area competitiveness, the pace of deterioration depends on the kind of measure of relative prices used[3].

In her analysis of external sector for the Euro Area and its major competitors, Aligieri (2011) quantifies key determinants of trade to export volume behaviour, i.e. export demand. In search of alternative explanatory variables, in addition to the traditionally used price and income variables, she accounts for unobserved components by adding a time-varying trend, in order to capture underlying non-price competitiveness, in her export demand model. Her findings confirm that stochastic trends are present as a result of technical change and other exogenous factors driving export flows, and the that the failure to account for these trends will lead to biased estimates of the long-run price elasticities (Aligieri 2011)[4]. An overview of all empirical studies on the EMU-area can be found in table A.1, A.2 and A.3 in the appendix.

All these studies raise and answer a lot of different questions. However, to the best of my knowledge, none of these studies consistently examines the driving factors behind intra- and extra-EMU demand for the exports and imports for all 17 EMU-member countries at the same time. To close this gap and to analyze the import and export demand of all 17 EMU-countries is the goal of the project of the IMK. Being a part of the larger project of the IMK, the goal of the thesis is to close this gap for Austria and the Netherlands.

The remainder of the thesis is organized as follows. The second chapter deals with the

[2]Further, they also analyze the effects the exchange rate on intra- and extra-EMU trade. They find that exchange rate volatility decreases trade vis-à-vis regions characterized by volatility and leads to substitution of trade away from higher-volatility regions towards lower-volatility regions.

[3]And according to their second result, the long-term price elasticities for intra-Euro-area exports are at least double those for extra-EMU exports.

[4]Two other short studies of the export and import demand of the EMU-area countries are part of bigger economic reports, and thus only by-products of bigger projects. In the course of estimating a new model of the OECD, Hervé et al. (2010) estimate the export and import demand of the EMU-area. The second short study is part of a monthly report conducted by the Deutsche Bundesbank (2011). These results can be found in table A.1, A.2, A.3.

theoretical questions of modeling import and export demand. In the first subsection of this chapter, the general literature on import and export demand will be introduced and the theoretical framework of import and export demand, as well as some details of the trade elasticities will explained. In the last subsection of the second chapter some further conceptual questions will be raised. The third chapter contains a descriptive analysis of Austrian and Dutch trade for the time period from 1990 to 2011. This chapter should help to understand the determintants of Austrian and Dutch import and export demand in more detail. In addition, some important questions, relevant for the empirical part of the thesis, will be raised. The fourth chapter contains the empirical part, and thus the core part, of the thesis. Besides the details of the data used for estimation, the empirical model specifications for import and export demand will be introduced in a first step. In a second step, the concepts, prerequisites and the necessary steps for the estimation process of import and export demand will be explained theoretically. Then, the results of these single steps, as well as the final results of the Austrian and Dutch import and export demand models will be presented. The thesis ends with the conclusion of the fifth chapter.

2 The Theoretical Background for the Estimation of Foreign Trade Flows

This chapter deals with the theory of estimating import and export demand. After a review of the general literature on the estimation of exports and imports, I will introduce the theoretical framework of import and export demand and some details concerning the demand elasticities of imports and exports. In the last part of this chapter, I will raise and answer some conceptional issues of modeling trade.

2.1 Literature

Not many subjects within international economics have attained so much interest like the estimation of foreign trade flows in the past decades. This is due to some obvious reasons. The theoretical framework is similar to that of the familiar consumer- and production theory. Further, the data needed for the estimation is easy-to-access and only a few variables are needed for the estimation of income and price elasticities, which are relevant for a wide range of macroeconomic policy issues (Goldstein and Khan, 1985:1042). The first empirical studies examining the determinants of the demand for imports and exports date back to the end-1930s, beginning of the 1940s. In the following decades, a multitude of studies investigated the effect of price and income components of the demand for imports and exports[5]. For a good overview of the earliest studies, see Leamer and Stern (1970), Magee (1975) and Stern et al. (1976); for the later studies, see Sawyer and Spinkle (1999), Marquez (2002) and Strauß (2004). Most of the early empirical studies used log-linear models for the estimation of imports and exports[6], assuming constant elasticities of the explanatory variables, namely income and price components[7]. This approach will be called the *traditional approach*[8] in the following. Among others, Harberger (1950), Orcutt (1950), Armington (1969), Houthakker and Magee (1969), Hooper (1976, 1978), Goldstein and Khan (1978,1985), Urbain (1995), Sawyer and Spinkle (1996), Clostermann (1996, 1998), Senhadji (1998), Senhadji and Montenegro (1998), Marquez (2002), Meurers (2003) and Strauß (2002, 2004) are noticeable works of the *traditional approach*. Burgess (1974 a, b) was the first who criticized the constant-elasticity models of the *traditional approach* and the associated theoretical and functional restrictions with regard to the estimated elasticities. Instead, he proposed using empirical models with more flexible

[5] By 1957, already 42 books and articles (at least) containing estimates of income and price elasticities of imports and exports were published.

[6] In a survey of empirical studies estimating import and export demand functions, Marquez (2002:31) finds that since the 1940s, more than two thirds of all examined studies employed the log-linear model.

[7] And thus, constant income- and price-elasticities.

[8] The classification of the *traditional and the theory-consistent approach*, which will be mentioned in the following, are taken from Stephan (2005:10 et seq.

functional forms than the constant-elasticity models of the *traditional approach*. Thereby, the theoretical factor demand is directly derived from a complex macroeconomic production function (as for example the translog production function), which is then used for the estimation of import or export demand. This way, the theoretical assumptions can be transformed in the empirical model and directly be tested in practice. These flexible functional forms have the advantage that the elasticities of production and substitution are determined "within the system". This way, varying price and production/income elasticities are allowed for and don't have to be restrained to certain values in advance, as in case of the models used by the *traditional approach* (Stephan, 2005:14). In addition, the price and income/production elasticities estimated with these flexible empirical models are more in accordance with the assumptions of the foreign trade theory. Thus, this approach will be called *theory-consistent approach* in the following. Besides Burgess (1974a, b), the studies of Parikh (1988), Lawrence (1989), Kohli (1985, 1990, 1991), Dreger and Schumacher (1999), Marquez and McNeilly (1988), Marquez (1994, 1999) are to be mentioned.

If however, one is willing to maintain specific assumptions about the structure of production and/or preferences, as needed for the models of the *traditional approach*, the associated elasticities are constant, unitary and known in advance (Marquez, 2002:11). A widely used[9] model specification of the *traditional approach* is the log-linear model, which assumes constant elasticities of the parameters (Marquez, 2002:31).

The *traditional approach* has been criticized that the functional form of the empirical models normally isn't derived from a specific utility or production function, but chosen independently of the theoretical assumptions. In the early 1970ies and 1980ies theory was considered little helpful to find an adequate functional form for the estimation of demand for imports or exports. Much more weight was given to the choice of an empirical model with the best data-fit. And the theoretical consistency of the estimated elasticities was less important than it was in case of the *theory-consistent approach*.

If at all, export or import demand in the *traditional approach* is derived from a production function, typically a Cobb-Douglas or Constant Elasticity of Substitution (CES) function, then the associated assumptions of constant elasticities on of the parameters are often too restrictive and cannot be met in practice. Often, the estimated elasticities lie significantly above the assumed values close to unity. Consequently, these restrictions on the parameters often cannot be met and are not considered in the estimation of imports and exports. As a result, the *traditional approach* has been criticized for not reflecting the assumptions of the foreign trade theory. And thus, the branch of literature following the *traditional approach* has often been accused to lack theoretical foundation (Stephan, 2005:13 et seq.).

[9] Marquez (2002:31 et seq.) searched 126 empirical studies reporting estimates of income and price effects of international trade and found that more than two-thirds of these studies use the log-linear model.

The researchers following the *traditional approach* often need the estimated elasticities for purposes such as political consulting and other near-term work. Therefore, it needs straightforward and easy-to-handle methods for the construction of the variables and the estimation process. Thereby, the choice of the best data-fitting model is more important than the estimated elasticities.

In contrast to the *traditional approach*, the objective of the *theory-consistent approach* is the accuracy and the consistency of the theoretical and the estimated substitution elasticities. However, there are no uniquely correct price or income/production elasticities. Instead, the scale of the elasticities depends on the underlying production technology or utility function[10] (Stephan, 2005: 15 et seq.). Thus, even if one manages to obtain estimated elasticities which are close to the theoretically assumed ones, this doesn't mean that the empirical model or the estimation method is superior to other estimation models or techniques.

On the contrary, Marquez (2002:13 et seq.) shows that the constant-elasticity models of the *traditional approach* produce more accurate results than the varying-elasticity models of the *theory-consistent approach*[11]. He finds a clear trade-off between the theoretical consistency of the varying-elasticities and the predictive accuracy of the constant-elasticity models. While the strength of the former is the accordance of the estimated and the theoretically assumed elasticities, the latter provides results with the lowest prediction error, i.e. fits the data best. In addition, the *traditional approach* has often been preferred to the *theory-consistent approach*, as the formulation of the variables is more straightforward and the data used for their construction is easier available. The estimation of models following the *theory-consistent approach* requires a lot of special data, which is difficult to obtain or often not available in practice[12].

For the purpose of the thesis, I follow the *traditional approach* and use a log-linear and thus constant-elasticity model for the estimation of import or export demand.

[10] For example, if import or export demand is derived from a linear homogeneous function, the income elasticity is one. For the price elasticities on the contrary, no assumptions can be made.

[11] Therefore, he compares the estimation results of a log-linear constant-elasticity model specification (of the *traditional approach*) with those of two varying-elasticities models in terms of their prediction error. Thereby, the log-linear model is the one with the lowest prediction error.

[12] One criticism of the *traditional* and the *theory-consistent approach* has been the use of aggregate trade data (Ketenzi and Uz, 2011:841). A third approach, raising this critisim, argues that the problem associated with the use of aggregate data is a so-called "aggregation bias". That is, if aggregate data is used for the estimation of export or import demand, a country's signifcant price elasticity with one trading partner could be (more than) offset by a insignificant one. Instead, the studies following this third approach use bilateral trade data for the estimation of income and price elasticities of export and import demand. This implies the use of a completely different functional form for the estimation of export and import demand than in case of the *traditional* and the *theory-consistent approach*. Therefore, this third approach will not be considered for the purpose of the thesis. For a good overview of studies following this approach, see (Ketenzi and Uz, 2011:840 et seq.).

2.2 Formulation of Import and Export Demand

After a short introduction of the basic import and export demand model, import demand will be formulated in terms of the *consumer-based* and the *producer-based approach*. In a last step, some details concerning the elasticities of import and export demand will be explained.

2.2.1 The Basic Model

The import demand model is a function of the relative prices of all import goods P_m^* and domestic prices P_m for the same goods, as well as an activity variable, which could be for example the income of a representative domestic household or the production (and thus income) of a representative domestic firm Y_d. All prices are expressed in terms of the domestic currency. Therefore, P_m^* is multiplied by the exchange rate e. The model can be formulated as follows:

$$IM_i = (\frac{P_m^* \cdot e}{P_d}, Y_d) \tag{1}$$

Thereby, imports depend negatively on the prices of all import goods and positively on the domestic prices for the same goods and the activity variable. Thus, an increase in the prices of all import goods decreases country i's demand for imports and increases the demand for the corresponding domestic goods, while an increase in the prices of the domestic goods increases country i's import demand. Similarly, an increase of the domestic income/production increases country i's import demand.

Like the import demand model, the export demand model is a function of foreign and domestic prices and of an activity variable. This time, the export price of all exports of country i is set into relation to the prices of the same goods of all other $n - 1 = j$ countries. The activity variable is either the income of a representative foreign household or production of a foreign firm. Again, all prices are expressed in terms of the domestic currency and thus P_x^* is multiplied by the exchange rate e. The model becomes:

$$EX_j = (\frac{P_d}{P_x^* \cdot e}, Y^*) \tag{2}$$

In the model, exports to country j depend negatively on the domestic export prices, and positively on the foreign price for the same goods and on the income/production abroad. This means that an increase in the domestic export prices reduces the demand for domestic exports abroad. And an increase in the foreign price for the equivalent goods, as well as an increase in the income/production abroad increases country j's demand for country i's exports. Implications and related problems resulting from the estimation of income and price elasticities will be discussed in the next but one subsection. In the next paragraph, I want to introduce a more extensive formulation of import demand.

2.2.2 Detailed Formulation of Import Demand

In this section, only import demand will be modeled explicitly. After the introduction of export demand in the previous section, it should be possible for the reader to reformulate the optimization problem presented in this part of the thesis in terms of export demand[13]. In the following, two different approaches to model import demand will be introduced. One approach takes the production decisions of a representative firm into consideration. Thus, imports are modeled in terms of intermediate products. The other approach focusses on the consumption decisions of a representative household, wherefore imports are modeled in terms of final products. The first will be called *producer-based approach* and the second *consumer-based approach* in the following.
For both approaches, it is assumed that imports and domestic products are imperfect substitutes and that the supply of imports is perfectly elastic. Further, it is assumed that the representative producer or consumer has no money illusion. That is, a doubling of the nominal value of output/income and all prices doesn't affect demand for imports. The formulation of both approaches, is taken from Marquez (2002:8 et seq.). The models in the empirical part of the thesis are either constructed in terms of the *producer-based* or the *consumer-based approach*.

The optimization problem of the firm in the *producer-based approach* can be solved in two different ways- either by cost minimization or by profit maximization. The firm tries to minimize costs and to sell the output at a profit maximizing price. Both ways to solve this dual optimization problem will be presented next.
To minimize costs, the firm must find the cost-minimizing mix between domestic and foreign inputs to attain a given level of output. The optimization problem can be formulated as:

$$C(p_m, p_d, q_y) \equiv \min_{q_m, q_d}\{f(q_m, q_d) = q_m \cdot p_m + \ q_d \cdot p_d, \ s.th. \ f(q_m, q_d) \geq q_y\} \tag{3}$$

where p_m is the price and q_m the quantity of imports, p_d is the price and q_d the quantity of domestic bundle of capital and labour, q_y is the level of production (total sales or gross output), and $f(\cdot)$ the production function. Thus, at prices p_m and p_d, the firm has to choose the optimal mix between the quantity of imports (q_m) and quantities of domestic factors of production (q_d) to attain a given output-level (q_y).
For the maximization problem on the contrary, the level of aggregate domestic factor endowments (q_d) is taken as given and the firm has to find the optimal mix between levels of production (q_y) and imports (q_m):

$$\pi(p_m, p_y, q_d) \equiv \max_{q_y, q_m}\{f(q_m|q_d) = q_y \cdot p_y + \ q_m \cdot p_m, \ s.th. \ f(q_m|q_d) \geq q_y\} \tag{4}$$

[13] A formulation of the empirical export demand model, can be found in the quantitative part of the thesis

here, $\pi(\cdot)$ is the profit function, p_y the output price and $q_y \cdot p_y + q_m \cdot p_m = p_d q_d$ denotes the nominal GNP.

Assuming that the production function, $f(\cdot)$, exhibits increasing returns to scale, the *cost minimizing demand for imports* (q_m) is homogeneous of degree one[14] in q_y and can be written as:

$$q_m = \frac{\partial[C(p_m, p_d) \cdot q_y]}{\partial p_m} = C_{p_m}(p_m, p_d) \cdot q_y \tag{2.5}$$

where $C_{p_m}(p_m, p_d) = \frac{\partial C(p_m, p_d)}{\partial p_m}$. An increase in the the price of all import goods (p_m) increases the costs of production and decreases the demand for imports. If q_y is interpret as income, the income elasticity of imports equals one. A similar result holds in case the optimization problem is formulated in terms of profit maximization. In case $f(\cdot)$ exhibits increasing returns to scale, the demand function for imports is homogeneous of degree one in q_d and can be written as:

$$q_m = \left(\frac{-\partial \pi(p_m, p_y)}{\partial p_m}\right) \cdot q_d \tag{2.6}$$

Interpreting q_d as income, the income elasticity is again equal to one. Here, an increase in the price of all import goods (p_m) decreases profits and the demand for imports. The results for the income elasticities can be sensitive to the chosen income measures, q_y in the cost minimization and q_d in the profit maximization problem.

Unlike the income elasticities, the price elasticities cannot be known in advance, since they depend on the share of nominal imports in gross nominal output ($\frac{q_m \cdot p_m}{q_y \cdot p_y}$) on one hand and the elasticity of substitution (σ) between imports and composite domestic factors on the other hand. In practice, the share of nominal imports in gross nominal output is often taken as given. Then, the price elasticity of imports (exports) is (σ). Often, the Cobb-Douglas production function is used for the specification of the production function $f(\cdot)$. This production function is homogeneous of degree one and thus $\sigma = 1$ is assumed to hold.

Although the Cobb-Douglas production function is widely used in theoretical and empirical works, some of its restrictions are not needed for the applied empirical work. Other, more flexible production functions, seem more appealing in theory. In practice however, the flexible-form production functions with varying elasticities are outperformed by those with constant elasticities, which are used by the imperfect substitutes stream of the literature.

In the *consumer-based approach* the representative household spends his money on domestic (q_d) or foreign products (q_m) in order to maximize his utility function $u(q_m, q_d)$

[14] Thus, by doubling all inputs the level of output q_y will be doubled too.

subject to a given nominal income (Y):

$$\max_{q_d, q_m} \; u(q_m, q_d) \;\; s.th \;\; u(q_m, q_d) = q_d \cdot p_d + \; q_m \cdot p_m \geq Y \tag{2.7}$$

Thereby, the linearity of the budget constraint implies the following relations between the income and price elasticities: (i) $-(\epsilon_{m,p_m} + \epsilon_{m,p_d}) = \eta_m$. That is, the own- price elasticity, $\epsilon_{m,p_m} = \frac{\partial ln q_m}{\partial ln p_m}$, and cross-price elasticity, $\epsilon_{m,p_d} = \frac{\partial ln q_m}{\partial ln p_d}$, of import demand must be equal to the income elasticity (η). And (ii) $w_m \eta_m + (1 - w_m)\, \eta_d = 1$, i.e. the weighted sum of income elasticities must equal one for that the linear budget constraint holds. Where $\eta_m = \frac{\partial ln q_m}{\partial ln Y}$ is the income elasticity of imports and $\eta_d = \frac{\partial ln q_d}{\partial ln Y}$ the income elasticity for the demanded quantity of domestic factors of production. Both are weighted by expenditure shares w_m. If the income elasticities are equal to each another, they are also equal to one. If both are not equally in size, then one must be greater, the other less than unity, for that their convex combination adds up to one. Marquez (2002:10 et seq.) provides the proof of Deaton and Muellbauer (1980 as cited by Marquez, 2002:10 et seq.) that *if the income elasticities are constant, then they must be equal to one for the budget constraint to hold*. They examine the consequences of theoretical re-allocations of purchases from one good to another, when income elasticities are not equal to one. They show that the reduction in spendings for one good does not match precisely the additional spending on the other good. This is only the case, if *all* income elasticities are equal to one. If however all income elasticities are equal to one (corresponding to homothetic preferences[15]), that is if the elasticities are constant, they are known and their estimation is superfluous (Marquez, 2002:11).

2.2.3 Trade Elasticities

The above optimization problem is formulated terms of the *traditional model*. It has become clear that if one is willing to keep the above mentioned assumptions about the structure of production and preferences, the related income and price elasticities are unitary (Marquez, 2002:11). In practice, most studies following the traditional approach employ a log-linear model specification, which implies constant and thus unitary, income and price elasticities for the estimation export and import demand. However, the results of many empirical studies do not confirm the assumption of unitary income and price

[15]We speak of a homothetic preference relation if the slope of the indifference curves stays constant along any ray from the origin. In other words, if the shares of the demanded commodities remain constant in case of an expansion of the budget constraint, then the preferences are said to be homothetic. A function representing such homothetic preferences, i.e. a homothetic function, is a monotonic transformation of a linearly homogeneous function that is homogenous of degree one- as for example the Cobb-Douglas production function. Thus, a homothetic utility function can always be rescaled to a linearly homogenous utility function without a change in consumer behaviour. And the assumption of homothetic preferences can be be identified by that of linear homogeneity (Shephard, 1953:41 et seq.)

elasticities. Goldstein and Khan (1985:1076 et seq.) compare the elasticities of about 14 empirical studies on import and export demand models. They draw two important conclusions concerning the long-run elasticities of export and import demand. First, the sum of the long-run (≥ two years) price elasticities for import and export demand exceeds *one* for industrial countries[16], ranging on average between -1.25 and -2.50. And thus, they "(...) play a powerful role in the demand for total imports and exports" (Goldstein and Khan, 1985:1076). And second, the income elasticity (and if production is interpret as income, also production elasticity) of a representative industrial country ranges between *one* and *two* for import and export demand.

Both conclusions of Goldstein and Khan (1985), that in practice, income and price elasticities aren't close to one, are also confirmed by the rather scarce pool of empirical studies on the EMU-area as aggregate, or Austria and/or the Netherlands separately, as it can be seen in table A.4 in the appendix. In some of the studies listed in table A.4 only the price or income elasticities of Austria, the Netherlands or the EMU-area are reported. Due to the scarcity of studies reporting elasticities for the EMU-area countries, I listed the results of studies even if they were available for just one of both countries, or the EMU-area.

Table A.4 summarizes the range of elasticities found by the 14 studies examined by Goldstein and Khan (1985), by a study of Bahmani-Oskooee and Niroomand (1998) and of Camarero and Tamarit (2003) for Austria and the Netherlands. The price and income elasticities found in all three studies exceed one, which isn't the case for the elasticities of the remaining studies.

Bayoumi, Harmsen and Turunen (2011) estimate price and income elasticities for the entire intra- and extra-EMU-area. In their study they compare the estimation results of different price measures based on unit labour costs, producer prices, etc. The estimated intra- and extra-EMU income elasticities, as well the income elasticities for the entire EMU-area, are above one. This is only the case for the extra-EMU price elasticities, the others are below one. Anderton et al. (2004) get slightly different results than Bayoumi, Harmsen and Turunen (2011) for the elasticities of extra-EMU trade. They find price elasticities of extra-EMU trade below one and an income elasticity of imports above one (income elasticity of exports below one). All results can be found in table A.4 and A.5.

All in all, the results of some empirical studies support the assumption of unitary income and price elasticities, others don't. The broad conclusion to keep in mind is that the assumption of unitary income and price elasticities has not been unanimously confirmed by the empirical literature and thus remains disputable. The conflicting results of the empirical literature can be due to (partially huge) data problems, such as different statistical variable-/data-definitions, missing data, outliers, etc.

[16]Thus, the Marshall-Lerner Condition, stating that the sum of export and import price elasticities must be greater than one for that a currency devaluation has a positive effect on the trade balance is confirmed in these cases.

2.3 Further Issues of Modeling Foreign Trade Flows

In the following subsections, some issues concerning the formulation and estimation of export and import demand will be raised and discussed.

2.3.1 Perfect or Imperfect Substitutes Model

The choice of an appropriate analytic framework and thus formulation of an adequate model depends, among other things, on the type of good being traded[17], on the end-use of the traded commodities, the institutional framework under which trade is being modeled, the end of the modeling exercise and on the availability of the data used for the estimation process. Two models, the imperfect and the perfect substitutes model, have dominated the empirical trade literature in the past. Both have been considered as oppositional, but should rather be treated as complements- one as framework for modeling trade of differentiated goods, the other for close (not perfect) substitutes. Both will be explained in more detail next (Goldstein and Khan, 1985:1044).

The main assumption of the imperfect substitutes model is that neither imports, nor exports are perfect substitutes for domestic goods. This assumption is supported by two arguments. First, if domestic and foreign goods were perfect substitutes and were produced at constant (or decreasing) costs, either the domestic or the foreign good would dominate the entire market. Then, a country would be either an exporter or importer of a traded good, but not both at the same time. This however is contradicting the fact that most countries are both importer and exporter of the same good, especially in times of increasing intra-industry trade. So that the perfect substitutes hypothesis can be rejected. Second, even at the most disaggregate level within and across countries, there is no empirical evidence for the basic assumption of the perfect substitutes model that there exists a ”law of one price” for the ”same” good. Instead, there are price differences for most goods within and across countries, except of goods traded at international commodity exchanges[18](Goldstein and Khan, 1985:1044 et seq.).

Although the imperfect substitutes model has been used in most empirical works on trade equations, according to Goldstein and Khan (1985:1050 et seq.), there are at least three reasons to examine the perfect substitutes model. First, there is no denial that certain ”standard”, i.e. homogeneous, commodities[19] exist. For these goods, the perfect substitutes model offers a framework where demand and supply doesn't depend on price differentials between domestic and foreign goods. Second, it could be that the empiri-

[17] If perfectly homogeneous primary commodities or highly differentiated manufactured goods are being traded.

[18] Such as for example wheat or cropper or other primary commodities. The validity of the law of one price is normally assumed rather than tested.

[19] As for example primary products traded at international commodity exchanges.

cally confirmed price differences stem from different and country specific methodologies to construct price statistics, which may understate the true degree of substitutability of the commodities. And third, the perfect substitutes framework may lead to a better understanding and insights about the price and income elasticities, which would remain unrevealed otherwise. However, as the imperfect substitutes model has become the mainstay of empirical work on trade equations (Goldstein and Khan, 1985:1050) and because I estimate import and export demand for manufactured goods and not primary commodities, I chose the imperfect substitutes framework for the purpose of the thesis.
In the next section, a further controversial point in the field of trade modeling, concerning the supply-side of exports, or imports, will be discussed.

2.3.2 An Upward Sloping Supply Curve?

In a two-country world, the export and import demand of both countries is symmetric. The import demand of country *i* is the export demand of country *j* and country *i*'s export demand is the import demand of country *j*. Further, the import demand of country *i* is equivalent to the export supply of country *j*. Thus, if we speak of demand or supply for exports or imports does not matter in a two-country world. Leaving the two-country model world for the *n*-country world, this symmetry between exports and imports disappears. Then, a countries exports face competition not only from domestic producers in the importing country, but also from exporters in other regions of the world (Goldstein and Khan, 1985: 1046 et seq.).
In a multi-country world, there are basically two ways to model trade. First, if one does not discriminate between export or import demand and supply, then the symmetry of the two-country world stays unchanged in the *n*-country world[20]. Second, if one does discriminate between export or import demand and supply, the symmetry of the two-country world cannot be sustained in a *n*-country world and thus must be re-formulated.
According to the first approach, it is assumed that the supply price elasticities of exports or imports of any country are infinitely elastic (horizontal supply curve; no interaction between prices and quantities) and prices are exogenous. Consequently, import or export supply always meets import or export demand and thus no difference has to be made between demand and supply. This corresponds to the case of perfect competition. Most empirical studies of the 1960ies, 70ies and early 1980ies modeled exports and imports in terms of this approach, until Goldstein and Khan (1978 and 1985) came up with their critique of the assumption of infinitely elastic supply price elasticities. While this assumption seems reasonable in case of formulating the world supply to a single country[21],

[20] Then, the only difference is that, instead of one country *j*, there is now a whole group of countries as trading partner of the importing and exporting country *i*.

[21] Then, one can assume that the world will always be able to meet the demand of a single country without any change in prices.

it does not seem logic in the opposite case, when a single country supplies exports to the world (Goldstein and Khan, 1978:275). In the first case, it is possible that an increase in the demand for exports can be satisfied without an increase in export prices, while it is not in the second. That is, the supply curve of exports is perfectly elastic with respect to price changes in the first case, but not in the second[22].

Taking the supply side of exports into consideration implies looking at the relative profitability of the exporting activity compared to the domestic market. Hence, the domestic prices enter the analysis. Then, an increase in the relative profitability of exporting will lead to an increase in exports. This increase in exports however is not as large as under the assumption of a perfectly elastic supply curve. Since exporters compete with domestic producers for a finite stock of factors of production and non-tradeable goods may be produced with different factor intensities, increasing export supply is costly and thus the supply curve is assumed to be relatively inelastic. This corresponds to the case of an upward-sloping supply curve, and it is claimed that the increase in exports depends on the strength of the increase in the export price (Strauß,2002:7 et seq.). If the price elasticities of export supply are inelastic (upward-sloping supply curve; interaction between prices and quantities), then prices can no longer be assumed exogenous and export prices and quantities should be either estimated in terms of other, exogenous variables of the system or in a full structural model to estimate export supply and demand simultaneously[23] (Goldstein and Khan, 1985:1048). In their study, Goldstein and Khan (1978) investigate the price responsiveness of export demand and export supply empirically. Their results support the hypothesis of an inelastic export supply curve. They find a significant simultaneous relationship between prices and quantities of exports, and that "(...) the demand-price elasticities for (aggregate) exports can be substantially different when export supply relationships are explicitly taken into account" (Goldstein and Khan, 1978:276).

In practice, the estimation of separate simultaneous equations for export supply and demand can be very complex and time-consuming. This may be one of the reasons why the first approach, where only export or import demand is modeled, has been favoured to the second one in the past. Also, because it allows to estimate export or import demand in the straightforward framework of a single equation error correction model (SEECM), leaving exact adjustment process of the (of demand and supply) system to the data (Strauß, 2004: 34). For the purpose of the thesis, I follow the first approach. That is, I model a country's import and export demand, assuming that export or import prices are exogenous and that supply is perfectly elastic.

[22] Meaning that is very unlikely that a single country can satisfy the entire increase in world demand.

[23] As it has been done by Goldstein and Khan (1978).

2.3.3 The Role of Globalization

As we have seen in the previous paragraph, the price and income elasticities of many empirical studies doesn't lie within the expected range between zero and one. Thereby, the price elasticity of imports or exports is more likely to lie within this range, while the income/production elasticity is often found to be substantially larger than one. Often, export and import demand is derived from a CES-production function, assuming unitary price and income/production elasticities. In this functional setting it could be assumed that all "other factors", which influenced exports or imports in the past, and cannot be explained by the price and income/production variables, could be the reason for price and income/production elasticities above one[24]. Arguing this way, the assumption of unitary price and income/production elasticities could be maintained and elasticities above one could be assigned to these unexplained factors.

Strauß (2004) finds different possible explanations for the elasticities above unity. According to Strauß (2004:29) an income/production elasticity of exports above one is a consequence of the fact that worldwide, exports have been growing faster than production since World War II. In this case, "other factors" than income/production contributed to the rapid export growth after World War II, which are partially captured by the income/production variable. Thus, the effect of the income/production variable on exports tends to be overestimated. Such "other factors" also could be a consequence of the fact that exporters saved costs from outsourcing parts of the production chain, buying inputs internationally and creating networks of multinational firms, leading to an increase in trade of intermediate products (Strauß, 2004:30). In fact, for the majority of Austrian and Dutch trade in manufactured goods, for which export and import demand will be estimated in the following, the import content of exports[25] has been increasing since the 1990ies (+19.8% for Austria and +12.3% for the Netherlands). Any other factors of this kind, which are a consequence of the increasing globalization process, and which are not captured by the price or income/production variable, can be one explanation for the phenomenon of non-constant returns to scale, and thus coefficients above unity. If for example firms "slice-up" the value chain, by outsourcing production to other countries, it could happen that inter-industry imports and thus re-exports increase, while domestic production doesn't increase at the same pace (Strauß, 2004:30).

To account for such consequences of an increasing globalization process, some empirical studies included a simple linear trend in their regression equation as a proxy for global-

[24]The CES-production function assumes constant elasticities of the parameters, here prices and the activity variable, as well as of technology parameters and doesn't account for increasing or decreasing returns to scale.

[25]The import content of exports can be seen as a measure to quantify the extent of how much an economy's firms are interconnected internationally, have split-up the production chain worldwide. Then, the imported intermediate goods are processed and re-exported to complete the process of the production-chain.

ization. However, the practice of including a linear trend can cause problems when testing the variables of the regression equation for unit roots, i.e. their order of integration, when the underlying data generating process doesn't show a trending behaviour. Also, the effects captured by a linear trend in the regression equation must not come from globalization factors, but could be the consequences of data of modeling problems. Therefore, Strauß (2004) employs a different proxy than a simple linear trend. This proxy is the ratio of world trade to world GDP[26]. The proxy should account for global effects on world trade, resulting from an increase of the world production/income. He finds empirical evidence for the existence of some unexplained factors which are captured by the proxy. In her study on export demand in the EMU, Aligieri (2011) also adds an unobserved component in the form of a time-varying trend in her export equations in order to capture underlying non-price competitiveness. She finds evidence that other, unobserved factors, apart from prices and income, have a significant effect on export demand. In addition, she finds that a failure to account for these factors will lead to biased estimates of long-run price elasticities. Thus, there is some empirical evidence that it could make sense to employ such proxies to account for other factors than prices or income on imports and exports, namely for unexplained factors.
Strauß (2004) includes this globalization proxy only in his export demand equation. Also, Aligieri (2011) estimates the unobserved component model only in terms of export demand. If however, it is true that such other factors, like globalization processes, have to be accounted for, than this globalization proxy must also enter the import demand equation. If for example such unexplained factors result from a global outsourcing process and slicing-up of the production chain, then firms do not only increasingly export goods, but also import these goods elsewhere. Thus, also imports are affected by such processes and the globalization proxy must also be included in the import demand equation.
For the purpose of the thesis I include a linear trend and the proxy of Strauß (2004) in both, export and import demand models, as a proxy for globalization.

In this chapter, the general literature on export and import demand, as well as special studies for intra- and extra-EMU export and import demand were introduced. In a second step, the theoretical import demand model was formulated in terms of the *consumer-based* and the *producer-based approach* and the details of the trade elasticities were described. Finally, some controversial points concerning the formulation of export and import demand were raised and explained. Before estimating export and import demand in the fourth chapter, we shall look at the historical development of Austrian and Dutch intra- and extra-EMU exports and imports in more detail in the next chapter.

[26]Thus, world trade as a share of world GDP.

3 Descriptive Analysis of Austrian and Dutch Imports and Exports

In this section I want to give general overview of the extra-/ and intra-EMU trade of Austria and the Netherlands. In particular, I want to refer to the Austrian and Dutch trade in goods, which accounts for more than half of total intra-/ and extra-EMU trade since 1990. After a general introduction to the export and import structure of Austria and the Netherlands vis-à-vis the Euro-area and the rest of the world, I will describe the goods exports and imports, their structure in more detail.

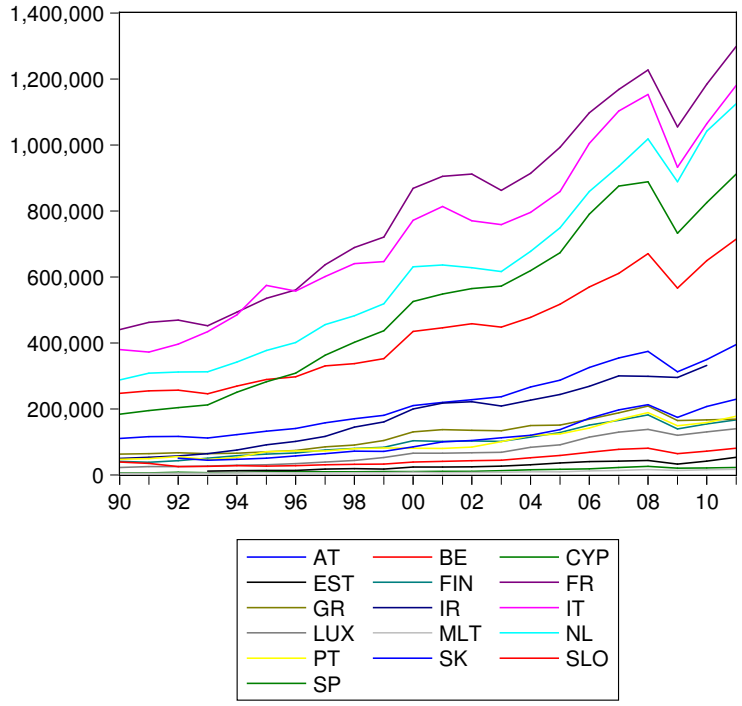
3.1 Overview of the Austrian and Dutch Extra-/ and Intra-EMU Trade

Since the beginning of the 1990ies, the total trade volume of all 17 EMU-member countries has been constantly growing. While some memebers like Germany, France, Italy, Spain and Belgium significantly increased their total imports and exports from 1990 to 2011, the growth of trade in other EMU-countries, as for example Greece, Portugal and Ireland almost stagnated. Figure 3.1 depicts the growing dispersion between the trade volumes of all EMU-member countries, except Germany[27], from 1990 to 2011. While this dispersion grew at a constant rate until the introduction of the Euro in 1999, the drifting apart of the trade volumes among all EMU-countries increased at an even higher rate in the years thereafter. During the economic crisis of the years 2008 and 2009, the growth in total trade of the economically strong EMU-countries was slowing down, while countries with a comparatively low or no growth in total trade before 2008/2009 were less affected by the crisis. With the exception of Ireland, the trade volumes of almost all economically strong countries gained momentum after the downturn in 2009. Some continued growing at an even higher rate than before the crisis.

Austria and in particular the Netherlands are among those EMU-member countries with a high growth in total trade since the beginning of the 1990s. Between 1990 and 2011, Austrian and Dutch exports and imports doubled or even tripled. In this time period, Austria's exports grew by 174%, and therewith stayed a little bit below the EMU-average with a plus of 186%, while Dutch exports even increased by 203% compared to the value of 1990 (compare table 3.1). The increase in imports was with a plus of 134% for Austria and 199% for the Netherlands in both countries smaller than the increase in exports, but still above the EMU-average (+115%).
Looking at smaller time intervals, it turns out that, with the exception of Austrian exports and imports, the period with the highest growth of Dutch and EMU-average trade falls

[27]Due to its comparatively high volume of total trade, Germany had to be omitted from the sample of EMU-countries. It thus, it had to be treated as a outlier.

Figure 3.1: Total Trade of all EMU-Countries except Germany



Source: DOTS Database (IMF).

in the time period before the introduction of the Euro, namely from 1990 to 1999. The period with the highest growth of Austrian exports and imports lies between 1999-2007. In the time-span between 1990 to 1999, Austrian exports increased by 55%, about 17%-points below the EMU-average (+72 %), and Dutch exports by 82%, and thus lied 10% above the EMU-average. In the same time period, the increase in Austrian imports was with 47% below the increase of its exports, while Dutch imports grew with about 85% at an even higher rate than its exports. Therewith, the increase of Austrian imports was below, that of Dutch imports above the EMU-average (+65%).
Summing up, the increase in total Dutch trade was higher in the time period before the introduction of the Euro, and lower in the period thereafter (1999-2007), while the opposite case holds for Austria. Total Austrian trade increased at a higher pace in the time between 1999 and 2007. Hence, one possible conclusion could be that Austria profited more, the Netherlands less from the introduction of the Euro. However, since we speak of total intra-and extra-EMU trade of both countries, this conclusion has to treated with caution. The increase in total trade of both countries could also be due to other effects, as for example an increased trade activity with countries outside the EMU.

Figure 3.2 and figure 3.3 show total Austrian and Dutch exports and imports vis-à-vis the EMU-average. Both figures visualize that, despite their immense increase from

Table 3.1: Growth of Austrian and Dutch Total Trade for the Time Period 1990-2011

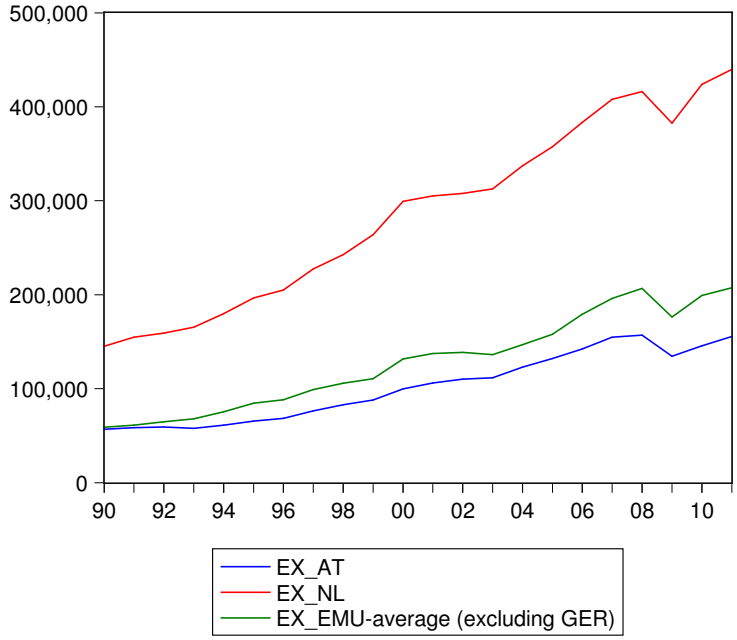
	Austria	**Netherlands**	**EMU**	**EMU excl. GER**
%-tual increase in...				
...Exports from				
1990-1999	+55	+82	+72	+87
1999-2007	+76	+55	+60	+77
2007-2011	0	+8	+4	+6
1990-2011	+174	+203	+186	+251
... Imports from				
1990-1999	+47	+85	+65	+75
1999-2007	+60	+50	+55	+88
2007-2011	0	+8	+2	+5
1990-2011	+134	+199	+115	+165

Source: DOTS Database (IMF), OECD.

1990-2011, Austrian exports and imports constantly lied below the EMU-average. In the same time period, Dutch exports and imports constantly amounted to a volume which was twice as high as the as the respective EMU-average.
Austria's below EMU-average trade volume and the Dutch above EMU-average are also reflected in the respective country's share in total EMU-exports and /- imports. Here, Austrian exports make up only 3% of total EMU-exports in 2011, while the Dutch 2011 export share amounts to 8.5% of total EMU-exports (compare tables 3.2 and 3.3). Both countries had larger shares in total EMU-exports in 1990 (Austria: 4.3% and the Netherlands: 11.1%). In 2011, Austrian imports amounted to only 2.7%, and Dutch imports to 7.8% of total EMU-imports. Again, both countries shares in total EMU-imports were higher in 1990 (Austria: 4.4% and the Netherlands: 9.7%).
These results don't necessarily imply that Austrian and Dutch shares in total EMU-trade were shrinking since 1990, but could stem from the fact that additional countries joined the EMU. And/or that formerly economically weaker member countries increased their economic activity, and thus their export and import capacities since then. Consequently, the enlargement of the EMU and the economic strengthening, and thus larger trade volume, of some EMU-member countries, could have led to a relative decline of Austrian and Dutch shares in total EMU-imports and -exports.

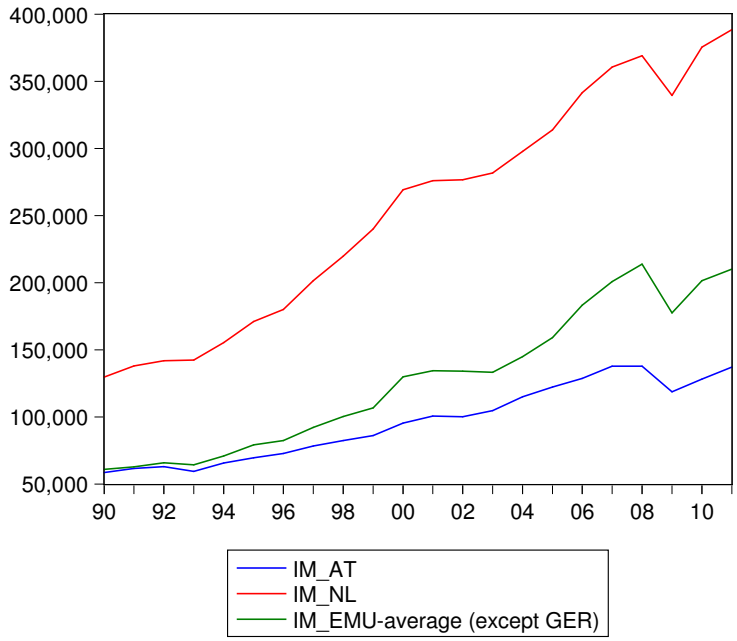
The data needed for the estimation of intra- and extra-EMU export and import demand, must allow to discriminate between intra- and extra-EMU imports and exports. Unfortunately, there exists no data source providing bilateral data for the *total* intra- and

Figure 3.2: Total Austrian and Dutch Exports vis-à-vis the EMU-average (except Germany)



Source: DOTS Database (IMF).

Figure 3.3: Total Austrian and Dutch Imports vis-à-vis the EMU-average (except Germany)



Source: DOTS Database (IMF).

extra-EMU trade, or at least for the biggest EMU-countries. Thus, we cannot differentiate between *total* intra and extra trade of the entire EMU-area. However, as far as the trade in goods is concerned, there exists bilateral trade data for all EMU-countries for the trade in goods[28], which allows to differentiate between the share of intra- and extra goods trade of the entire EMU-area.

Since 1990, the share of goods trade makes up the largest part of total EMU-trade: at the beginning of the 1990ies, this share was above 50% for most of the EMU-members. Since the introduction of the Euro in 1999, the share of goods exports of most EMU-countries ranges between 60% to 70%, and that of goods imports even between 70% to 80%, with increasing tendency. Also for Austria and the Netherlands, the share of goods-exports and -imports has been constantly increasing for both countries since 1990 (+16% for Austrian exports, +12% for imports, and +5% for Dutch exports, +9% for its imports). In 2011, goods exports had a share of 72.9%, goods imports of 81.3% in total Austrian exports and imports and even a share of 79.8% in total Dutch exports and of 78.6% in total imports (compare tables 3.2 and 3.3).

Thus, trade in goods makes up a larger share of total Austrian and Dutch trade than trade in services. This fact is inasmuch important for the thesis, as the availability of bilateral trade data only allows us to estimate export and import demand functions in terms of trade in goods, and not of trade in services. Hence, it should suffice to approximate the *total* trade of the entire EMU-area by using trade in goods. This is one important result, we should keep in mind for the estimation part of the thesis.

A second, very important result for the estimation part of the thesis is that intra-EMU trade makes up a larger share in total Austrian and Dutch trade than extra-EMU trade, with the exception of Dutch imports. In 2011, the majority of total Austrian exports (54.4%) and imports (59.3%), and of total Dutch exports (55.0%) were exported or imported to other EMU-member countries, while the majority of Dutch imports (60.4%) were imported from countries outside the EMU (compare table 3.2 and 3.3). In *goods trade*, the share of Austrian intra-EMU exports (54.8%) and imports (67.5%) and Dutch intra-EMU exports (74.0%) was even larger than the intra-EMU share in total trade. The share in total Dutch intra-EMU goods imports (41.7%) was smaller than that of extra-EMU imports.

One possible reason for the remarkably high Dutch extra-EMU import shares could be the fact that the Netherlands serves as a hub for imports from countries outside the EMU, which are destined for the entire EMU-area. The import goods from extra-EMU countries, as for example China, are shipped to big harbours, as Rotterdam, where they are turned over. Then, these goods are re-exported to other countries inside the EMU, which is reflected in the high Dutch intra-EMU goods export share of 74%. Looking at the share of Austrian intra-EMU trade (total and goods trade) over time, one can observe that

[28]The data on bilateral goods trade was taken from the IMF's DOTS database.

Table 3.2: Austrian Exports and Imports 1990-2011

	1990	1997	2007	2011	for 2011, Index 1990=100
Austria					
Exports (in%)					
Austrian exports as share of total EMU-exports	4.3	3.6	3.4	3.0	70
Exports of Goods and Services					
Exports of Goods	63.0	70.6	73.3	72.9	116
Exports of Services	37.0	29.4	26.7	27.1	73
Intra-/ Extra-EMU Trade...					
... of Total Exports:					
Intra-EMU	n.n.	54.7	53.7	54.4	99
Extra-EMU	n.n.	45.3	46.3	45.6	101
...of Total Goods Exports:					
Intra-EMU	57.5	58.5	55.1	54.8	95
Extra-EMU	42.5	41.5	44.9	45.2	106
Imports (in%)					
Austrian imports as share of total EMU-imports	4.4	4.0	3.1	2.7	63
Imports of Goods and Services					
Imports of Goods	72.6	74.8	80.9	81.3	112
Imports of Services	27.4	25.2	19.1	18.7	68
Intra-/ Extra-EMU Trade...					
... of Total Imports:					
Intra-EMU	n.n.	58.6	58.8	59.3	101
Extra-EMU	n.n.	41.4	41.2	40.7	98
... of Total Goods Imports:					
intra-EMU	64.2	64.9	69.6	67.5	105
extra-EMU	35.8	35.1	30.4	32.5	91

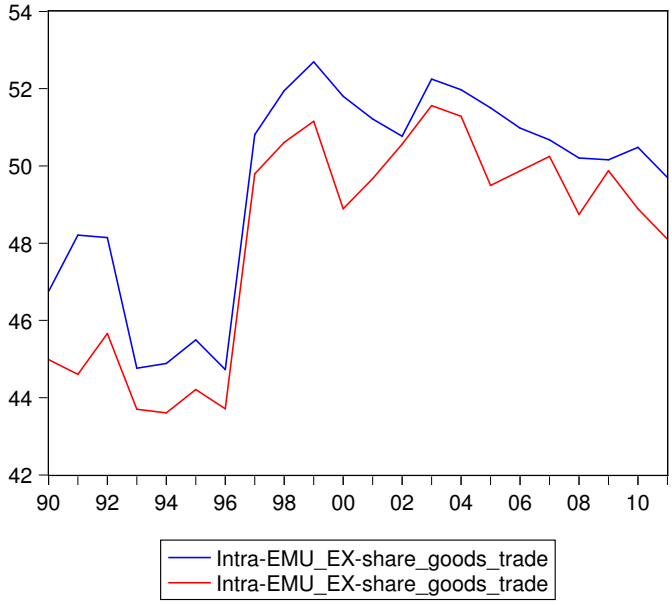
Source: DOTS Database (IMF), OECD.

Table 3.3: Dutch Exports and Imports 1990-2011

	1990	1997	2007	2011	for 2011, Index 1990=100
Netherlands					
Exports (in%)					
Dutch exports as share of total EMU-exports	11.1	10.7	9.0	8.5	77
Exports of Goods and Services					
Exports of Goods	76.0	76.0	80.0	79.8	105
Exports of Services	24.0	24.0	20.0	20.2	84
Intra-/ Extra-EMU Trade...					
... of Total Exports:					
Intra-EMU	64.4	59.7	53.2	55.0	85
Extra-EMU	35.6	40.3	46.8	45.0	126
... of Total Goods Exports:					
Intra-EMU	61.8	56.4	71.7	74.0	120
Extra-EMU	38.2	43.6	28.3	26.0	68
Imports (in%)					
Dutch imports as share of total EMU-imports	9.7	10.2	8.2	7.8	81
Imports of Goods and Services					
Imports of Goods	72.0	72.6	78.6	78.6	109
Imports of Services	28.0	27.4	21.4	21.4	76
Intra-/ Extra-EMU Trade...					
...of Total Imports::					
Intra-EMU	71.4	53.4	43.1	39.6	55
Extra-EMU	28.6	46.6	56.9	60.4	211
...of Total Goods Imports:					
intra-EMU	53.0	41.3	47.2	41.7	79
extra-EMU	47.0	58.7	52.8	58.3	124

Source: DOTS Database (IMF), OECD.

Figure 3.4: Share of Intra-EMU Goods Trade in Total Goods Trade



Source: DOTS Database (IMF).

it had been quite constant in the entire time period between 1999 and 2011[29]. In total Austrian exports, this share slightly shrunk from 1999 to 2011 (- 1% in total and -5% in goods exports), while it increased minimally in imports (+1% in total and +5% in goods imports). Compared to the change of the Austrian share of intra-EMU trade, the Dutch share changed more dramatically- which is mostly due to the different time periods chosen. The intra-EMU share of *total* exports went down (-5% from 1990 to 2011) while that of goods exports increased significantly (+20%). In total imports the intra-EMU trade share changed even more dramatically (it decreased by 45% since 1990, and that of goods imports by 21%).

For the empirical part of the thesis, these high shares of intra-EMU trade imply that total Austrian and Dutch exports and Austrian (but not the Dutch) imports are more dependent on intra-/ than on extra-EMU demand for exports and imports. Thus, we should keep in mind that more weight should be given to the estimation results of the demand for Austrian intra-EMU exports and imports and for Dutch intra-EMU exports, than to those of extra-EMU trade- with the exception of Dutch import demand.

Also for the entire EMU-area, intra-EMU trade in goods has a larger share in *total* goods trade than extra-EMU trade. As it can be seen in figure 3.4, in the time period from 1990 to 1997 the share of intra-EMU goods exports and imports made up about 45% to 47% of total goods exports and imports. From 1998 until 2003/2004, the intra-EMU share

[29]Due to data unavailability, the starting point of the time period under observation had to be reduced from 1990 to 1999.The observation period for Austria thus ranges between 1999 and 2011

for goods imports and exports even increased to a value slightly above 50% and declined thereafter below the 50%-mark. However, for the entire period from 1990 to 2011, the share of intra-EMU goods exports and imports in total EMU goods trade increased. Consequently, that of extra-EMU trade in goods declined.
In the following part, I will describe the breakdown and the structure of Austrian and Dutch goods exports and imports in more detail.

3.2 Breakdown of Austria's Trade in Goods

In the foregone section, we already saw that goods trade makes up the largest share of total Austrian trade and that most Austrian goods trade in 2011 was conducted with other EMU-member countries. Thus, trade in goods can be used as a proxy to analyze the structure and breakdown of total Austrian exports and imports. Since there is no data available for the year 2011, we must have a look at Austria's 2010 trade in goods in the following part of the thesis[30]. For a better understanding of the trade structure, Austrian 2010 exports and imports are separated into eleven goods categories.

3.2.1 Austrian Exports

The larger share of most all Austrian export goods categories are traded within the EMU-area. For seven out of the eleven goods categories the largest share (about 52.0%) of total exports was demanded by countries inside the Euro-area (compare 3.4). Enlarging the group of Austria's 16 European trade partners to the group of all 26 European countries (EU26, without Austria) the share of intra-European trade for all eleven goods categories increases even further (67.8% of all exports). A quarter of Austria's goods exports goes to countries as for example Switzerland (4.7%), the USA (4.4%), Asian countries (4.1%), and the remaining quarter (15.6%) to other countries, which are not listed in table 3.4.
About 61% of Austrian food products are exported to the EMU. Therewith, it is the goods category with the highest intra-EMU export share, followed by road vehicles, which constitute with 58.2% the category with the second largest share in Austrian intra-EMU exports. The remaining goods categories with an intra-EMU export share > 50% can be ranked as follows: textile products (56.9%), paper (55.9%), metal products (55.8%), computers (54.8%) and rubber manufactures (52.6%). Chemicals and related products constitute the product category with the lowest intra-EMU export share (39.7%). For this and the product categories electrotechnical equipment (46.8%), mineral fuels and related products (47.2%) and machinery goods (48.4%), the larger export-share of Austrian exports goes to countries outside the EMU.

[30] As in the year 2011, intra-EMU goods trade made-up the major share of total EMU goods trade in 2010 and can thus be used as substitute for the goods trade in 2011.

Table 3.4: Exports Austria, 2010

2010																
Category of Goods	European Monetary Union (EMU16)	EU26 without EMU16	EU26	Switzer-land	Turkey	USA	Russia	China	Japan	Korea	Asia	India	Brazi	BRIC	MOE*	Remaining Countries
Food products[1]	61.0	15.5	76.5	3.4	0.7	4.8	2.4	0.2	0.8	0.5	1.5	0.1	0.4	3.0	14.6	10.3
Textiles	56.9	17.6	74.5	4.7	0.9	1.9	1.7	0.6	0.4	0.2	1.2	0.2	0.2	2.6	14.6	14.8
Paper products	55.9	18.3	74.2	5.3	1.3	1.2	2.1	0.2	0.1	0.1	0.5	0.2	1.4	3.9	16.5	13.8
Mineral fuels & related products[2]	47.2	25.1	72.3	2.2	0.1	0.1	0.3	0.1	0.0	0.0	0.1	0.0	0.0	0.4	23.5	24.9
Chemicals & related products	39.7	16.2	56.0	8.8	1.0	4.2	7.5	2.4	0.7	0.5	3.7	0.3	1.0	11.3	19.5	17.5
Rubber manufactures	52.6	21.3	74.0	1.7	0.4	1.6	0.7	0.6	0.4	0.2	1.1	0.6	0.3	2.2	17.8	19.5
Metals[3]	55.8	15.9	71.7	4.6	0.8	2.9	1.2	0.9	0.5	0.3	1.7	0.7	0.9	3.8	12.9	15.4
Machinery [4]	48.4	11.4	59.8	3.1	1.3	7.3	2.7	4.6	0.6	1.0	6.2	1.0	1.1	9.5	10.1	17.5
Computers [5]	54.8	19.4	74.1	3.6	0.7	4.2	1.3	1.8	0.4	0.2	2.4	0.4	0.4	3.9	16.2	12.7
electrotechnical equipment	46.8	17.9	64.7	3.2	0.9	6.2	1.3	4.6	0.9	1.0	6.5	0.8	0.4	7.0	15.0	16.0
Road vehicles[6]	58.2	19.6	77.8	2.2	0.6	3.9	1.0	3.6	0.7	0.4	4.6	0.1	0.4	5.1	13.7	9.3
Share of all goods categories in total goods exports	**52.0**	**15.8**	**67.8**	**4.7**	**0.9**	**4.4**	**2.3**	**2.5**	**0.9**	**0.6**	**4.1**	**4.1**	**0.6**	**6.1**	**13.6**	**14.7**

Source: OECD.

* Bulgaria, Latvia, Lithuania, Poland, Rumania,Czech Republic, Hungary, Russia.

[1] Including live animals, animal and vegetable oils, fats, waxes and beverages;

[2] including lubricants;

[3] including iron, steel and non-ferrous metals as well as manufactures of metals, n.e.s.;

[4] including transport equipment;

[5] comprising office machines and automatic data-processing machines;

[6] including air-cushion vehicles.

The four goods categories with the lowest intra-EMU export share account for 43.6% of total Austrian goods exports[31] (compare table 3.2.2). Thus, the larger share of these four goods categories are exported to extra-EMU countries (overall, about 45.2% of all Austrian goods exports go to countries outside the EMU). This menas that a not negligible large part of Austrian goods exports are dependent on changes of extra-EMU exports. And thus, are likely to react very strongly to changes in the export demand of these four categories. Even if still the larger share of Austrian exports goes to countries inside the EMU, this is very important fact we should keep in mind for the estimation part, as it increases the importance of extra-EMU export demand for Austrian goods.

3.2.2 Austrian Imports

Also, the larger share (59.1%) of Austrian total goods imports comes from EMU-member countries- again for seven out of the eleven goods categories (compare table 3.6). An even larger share (71.2%) of all eleven goods categories than for Austria's exports comes from EU26-countries. A remarkably large share of 5.2% of Austria's goods imports comes from Switzerland, about 4.7% from China and 2.8% from the USA. The remaining share (11.9%) of countries demanding Austrian imports, can be taken from table 3.6.
About 73.8% of all Austrian road vehicles imports come from countries within the EMU and thereby constitute the goods category with the largest intra-EMU import-share. Other categories with an intra-EMU import-share >50% can be ranked as follows: machinery goods (73.2%), food (71.0%), metal (70.0%) and paper products (69.9%), rubber manufactures (68.1%) and chemicals and related products (63.2%). Mineral fuels and related products imports is the category with the lowest import-share (40.6%) of Austrian intra-EMU imports. About 45.7% of mineral fuels and related products imports come from countries which are not listed in table 3.6[32]. Besides these, other goods categories with an larger share of extra-EMU imports are: textiles (45.3%), electrotechnical equipment (46.5%) and computers (47.2%).
Contrarily to Austrian goods exports, the four categories of import goods with larger extra-EMU import shares make up only 29.9% of total Austrian exports[33]. The remaining seven goods categories, which make up the major share of all goods imports, are those with a higher share of intra-EMU imports[34].

[31] While the category chemicals and related products exhibits the lowest intra-EMU export share of Austrian exports in 2010, it has the third largest share (11.2%) in total Austrian goods exports among all eleven goods categories in the same year. Also, machinery products with the largest share (18.0%) in total 2010 goods exports, as well as electrotechnical products (11.1%) and mineral fuels and related products (3.3%).

[32] Which presumably mostly consist of Arabic countries or countries from the Middle East

[33] To these four categories belong: electrotechnical equipment (10.9%), mineral fuels and related products (10.8%) and computers (2.2%)

[34] Among these are: chemical products (12.2%), machinery products (11.0%), road vehicles, (9.5%), metal products (9.8%), food (6.6%), textiles (6.0%), paper products (2.2%), computers (2.2%) and rubber manufactures (1.0%).

Table 3.5: Structure of Austrian goods imports and exports in 2010

Share of the respective category of goods in 2010 in...		
... Total Goods Exports		
	in %	**cumulated**
Machinery[1]	18.0	
Metals[3]	13.1	31.0
Chemicals & related products	11.2	42.3
Electrotechnical equipment	11.1	53.4
Road vehicles[4]	8.0	61.3
Food products[5]	6.7	68.0
Textiles	3.7	71.7
Paper products	3.6	75.4
Mineral fuels & related products[2]	3.3	78.6
Computers[6]	0.9	79.6
Rubber manufactures	0.5	80.1
Remaining goods (categories)	19.9	100.0
... Total Goods Imports		
	in %	**cumulated**
Chemicals & related products	12.2	
Machinery [1]	11.0	23.2
Electrotechnical equipment	10.9	34.1
Mineral fuels & related products[2]	10.8	44.9
Metals[3]	9.8	54.7
Road vehicles[4]	9.5	64.2
Food products[5]	6.6	70.8
Textiles	6.0	76.8
Paper products	2.2	79.0
Computers[6]	2.2	81.2
Rubber manufactures	1.0	82.2
Remaining goods (categories)	17.8	100.0

Source: OECD.

[1] Including transport equipment;
[2] including lubricants;
[3] including iron, steel and non-ferrous metals as well as manufactures of metals, n.e.s.;
[4] including air-cushion vehicles;
[5] including live animals, animal and vegetable oils, fats, waxes and beverages;
[6] comprising office machines and automatic data-processing machines.

Table 3.6: Imports Austria, 2010

2010																
Category of Goods	European Monetary Union (EMU16)	EU26 without EMU16	EU26	Switzer-land	Turkey	USA	Russia	China	Japan	Korea	Asia	India	Brazi	BRIC	MOE*	Remaining Countries
Food products[1]	71.0	12.7	83.7	3.2	1.3	0.7	0.1	0.8	0.1	0.0	0.9	0.3	1.6	2.7	11.0	8.3
Textiles	45.3	10.7	56.0	1.6	4.6	0.5	0.0	17.6	0.1	0.2	17.9	2.8	0.2	20.7	8.9	16.4
Paper products	69.0	20.0	89.0	3.0	0.1	0.6	0.5	0.7	0.2	0.0	0.8	0.0	3.0	4.1	8.6	3.0
Mineral fuels & related products[2]	40.6	10.1	50.7	0.3	0.0	0.8	2.5	0.0	0.0	0.0	0.0	0.0	0.0	2.5	12.2	45.7
Chemicals & related products	63.2	8.2	71.4	13.1	0.2	7.9	0.2	1.9	0.8	0.1	2.8	0.5	0.1	2.6	3.8	3.8
Rubber manufactures	68.1	19.2	87.3	1.1	2.5	1.4	0.0	0.1	2.5	1.6	4.2	0.3	0.2	0.7	17.3	2.9
Metals [3]	70.0	12.5	82.5	3.3	0.8	1.0	1.9	2.8	0.6	0.3	3.6	0.2	0.3	5.1	11.4	6.3
Machinery[4]	73.2	10.9	84.0	4.4	0.6	2.9	0.1	2.4	2.0	0.3	4.6	0.3	0.2	2.9	7.6	2.9
Computers[5]	47.2	10.4	57.6	1.1	0.0	5.9	0.0	18.8	6.9	1.4	27.1	0.0	0.0	18.8	7.4	8.2
Electrotechnical equipment	46.5	14.2	60.7	4.1	0.6	4.5	0.0	12.3	4.2	1.8	18.3	0.4	0.1	12.7	11.0	11.4
Road vehicles[6]	73.8	13.4	87.2	0.6	0.6	2.4	0.0	0.6	4.8	0.7	6.1	0.4	0.1	1.2	8.9	2.5
Share of all goods categories in total goods imports	**59.1**	**12.1**	**71.2**	**5.2**	**0.8**	**2.8**	**0.6**	**4.7**	**1.6**	**0.4**	**6.7**	**0.4**	**0.4**	**6.0**	**9.7**	**11.9**

Source: OECD.

* Bulgaria, Latvia, Lithuania, Poland, Rumania,Czech Republic, Hungary, Russia.

[1] Including live animals, animal and vegetable oils, fats, waxes and beverages;

[2] including lubricants;

[3] including iron, steel and non-ferrous metals as well as manufactures of metals, n.e.s.;

[4] including transport equipment;

[5] comprising office machines and automatic data-processing machines;

[6] including air-cushion vehicles.

Thus, as the larger share of total imports comes from countries inside the EMU, one can assume that Austria's demand for imports is more dependent on intra- than on extra-EMU imports. Again, we should keep this fact in mind for the estimation part of the thesis. All other goods, which do not fall into one of the eleven categories, make up about 17.8% of total Austrian imports.
In the next subsection, the development of Dutch exports and imports since 1990 will be described in more detail.

3.3 Breakdown of Dutch Trade in Goods

As mentioned in the introduction, the majority of Dutch goods exports in 2011 (74.0%) are destined for the Euro-Area, while only 41.7% of total goods imports to the Netherlands come from EMU-member countries. To get a better overview of the structure and distribution of the Dutch goods exports and imports, we must have a look on 2010 trade data for the Netherlands, which is the latest year for which complete data was available.

3.3.1 Dutch Exports

In 2010, most of the Dutch export goods falling into one of the 11 categories were demanded by countries inside the EMU (about 52.0%). Taking into the entire European Union (EU26) into account, this share is even larger (66.4%), if the entire European Union (EU26) is taken into account (compare table 3.7). About 4.5% of 2010 Dutch goods exports go to the USA, round 3.9% to BRIC-countries[35], 1.4% to Switzerland and 1.2% to Turkey. The remaining part of Dutch exports are distributed among the other countries listed in table 3.7 and about 20.7% to others which are not mentioned in the table.
Among all eleven goods categories, listed in table 3.7, rubber manufactures constitute the largest (69.2%), and machinery products the lowest (29.0%) intra-EMU export share. All other categories with intra-EMU export share >50% are: textile (63.9%), metal products (62.8%), mineral fuels and related products (61.4%), food products (58.3%), chemicals and related products (57.8%), paper products (54.3%), road vehicles (53.9%), electrotechnical equipment (53.2%) and computers (51.1%).
In 2010, the major share of all 11 Dutch exports goods categories was demanded by countries inside the EMU[36] (compare table 3.8).

[35](Brazil, Russia, Indian and China)

[36]Among these ten categories, chemicals and related products have the largest share (17.8%) in total Dutch goods exports. Together with the categories mineral fuels and related products (13.7%), foods products (12.5%) and electrotechnical equipment (11.5%) they make up more than half (55.5%) of all Dutch goods exports. The remaining part (44.5%) is distributed as follows: computers (7.6%), machinery products (6.8%), metal products (5.0%), textiles (2.8%), road vehicles (2.7%), paper products (1.3%) and rubber manufactures (0.6%).

Table 3.7: Exports Netherlands, 2010

2010																
Category of Goods	European Monetary Union (EMU16)	EU26 without EMU16	EU26	Switzer-land	Turkey	USA	Russia	China	Japan	Korea	Asia	India	Brazi	BRIC	MOE*	Remaining Countries
Food products[1]	58.3	18.6	76.9	1.1	0.5	3.1	2.1	0.8	0.8	0.4	1.9	0.1	0.2	3.3	6.8	14.0
Textiles	63.9	19.6	83.4	1.5	1.4	2.4	0.9	0.8	0.5	0.1	1.5	0.2	0.3	2.2	6.1	8.4
Paper products	54.3	16.1	70.4	3.0	1.1	1.7	1.7	5.6	1.2	0.4	7.2	1.6	0.2	9.0	6.3	13.1
Mineral fuels & related products[2]	61.4	8.4	69.8	1.6	0.6	4.9	0.1	0.6	0.2	0.1	1.0	0.1	0.6	1.5	0.5	21.3
Chemicals & related products	57.8	14.0	71.8	1.3	1.5	8.0	1.5	1.6	0.8	0.8	3.2	0.7	0.9	4.7	5.5	11.1
Rubber manufactures	69.2	13.8	83.0	0.8	0.7	0.9	0.5	0.8	0.2	0.2	1.3	0.1	0.2	1.8	4.8	12.4
Metals [3]	62.8	14.3	77.0	1.5	1.1	5.2	0.8	1.0	0.3	0.2	1.5	0.4	0.4	2.6	5.0	12.0
Machinery[4]	29.0	9.4	38.4	1.2	1.1	10.4	2.5	4.9	2.6	6.7	14.3	1.0	1.2	9.6	5.5	30.0
Computers[5]	51.1	27.8	78.9	2.1	1.9	1.6	3.4	0.5	0.2	0.1	0.9	0.2	0.1	4.1	16.7	11.1
Electrotechnical equipment	53.2	19.3	72.4	1.7	1.5	4.5	2.1	1.2	1.2	0.6	3.1	0.7	0.5	4.5	8.7	13.5
Road vehicles[6]	53.9	18.1	72.1	1.5	2.6	0.8	2.0	0.5	2.0	0.9	3.4	0.2	0.1	2.8	10.1	17.4
Share of all goods categories in total goods exports	**52.0**	**14.5**	**66.4**	**1.4**	**1.2**	**4.5**	**1.5**	**1.4**	**0.9**	**0.9**	**3.2**	**0.5**	**0.5**	**3.9**	**5.9**	**20.7**

Source: OECD.

* Bulgaria, Latvia, Lithuania, Poland, Rumania,Czech Republic, Hungary, Russia.

[1] Including live animals, animal and vegetable oils, fats, waxes and beverages;

[2] Including lubricants;

[3] including iron, steel and non-ferrous metals as well as manufactures of metals, n.e.s.;

[4] including transport equipment;

[5] comprising office machines and automatic data-processing machines;

[6] including air-cushion vehicles.

Thus, Dutch goods exports are much more dependent on the intra- than on extra-EMU demand. Compared to the Austrian exports, where categories with a high extra-EMU export share make up about 43.6% of total goods exports, Dutch exports react very weakly to changes in extra-EMU export demand.

3.3.2 Dutch Imports

In 2010, about 34.5% of all Dutch import goods belonging to one of the 11 categories were imported from countries inside the EMU (compare table 3.9). Taking the imports of all other 25 European member states to the Netherlands into consideration, the intra-European import-share increases to to an average of 46.4%. A remarkably high share of 9.3% of total goods imports comes from China and about 7.2% from the USA. The distribution of the remaining share of all Dutch goods imports can be found in the table 3.9. Other countries, which are not considered in the table make-up about 26.2% of total Dutch imports. All in all, the larger share of Dutch imports comes from countries outside the EMU. As mentioned earlier, one possible reason for this could be that the Netherlands serve as a hub for extra-EMU imports, which are destined for the entire EMU-area. Only four out of the eleven goods categories exhibit intra-EMU import shares
> 50%: road vehicles (65.3%), paper products (63.0%), chemicals and related products (52.7%) and metal products (51.9%). The major share of the remaining seven goods categories display lower intra-EMU import shares: foods products (49.8%), rubber manufactures (46.9%), machinery products (42.2%), textiles (34.6%), electrotechnical equipment (27.2%), mineral fuels and related products (20.0%) and computers (12.4%).
Taking the four goods categories with the higher intra-EMU import-share together, they account for about 25% of all Dutch goods imports (compare table 3.8). Thus, the largest share of the remaining seven goods categories of Dutch goods imports comes from countries outside the Euro-Area. This makes Dutch import demand very much dependent on extra-EMU import supply.
In this chapter the development of Austrian and Dutch imports and export over the past 21 years (1990-2011) was described in detail. In this time period, both countries significantly increased their external sector performances- the Netherlands more than Austria. It will be interesting to analyze the reasons for this increase in exports and imports of the recent years empirically the next section. On one hand we will look at factors determining the price competitiveness of Austrian and Dutch intra- and extra-EMU exports and imports. On the other hand, we will test which income factors were the driving factors of demand for Austrian and Dutch goods.

Table 3.8: Structure of Netherlands goods imports and exports in 2010

Share of the respective category of goods in 2010 in...

... Total Goods Exports

	in %	**cumulated**
Chemicals & related products	17.8	17.8
Mineral fuels & related products[1]	13.7	31.5
Food products[2]	12.5	44.0
Electrotechnical equipment	11.5	55.5
Computers[3]	7.6	63.1
Machinery[5]	6.8	69.9
Metals [4]	5.0	74.9
Textiles	2.8	77.7
Road vehicles[6]	2.7	80.5
Paper products	1.3	81.8
Rubber manufactures	0.6	82.3
Remaining goods (categories)	17.7	100.0

... Total Goods Imports

	in %	**cumulated**
Mineral fuels & related products[1]	18.0	18.0
Chemicals & related products	13.7	31.7
Electrotechnical equipment	12.8	44.6
Food products[2]	9.0	53.5
Computers[3]	8.5	62.0
Metals [4]	5.4	67.4
Machinery[5]	4.9	72.3
Road vehicles[6]	4.4	76.6
Textiles	3.5	80.2
Paper products	1.5	81.6
Rubber manufactures	0.7	82.3
Remaining goods (categories)	17.7	100.0

Source: OECD.

[1] Including lubricants;
[2] including live animals, animal and vegetable oils, fats, waxes and beverages;
[3] comprising office machines and automatic data-processing machines;
[4] including iron, steel and non-ferrous metals as well as manufactures of metals, n.e.s.;
[5] including transport equipment;
[6] including air-cushion vehicles.

Table 3.9: Imports Netherlands, 2010

2010																
Category of Goods	European Monetary Union (EMU16)	EU26 without EMU16	EU26	Switzer-land	Turkey	USA	Russia	China	Japan	Korea	Asia	India	Brazi	BRIC	MOE*	Remaining Countries
Food products[1]	49.8	8.1	57.9	0.6	0.8	2.4	0.2	1.6	0.1	0.0	1.7	0.8	6.6	9.2	3.2	29.0
Textiles	34.6	9.9	44.5	0.1	5.5	1.2	0.0	26.0	0.2	0.5	26.7	3.8	0.4	30.2	4.0	17.7
Paper products	63.0	16.5	79.5	0.3	0.2	7.5	0.2	2.5	1.4	0.0	4.0	0.1	1.6	4.5	2.5	6.6
Mineral fuels & related products[2]	20.0	16.8	36.8	0.1	0.0	2.4	21.0	0.1	0.2	0.4	0.7	2.0	0.6	23.8	22.7	36.2
Chemicals & related products	52.7	10.6	63.3	1.9	0.2	19.0	0.2	2.2	1.4	0.3	3.9	0.5	0.7	3.7	1.1	10.3
Rubber manufactures	46.9	14.8	61.7	0.1	1.9	4.6	0.0	10.4	4.6	2.1	17.0	1.7	0.2	12.4	5.2	12.7
Metals[3]	51.9	11.4	63.2	0.4	0.6	1.7	5.1	7.2	1.2	0.5	8.8	0.7	1.0	13.9	8.0	18.5
Machinery[4]	42.2	13.9	56.2	2.1	0.6	14.5	0.1	5.0	9.3	1.8	16.2	0.4	0.2	5.7	3.7	9.8
Computers[5]	12.4	11.1	23.5	0.1	0.1	4.6	0.0	37.7	6.6	0.7	45.1	0.2	0.0	38.0	5.8	26.4
Electrotechnical equipment	27.2	13.9	41.1	0.8	0.2	11.7	0.0	18.0	7.4	1.4	26.8	0.8	0.0	18.9	9.4	18.4
Road vehicles[6]	65.3	20.4	85.7	0.1	0.3	1.2	0.0	1.8	5.1	0.8	7.7	1.1	0.1	3.1	7.3	3.7
Share of all goods categories in total in total goods exports	**34.5**	**11.9**	**46.4**	**0.6**	**0.5**	**7.2**	**4.2**	**9.3**	**2.7**	**0.6**	**12.6**	**1.0**	**1.3**	**15.8**	**7.9**	**26.2**

Source: OECD.

* Bulgaria, Latvia, Lithuania, Poland, Rumania,Czech Republic, Hungary, Russia.

[1] including live animals, animal and vegetable oils, fats, waxes and beverages;

[2] including lubricants;

[3] including iron, steel and non-ferrous metals as well as manufactures of metals, n.e.s.;

[4] including transport equipment;

[5] comprising office machines and automatic data-processing machines;

[6] including air-cushion vehicles.

Two important facts for the next part of the thesis were mentioned in this chapter. First, that a larger share of Austrian and Dutch trade is conducted in goods trade. Second, that, with the exception of Dutch imports, the share of intra-EMU trade is larger than that of extra-EMU trade. The first fact concerns the data used for the estimation of export and import demand, the second the weight given to the estimation results of extra- or intra-EMU trade.

4 Estimation of Austrian and Dutch Import and Export Demand

The estimation of Austrian and Dutch intra- and extra-EMU import and export demand is the core part of the thesis. For a better understanding of the determinants driving the demand for Austrian and Dutch exports and their demand for imports, I want to evaluate these determinants by estimating import and export demand functions for intra- and extra-EMU trade separately.

According to the literature, the demand for imports and exports is basically driven by two factors. First, by the prices of the export (import) goods in relation to the prices of the domestic substitute good. And secondly, by income components, such as the production of a firm or the income of a household. Each of the import and export demand models for Austria or the Netherlands basically includes two explanatory variables- one for measuring reactions of exports and imports, which are due to changes in relative export or import prices, and a second variable to measure reactions as a consequence of changes in demand components, as for example GDP, industrial production, etc.[37].

Now, one could criticize that the import and export demand models, used to estimate Austrian and Dutch intra- and extra-EMU trade, are rather crude measures in order to analyze the determinants driving Austrian and Dutch import and export demand. And that other factors, apart from prices or income, are as least as important. In a way, the analysis based on prices and income is crude. And as it has been mentioned in the second chapter, some studies (for example Aligieri (2011) found that there are in fact other factors, than prices or income, driving import and export demand.

Alternatively, one could analyze imports and exports qualitatively, as it was done in the previous section. But also this way has its limitations. Hereby, we could examine the structure of imports and exports and deduce potential factors which might be important for import and export demand. However, at the end of the day, we cannot say anything about the *ceteris paribus effects* of these potential factors on imports or exports. This can only be done by estimating the effects of these potential factors statistically.

Thus, it makes perfect sense to estimate the effects of prices and income on import and export demand, as it will be done for Austrian and Dutch imports and exports in the following part of the thesis. Thereby, I use different price and income measures, broadly classified after either the *consumer-based* or the *producer-based approach* to estimate many different import and export demand models. This way, I want to test which of these measures explains the demand for Austrian and Dutch imports and exports best.

Besides prices and income, I also account for the effects of other, unobserved factors on

[37]To account for the increasing trade intensity within, as well as outside the EMU in the past years, I included a proxy for globalization in addition to the price and demand variable in some of the models.

imports and exports, by using a proxy to capture effects resulting from globalization processes. In comparison to the unobserved component model of Aligieri (2011), this was clearly an easier way to account for the statistical effects of such unobserved factors on imports and exports. However, employing a more sophisticated model to account for unobserved components *and* to using different price and income measures goes beyond the scope of this thesis.

Thus, the focus of this thesis is to analyze the effects of the different price and income measures on the demand for Austrian and Dutch imports and exports. Therewith, I want to broaden my understanding of the determinants driving Austrian and Dutch trade, and to educe consequences for the future development of their trade vis-à-vis the Euro-area and the rest of their trade partners.

Table 4.1: Road Map for the Estimation of Import and Export Demand

a) Testing all Variables of the Emprical Import and Export Demand Models for Unit Roots
Using two different tests:
1. The Augmented Dickey Fuller Test (ADF-Test)
2. The Kwiatkowski-Phillips-Schmidt-Shin Test (KPSS-Test)
→ Results of the unit root tests
b) Introduction and Explanation of the Theoretical Concepts and Prerequisites for the Estimation of Import and Exprt Demand Models
1) The concept of cointegration
2) VAR- and VEC-Models
3) The single steps of the Johansen procedure
c) Applying the Model Selection Procedure
1) The Model selection procedure in practice
→ Results of the model selection procedure for Austrian and Dutch intra- and extra-EMU import and export demand
2) Final models for Austrian and Dutch import and export demand
3) Discussion of the estimation results
d) Conclusion

Source: Own description.

In this chapter, I will first describe the particularities of the data used for the estimation of Austrian and Dutch import and export demand in more detail. Then, I will introduce the empirical import and export demand models for intra- and extra-EMU trade. A road map of the necessary the steps for the estimation on import and export demand models after these two steps is given in table 4.1. In the third subsection of this chapter, unit root test will be introduced and the results of the variables of the import and export demand models will be presented. After an explanation of th theoretical concepts and prerequisites

for the estimation of import and export demand, I will shortly explain the all necessary steps for the estimation process. Finally, I will present the results of these steps and the final models for Austrian and Dutch import and export demand.

4.1 Data

For the estimation of the export and import demand functions, I used quarterly time series data covering the time period from 1995 until 2011, starting from the first quarter of 1995 until the last quarter of 2011.
In contrast to the previous chapter, where I used data for the time from 1990 to 2010/2011, I had to reduce the time period of the data used for the estimation of import and export demand by five years. This is due to the poor availability of the data needed for the construction of some variables for intra-EMU import and export demand- in particular the price variables. The difficulty is, that the time series needed for the construction of most variables have to be available for all 17 EMU-member states at the same time, over the entire period from 1990 to 2011. The major problem with the data, in particular for the price indices of the biggest EMU-states, was that there was no common starting date, from which onwards all time series for all (or at least the larger) EMU-countries were available. For example, the producer price index (PPI) of one larger EMU-country was available from 1990, and its the consumer price (CPI) from 1997 onwards. While for another country, the PPI was available from 1995 and the CPI from 1990 onwards.
Since these problems were present for larger and smaller EMU-countries, the only compromise was to choose the year 1995 as a starting point. From 1995 onwards, the time series for most (but still not all!) EMU-countries were available. Choosing a later date as starting point for the sample would imply losses in degrees of freedom, since this would reduce the number of observations. For the time period from 1995 to 2011, we have 64 degrees of freedom. Depending of the number of parameters in the models, we would end up with 55 or 54 degrees of freedom, which is still a reasonable number. However, this number of degrees of freedom shouldn't be reduced down further by shortening the observation period by some more years.
The variables in all import and export demand models are seasonally adjusted. Despite this adjustment of all variables, seasonal dummies are used in all import and export demand model specifications in order to correct for remaining seasonal irregularities, which were still visible in the graphs of some variables, for example in the real effective exchange rate (REER) based on unit labour costs (compare section A.4 of the appendix). In addition, all variables have the base year 2005 (2005=100).
In the first section of the thesis, we learned that the demand for exports and imports can be either explained by the demand of a representative household or by that of a representative firm. Both approaches, the *consumer-based* and the *producer-based approach*,

were accounted for in the construction of the export and import demand models. Besides the dependent variables, either exports or imports, these models include one price and one demand variable as explanatory variables, which are varied and combined in the different specifications. The data for the intra- and extra-EMU exports and imports of comes from two different sources, namely the Direction of Trade Database (DOTS) of the IMF and from the OECD.

For the estimation of the *consumer-based* models, I used real effective exchange rates (REERs) based on consumer price indices as price variables and GDP or consumption data for the activity variables. Thereby, the consumer price indices shall act as a proxy for the prices of all final goods and the activity variable as a proxy for the income of all households. The data for the construction of the household-based models was taken from the EUROSTAT and the OECD databases.

The REERs used as price variables for the *producer-based* models are based on producer price and unit labour cost indices, which shall serve as a measure for the output prices of the entire economy. Two distinct producer price indices of different scope are used: (i) one broader measure for the producer prices of the entire industry[38] and (ii) a narrower measure for the producer prices of all manufactured goods[39]. Both PPIs can be further classified. In addition to the (i) normal industry PPI, a version of this PPI, based on the prices of all exporting industries will be used to estimate import and export demand. Similarly, besides the (ii) normal PPI for manufactures, a version of this PPI, based on the prices of all manufacturing industries producing for the export market will be employed. Thus, for each of both PPIs (i) and (ii), a version based on the prices of the exporting sector and a version based on prices for domestic and exporting sector together, will be used for the Austrian and Dutch import and export demand models.

For the demand variables of the producer-based models, I also used income/production measures of different scope: broader measures like GDP, as well as narrower measures like industrial production. The data for the producer-based approach comes from the International Financial Statistics (IFS) of the IMF, the EUROSTAT and the OECD databases. More details about the construction of the variables and the data sources can be found in sections A.2 and A.3 of the appendix.

In the following subsection, the empirical model specifications for the estimation of Austrian and Dutch intra- and extra-EMU import and export demand will be introduced.

[38] Including the prices for the following economic activities of the NACE classification: mining and quarrying (section C); manufacturing (section D); electricity, gas and water supply (section E).

[39] Section D: manufacturing of the NACE classification system.

4.2 Empirical Model Specifications for Import and Export Demand

As mentioned in the introduction, the estimation of intra- and extra-EMU demand for Austrian and Dutch exports and imports is carried out separately. Thus, all demand functions for exports and imports are estimated twice for each country, once for the intra- and once for the extra-EMU trade.
In the following two subsections, I will introduce the time series used for the estimation of Austrian and Dutch intra-EMU and extra-EMU trade, as well as the model specifications used to estimate both countries intra-EMU and extra-EMU export and import demand. In the first subsection, I will refer to intra- in the second to extra-EMU trade.

4.2.1 Models for Intra-EMU Trade

To estimate Austrian and Dutch intra-EMU export and import demand, about 27 different variables for each country are used to specify three consumer-based and nine producer-based models for imports and exports separately (12 models for exports and 12 for imports). Thus, all in all 24 models for each country are employed to estimate the demand for Austrian and Dutch exports and imports inside the Euro-Area. A description of the 27 variables used for each country can be found in tables A.2 in the appendix.
Since the formulation of the variables and the model specifications is the same for both countries, the only difference between the Austrian and Dutch export and import demand models is the data used for their estimation. Therefore, the following explanations of the model specifications are valid for both countries to the same extend. First, I will introduce the consumer and producer-based export demand models, and in a second step those of the import demand models.
In the following, the term "trade partners" refers to all EMU-countries, with the exception of Austria (or the Netherlands) if we speak of Austrian (or Dutch) models for export or import demand in more detail.

4.2.1.1 Export Demand

The following, export demand model is the empirical counterpart to the model introduced in the theoretical part of the thesis. It is formulated in terms of both, the *consumer-* and the *producer-based approach*.
Each model contains two explanatory variables, one price and one activity/income variable. It is expected that export demand reacts positively to changes in the demand variable and negatively to changes in the price variable. The logarithmic form of the empirical export demand model, derived from the theoretical part, can be formulated as follows:

$$EX_{EMU} = \beta_0 + \beta_1 y^*_{(EMU)} + \beta_2 (p_{(AT|NL)} - p^*_{(EMU)}) + \varepsilon \tag{4.1}$$

Where the dependent variable, EX_{EMU}, is the logarithm of real Austrian or Dutch goods exports to the EMU, $y^*_{(EMU)}$ is the logarithm of the respective activity variable for all EMU-countries except Austria or the Netherlands, while $p_{(AT|NL)}$ stands for the logarithm of Austrian or Dutch price level and and $p^*_{(EMU)}$ for the logarithmic price level of the remaining EMU-countries.

Table 4.2 depicts all 12 specifications used for the estimation of Austrian and Dutch export demand. The dependent variable of all 12 model specifications listed in table 4.2 is either Austrian or Dutch goods exports to the EMU. The demand variables used in these specifications are either chosen according to the consumer- or the producer-based approach.

All real effective exchange rates (REERs) used as price variables in the export (and import) demand models are trade-weighted, geometric indices. This means that the national price indices of all trade partners are weighted according to their share in Austrian or Dutch exports (or imports). Then, the Austrian or Dutch price index is divided by the product of the weighted price indices of all other EMU-countries and thus formulated in terms of the total-EMU price level[40]. While only the usual national consumer price indices were used for the construction of the REER of the *consumer-based approach*, about five different price indices were used for the construction of the REERs of the *producer-based approach* .

All three *consumer-based* model specifications, models 1a_i to 2a, share the same price variable, namely the real effective exchange rate (REER) based on the ratio of Austrian or Dutch consumer price indices to that of their trade partners ($REER^{ex}_{CPI}$). It is expected that an increase in the consumer prices of the trade partners leads to an relative decrease of Austrian or Dutch prices and thus makes Austrian or Dutch exports more attractive. The activity variables in the *consumer-based* export demand models are household consumption ($HH_consumption_{EMU}$), final consumption ($final_consumption_{EMU}$) and the gross domestic product (GDP) of all Austrian or Dutch intra-EMU trade partners (GDP_{EMU}). By assumption, an increase in one of these variables should augment the demand for Austrian or Dutch exports[41].

The four models 3a_i- 4a_ii, formulated in terms of the *producer-based approach*, differ-

[40] In the logarithmic formulation of the export model above, the quotient of the Austrian or Dutch price index and the indices of all othe EMU-members: $\frac{p_{(AT|NL)}}{p^*_{(EMU)}}$ is reformulated to: $p_{(AT|NL)} - p^*_{(EMU)}$, since $ln(\frac{a}{b}) = ln(a) - ln(b)$.

[41] The broadest measure of all three activity variables is GDP_{EMU}, the GDP of all EMU-members, except Austria or the Netherlands, as it includes the other two variables. The variable final consumption ($final_consumption_{EMU}$) includes the consumption expenditure of all households and enterprises in the EMU-member countries for goods and services. Since households make about 70% of the total final consumption, it is reasonable to use this variable for a consumer-based model. Strictly speaking, only model 1a_i is a purely consumer-based model, as it includes only consumer-based variables and not broader measures as GDP or final consumption (as in models 1a_ii and 2a), which also comprise the demand of other economic agents, as for example enterprises.

Table 4.2: Models for Intra-EMU export demand

Export model no.	Model specification
	i) consumer-based
1a_i	$EX_{EMU} = REER^{ex}_{CPI} + HH_consumption_{EMU} + \varepsilon$
1a_ii	$EX_{EMU} = REER^{ex}_{CPI} + final_consumption_{EMU} + \varepsilon$
2a	$EX_{EMU} = REER^{ex}_{CPI} + GDP_{EMU} + \varepsilon$
	ii) producer-based
3a_i	$EX_{EMU} = REER^{ex}_{PPI_ind} + IP_ind_{EMU} + \varepsilon$
3a_ii	$EX_{EMU} = REER^{ex}_{PPI_ind_ext} + IP_ind_{EMU} + \varepsilon$
4a_i	$EX_{EMU} = REER^{ex}_{PPI_manuf} + IP_manuf_{EMU} + \varepsilon$
4a_ii	$EX_{EMU} = REER^{ex}_{PPI_manuf_ext} + IP_manuf_{EMU} + \varepsilon$
5a	$EX_{EMU} = REER^{ex}_{PPI_ind} + GDP_{EMU} + \varepsilon$
6a	$EX_{EMU} = REER^{ex}_{PPI_ind} + GFCF_{EMU} + \varepsilon$
7a	$EX_{EMU} = REER^{ex}_{ULC} + IP_ind_{EMU} + \varepsilon$
8a	$EX_{EMU} = REER^{ex}_{ULC} + GDP_{EMU} + \varepsilon$
9a	$EX_{EMU} = REER^{ex}_{ULC} + GFCF_{EMU} + \varepsilon$

Source: Own description.

ent REERs, as price variables, and indices of industrial production, as activity variables, are used for the to estimate export demand. The REERs used in models 3a_i and 3a_ii are based on the (i) PPIs for the entire (domestic and exporting) industry, introduced in the data section. Thereby, model 3a_ii contains the industry PPI for the output prices of all goods produced by the exporting industries ($REER^{ex}_{PPI_ind_ext}$)[42], and model 3a_i the industry PPI for all goods produced for the domestic and foreign market ($REER^{ex}_{PPI_ind}$). The activity variable for both models is the index of industrial production of all Austrian or Dutch intra-EMU trade partners (IP_ind_{EMU}). It accounts for the industrial production of the entire domestic and exporting industries[43]. Due to data restrictions[44] no distinction between domestic and foreign market could be made for both indices of industrial production.

Models 4a_i and 4a_ii include narrower REERs based on (ii) producer prices of all manufacturing industries. As in models 3a_i and 3a_ii, the REER in model 4a_i is a measure for the prices of the domestic and exporting manufacturing industries ($REER^{im}_{PPI_manuf}$), while

[42]The prices of all goods produced by all exporting firms, of those goods which are destined for the foreign market.

[43]Including the prices for the following economic activities of the NACE classification: mining and quarrying (section C); manufacturing (section D); electricity, gas and water supply (section E).

[44]The data for the index of industrial production for the total and the manufacturing industry wasn't available for all EMU-countries.

the REER in model 4a_ii only accounts for the producer prices of all manufactured goods produced for the export market ($REER^{im}_{PPI_manuf_ext}$). The industrial production index, as a measure for the output of the manufacturing industries of all trade partners, enters in both models, 4a_i and 4a_ii, as activity variable (IP_manuf_{EMU}). It accounts for the industrial production of all manufacturing goods destined for the domestic and foreign market.
Models 4a_i and 4a_ii are both narrower formulations of models 3a_i and 3a_ii, since the prices and industrial production of the manufacturing industries are contained in the price and income measures of the models for the entire industry in terms of the REERs, since the REERs in models 3a_i and 3a_ii contain the prices used in the other two models. So-to-say, models 4a_i and 4a_ii are both contained in models 3a_i and 3a_ii. In addition, also model 3a_ii is a narrower version of model 3a_i, and model 4a_ii of model 4a_i, as both contain the producer prices of the goods produced by the exporting industries. Whereas models 3a_i and 4a_i contain the producer prices of the goods produced by the domestic *and* exporting industries.
Estimating import and export demand with such model specifications, of which one is a narrower formulation of the other, allows to test the sensitivity and reliability of the employed models. If for example model 3a_i or 4_i produces significant results, while model 3a_ii or 4_ii does not, one should question the trustworthiness of these results. This is because model 3a_ii or 4_ii contain explanatory variables which are only relevant for foreign market and thus should be in principle much more relevant for the export demand than models 3a_i or 4_i with variables which are relevant for both, the domestic and the foreign market. The confirmation or rejection of such considerations can be found in the estimation part of thesis.
In all four models, 3a_i, 3a_ii, 4a_i and 4a_ii, higher producer prices of the exporting country lead to lower, and an increase in the industrial production of the trade partners to higher export demand.
Models 5a and 6a both include the real effective exchange rate based on producer prices for the entire industry ($REER^{ex}_{PPI_ind}$). They are only different with respect to the activity variables. While model 5a includes the GDP of all trade partners (GDP_{EMU}), model 6a contains gross fixed capital formation ($GFCF_{EMU}$) of all Austrian or Dutch intra-EMU trade partners as activity variable. Gross fixed capital formation includes all investments made by domestic producers in a given period. Thus, it should serve as a measure for investments made by investors in all EMU-member states, except Austria or the Netherlands. In model 6a, it is expected that an increase in these investments leads to an increase in the demand for Austrian or Dutch exports. The models 7a, 8a and 9a include REERs, which are based on unit labour costs (labour cost per hour), as price variables ($REER^{im}_{ULC}$). An increase in the unit labour cost of all intra-EMU trade partners leads to an relative decrease of Austrian or Dutch labour cost. This increases the cost competitiveness of

Austrian or Dutch firms and thus the demand for their exports. The activity variables in those three models are the industrial production index for the entire industry, GDP and GFCF.
Next, the empirical models for intra-EMU import demand will be introduced.

4.2.1.2 Import Demand

As for the intra-EMU demand for exports, the logarithmic form of the empirical import demand function is derived from its theoretical counterpart.

Table 4.3: Models for Intra-EMU import demand

Import model no.	Model specification
	i) consumer-based
1b_i	$IM_{EMU} = REER^{im}_{CPI} + HH_consumption_{(AT\|NL)} + \varepsilon$
1b_ii	$IM_{EMU} = REER^{im}_{CPI} + final_consumption_{(AT\|NL)} + \varepsilon$
2b	$IM_{EMU} = REER^{im}_{CPI} + GDP_{(AT\|NL)} + \varepsilon$
	ii) producer-based
3b_i	$IM_{EMU} = REER^{im}_{PPI_ind} + IP_ind_{(AT\|NL)} + \varepsilon$
3b_ii	$IM_{EMU} = REER^{im}_{PPI_ind_ext} + IP_ind_{(AT\|NL)} + \varepsilon$
4b_i	$IM_{EMU} = REER^{im}_{PPI_manuf} + IP_manuf_{(AT\|NL)} + \varepsilon$
4b_ii	$IM_{EMU} = REER^{im}_{PPI_manuf_ext} + IP_manuf_{(AT\|NL)} + \varepsilon$
5b	$IM_{EMU} = REER^{im}_{PPI_ind} + GDP_{(AT\|NL)} + \varepsilon$
6b	$IM_{EMU} = REER^{im}_{PPI_ind} + GFCF_{(AT\|NL)} + \varepsilon$
7b	$IM_{EMU} = REER^{im}_{ULC} + IP_ind_{(AT\|NL)} + \varepsilon$
8b	$IM_{EMU} = REER^{im}_{ULC} + GDP_{(AT\|NL)} + \varepsilon$
9b	$IM_{EMU} = REER^{im}_{ULC} + GFCF_{(AT\|NL)} + \varepsilon$

Source: Own description.

This empirical import demand model can be formulated as follows:

$$IM_{EMU} = \beta_0 + \beta_1 y + \beta_2 (p^*_{(EMU)} - p_{(AT|NL)}) \tag{4.2}$$

Where the dependent variable, IM_{EMU}, is the logarithm of Austrian or Dutch goods imports from the EMU, $y_{(AT|NL)}$ is the logarithm of the respective Austrian or Dutch activity variable, while $p^*_{(EMU)}$ for the logarithmic price level of the remaining EMU-countries and $p_{(AT|NL)}$ stands for the logarithm of Austrian or Dutch price level.
The model specifications used for the estimation of import demand are quite similar to the export demand models, as one can see in table 4.3, which contains all 12 import demand models.

However, there are two differences between import and export demand models. The first lies in the construction of the REERS. This time, the national price indices of all trade partners are weighted according to their share in Austrian or Dutch imports. Also, the way these indices were set in relation to the Austrian or Dutch price indices to built the REERs is different. First, the aggregate price index of all other EMU-countries is divided by the Austrian or Dutch price index and thus formulated in terms of the Austrian or Dutch price level. The second difference concerns the formulation of the demand variables. Since the imports are demanded by domestic agents, the variables for import demand are specified for Austrian or Dutch households and firms (compare table 4.3.).

Table 4.4: Models for extra-EMU export and import demand

Export model no.	**Model specification**
	i) consumer-based
1_c	$EX_{(extra-EMU)} = REER^{ex}_{CPI} + consumption_{(extra-EMU)} + \varepsilon$
2_c	$EX_{(extra-EMU)} = REER^{ex}_{CPI} + GDP_{(extra-EMU)} + \varepsilon$
	ii) producer-based
3_c	$EX_{(extra-EMU)} = REER^{ex}_{PPI} + IP_{(extra-EMU)} + \varepsilon$
4_c	$EX_{(extra-EMU)} = REER^{ex}_{PPI} + GDP_{(extra-EMU)} + \varepsilon$
5_c	$EX_{(extra-EMU)} = REER^{ex}_{PPI} + GFCF_{(extra-EMU)} + \varepsilon$
6_c	$EX_{(extra-EMU)} = REER^{ex}_{ULC} + IP_{(extra-EMU)} + \varepsilon$
7_c	$EX_{(extra-EMU)} = REER^{ex}_{ULC} + GDP_{(extra-EMU)} + \varepsilon$
8_c	$EX_{(extra-EMU)} = REER^{ex}_{ULC} + GFCF_{(extra-EMU)} + \varepsilon$
Import model no.	**Model specification**
	i) consumer-based
1_d	$IM_{(extra-EMU)} = REER^{im}_{CPI} + consumption_{(AT\|NL)} + \varepsilon$
2_d	$IM_{(extra-EMU)} = REER^{im}_{CPI} + GDP_{(AT\|NL)} + \varepsilon$
	ii) producer-based
3_d	$IM_{(extra-EMU)} = REER^{im}_{PPI} + IP_{(AT\|NL)} + \varepsilon$
4_d	$IM_{(extra-EMU)} = REER^{im}_{PPI} + GDP_{(AT\|NL)} + \varepsilon$
5_d	$IM_{(extra-EMU)} = REER^{im}_{PPI} + GFCF_{(AT\|NL)} + \varepsilon$
6_d	$IM_{(extra-EMU)} = REER^{im}_{ULC} + IP_{(AT\|NL)} + \varepsilon$
7_d	$IM_{(extra-EMU)} = REER^{im}_{ULC} + GDP_{(AT\|NL)} + \varepsilon$
8_d	$IM_{(extra-EMU)} = REER^{im}_{ULC} + GFCF_{(AT\|NL)} + \varepsilon$

Source: Own description.

Since the two mentioned aspects are the only differences between the import and export demand models, I won't go into details of the import demand models at this point. In the next section the empirical models for the estimation of extra-EMU trade will be introduced.

4.2.2 Models for Extra-EMU Trade

For the estimation of extra-EMU export and import demand I used 16 different time series to specify two *consumer-based* and six *producer-based* models for Austrian and Dutch imports and exports separately. Table A.7, which can be found in section A.2 of the appendix, provides more information about all variables used for the formulation of the extra-EMU export and import demand models. It should serve as a key to understand the model specifications listed in table 4.4.

In the following, the term "trade partners" refers to all Austrian and Dutch extra-EMU trade partners, which are the same for both countries[45]. A list of all extra-EMU trade partners is provided in table A.8 in the appendix.

The formulation of the empirical model for extra-EMU export and import demand is almost the same as for intra-EMU exports and imports, except of two points. First, the variables are now based on data for the extra-EMU area. Secondly, this time, export or import demand is not only dependent on the level of the relative export or import prices (Austrian of Dutch versus their trade partners), but also on the level of the nominal exchange rate of the domestic (Austrian or Dutch) currency vis--vis the trade partner's currencies, and thus from the economic activity outside the EMU. Consequently, the nominal exchange rate was to be included in the REERs for exports and imports. As with the REERs of intra-EMU export demand, the Austrian or Dutch price index (based on CPI, PPI or ULC) are divided by the product of the weighted price indices of all extra-EMU trade partners. In addition, the price indices of all extra-EMU trade partners are multiplied by the nominal exchange rate of the domestic curreny vis-a-vis that of the trade partners. Thus, the extra-EMU REERs are formulated in terms of the extra-EMU export price level. The REERs for extra-EMU import demand is constructed by reversing this ratio of Austrian or Dutch price indices and that of their extra-EMU trade partners, i.e. by setting the aggregate price level of all trade partners in relation to the domestic (Austrian or Dutch) price level.

With the exception of the nominal exchange rate in the REERs, the construction of the price and the demand variables, as well the interpretation of the estimation results for extra-EMU import and export demand remains the same as for the models for intra-EMU trade, presented in the previous sections. Further, less import and export demand models are specified for the estimation of extra-EMU trade. And these specifications are less

[45] All countries considered as Austrian or Dutch trade partners had to have a share in Austrian or Dutch extra-EMU exports or imports of >0.5%.)

complex than those used for intra-EMU import and export demand, as it can been seen in table 4.4.

4.2.2.1 Export Demand

The logarithmic form of the empirical model for extra-EMU export demand can be formulated as follows:

$$EX_{(extra-EMU)} = \beta_0 + \beta_1 y^*_{(extra-EMU)} + \beta_2 (p_{(AT|NL)} - \mathbf{e} - p^*_{(extra-EMU)}) + \varepsilon \tag{4.3}$$

Here, the dependent variable, $EX_{extra-EMU}$, is the logarithm of real Austrian or Dutch goods exports to their trade partners outside the EMU, $y^*_{(extra-EMU)}$ is the logarithm of the respective activity variable of all extra-EMU trade partners, while $p_{(AT|NL)}$ stands for the logarithm of Austrian or Dutch price level, **e** is the nominal exchange rate of the domestic currency (in logs) and finally, $p^*_{(etxra-EMU)}$ refers to the logarithmic price level of all Austrian and Dutch extra-EMU trade partners.
The demand for extra-EMU exports is measured by eight models, two *consumer-* and six *producer-based models*. The two *consumer-based* models contain a REER based on consumer price indices ($REER^{ex}_{CPI_(AT|NL)}$, and the private final consumption expenditure ($consumpt_{extra-EMU}$), or the real GDP ($GDP_{extra-EMU}$) of all Austrian or Dutch extra-EMU trade partners as activity variables (compare table 4.4). The six *producer-based* models contain REERs based on either producer prices for the entire industry[46] ($REER^{ex}_{PPI_(AT|NL)}$), or on unit labour cost indices ($REER^{ex}_{ULC_(AT|NL)}$). The demand variables used in models 3c-8c are industrial production of the entire industry ($IP_{(extra-EMU)}$), GDP ($GDP_{extra-EMU}$) or GFCF ($GFCF_{extra-EMU}$) of all extra-EMU trade partners.

4.2.2.2 Import Demand

The logarithmic form of the empirical model for extra-EMU import demand can be formulated as follows:

$$IM_{(extra-EMU)} = \beta_0 + \beta_1 y_{(AT|NL)} + \beta_2 (p^*_{(extra-EMU)} - \mathbf{e} - p_{(AT|NL)}) + \varepsilon \tag{4.4}$$

Where the dependent variable is the logarithm of real Austrian or Dutch extra-EMU imports $IM_{(extra-EMU)}$, $y_{(AT|NL)}$ is the logarithm of the respective Austrian or Dutch activity variable, while $p_{(AT|NL)}$ stands for the logarithm of Austrian or Dutch price level, **e** is the nominal exchange rate of the domestic currency (in logs) and finally, $p^*_{(etxra-EMU)}$ refers to the logarithmic price level of all Austrian and Dutch extra-EMU trade partners.

[46] Of goods destined for the domestic and foreign market.

With the exception of following two facts, the specifications of the *consumer-* and *producer-based* import demand models are similar to those of the export demand, and thus won't be explained in detail. First, as in the intra-EMU import demand models, the activity variables in the extra-EMU import models are formulated for Austria and the Netherlands and not for the etxra-EMU trade partners. As in the import demand models for intra-EMU trade, the REERs account for the prices of all trade partners in relation to the domestic prices, and in addition for the effects resulting from exchange rate differences of the extra-EMU trade partners against that of the domestic currency.

4.2.3 Proxy for Globalization

In addition to the price and activity variables introduced in the previous subsections, each import or export demand model specification was also estimated with a *proxy for globalization*. This proxy should account for unobserved, global effects on the demand for exports and imports, which are not captured by the price or income/production variables of the models. A detailed theoretical justification for the proxy was already given in the introduction. To account for these global effects, some empirical studies included a simple linear trend in their regression model. However, this practice can cause problems when testing the variables of the regression equation for unit roots, i.e. their order of integration, when the underlying data generating process doesn't show a trending behaviour. Strauß (2004) suggests the use of a different proxy than just a simple linear trend. This proxy is the ratio of world trade to world GDP[47]. As the linear trend, this proxy should account for global effects on trade. For the purpose of the thesis I include a linear trend and the proxy of Strauß (2004) in both, export and import demand models, as a proxy for globalization.
In the next subsection, the first step of a longer testing procedure of the variables and models used for the estimation of export or import demand, will be introduced.

4.3 Testing for Unit Roots

Before running the regressions for export and import demand, it is important to find out which of the included variables is non-stationary, i.e. contain a unit root[48], and to identify their correct order of integration.

[47] Thus, world trade as a share of world GDP.

[48] Consider $y_t = \sum_{i=1}^{t} a_i y_{t-i} = 0$, where $\sum_{i=1}^{t} a_i$ is the sum of characteristic roots of y_t. A stationarity condition for the series y_t is that the sum of characteristic roots, $\sum_{i=1}^{t} a_i$, lie inside the unit circle; that is $\sum_{i=1}^{t} a_i < 1$. Since the values of the a_i can be positive or negative, a sufficient condition for that all characteristic roots lie inside the unit circle is: $\sum_{i=1}^{t} |a_i| < 1$. Any sequence that contains one or more characteristic roots that

A time series which contains a unit root shows a systematic pattern in its movement (though unpredictable movement) which is called a *stochastic trend* (Kim and Mandalla, 1998:48). Consider the model $y_t = y_0 \sum_{i=1}^{t} \varepsilon_i + a_0 \cdot t$, where $a_0 \cdot t$ represents a deterministic trend component, and $y_0 \sum_{i=1}^{t} \varepsilon_i$ a stochastic intercept term. Each random shock by ε_i shifts the intercept term permanently and thus the conditional mean of the series, since all values of $\{\varepsilon_i\}$ have a coefficient of unity (Enders, 2010:184). Such a sequence $\{\varepsilon_i\}$ is said to contain a *stochastic trend* and to be integrated of order d (denoted $y_t \sim I(d)$) if it becomes stationary after differencing it d times (Engle and Granger, 1987:252).

In contrast to the stochastic time trend, a deterministic trend (denoted by t) follows a linear or a quadratic time pattern, which is more or less predictable, as the trending series changes by a constant amount each period.

A series can also contain both, stochastic and deterministic trends. It is, however, not so easy to discriminate between both in practice. If a series contains a stochastic and/or a deterministic trend, can be tested by performing unit root tests and by plotting the series.

In applied time series estimation, the time series are often de-trended. This is done in order to apply estimation methods for stationary time series, or to find out the order of integration of a series. A process with a stochastic trend is de-trended (i.e. made stationary) by differencing it d times. It becomes *difference-stationary*. A process with a deterministic trend is de-trended by including a linear or non-linear time trend in the regression. It becomes stationary around a trend, and is thus called *trend-stationary*. Differencing a series which only contains a deterministic trend (overdifferencing), or which is stationary, or including a linear trend in a regression which only contains a stochastic trend, can cause spurious regression results. Identifying the kind of trend of the data generating process, and, in case a stochastic trend is present in the series, finding the correct order of integration of a series, is very important for the consistency of the regression results and thus for the sequel of the thesis.

Also, the question if the system of variables is found to be cointegrated or not, depends on the fact, whether all variables are integrated of the *same* order, or of different order. According to the definition of the concept of *cointegration*, only if the variables in a system of equations are integrated of the *same* order, $I(d)$, and a linear combination between these variables is found to be stationary, i.e. integrated of order $I(d-b), b > 0$, then this system is said to be *co-integrated*.

To test all variables used for the estimation of export and import demand models for stationarity and to detect their order of integration, I employ two different unit root tests, namely the Augmented Dickey Fuller (ADF) Test and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) Test. In general, unit root test do not have much power in distinguishing

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equal unity, i.e. $\sum_{i=1}^{t} a_i = 1$, is called a unit root (Enders, 2010:30 et seq.).

between near unit root processes, i.e. with characteristics roots close unity, and true unit root processes. On one hand, this is due to the power [49] of these tests, on the other hand partly due to the presence of deterministic regressors in the estimated equations (Enders, 2010:234). Discriminating between difference and trend stationary processes can be very complicated, since "(...) any trend-stationary process can be arbitrarily well approximated by a unit root process, and a unit root process can be arbitrarily well approximated by a trend-stationary process." (Enders, 2010:34).

Especially the (Augmented) Dickey Fuller Test, which is one of the unit root tests that I employ in this section, has been shown to have very low power to differentiate between near-unit root processes and real unit root processes[50]. The KPSS-Test, also has been judged to be equally low in power like the ADF-Test (Kim and Mandalla, 1998:45). However, since it assumes a stationary process under the null, it can be used for a confirmatory analysis in conjunction with the ADF-Test, which assumes a non-stationary process under the null.

In the next two subsections, the ADF- and the KPSS-Test will be introduced. Thereafter, I will present the results of the unit root tests for the time series used for the estimation of export and import demand.

4.3.1 The Augmented Dickey Fuller Test

Consider a series of first differences $\{\triangle y_t\}$. We can test the null hypothesis of a unit root by using OLS to estimate an autoregression of $\triangle y_t$ on its own lags and y_{t-1}.

$$\triangle y_t = \alpha + \rho y_{t-1} + \delta t + \sum_{j=1}^{p} \beta_j \triangle y_{t-j} + \varepsilon_t \tag{4.5}$$

Equation 4.5 shows the regression equation of the Augmented Dickey Fuller (ADF) Test. In case $\{\triangle y_t\}$ contains a unit root, the null hypothesis $H_0 : \rho = 1$ cannot be rejected. For simplicity, the regression 4.5, which includes up to $(p-1)$ lags, is reduced to an model which includes only one lag. Under the null of a unit root, the test statistic does not follow a standard t-distribution, but a special Dickey-Fuller (DF) distribution[51], which is a function of a standard Brownian motion (Wiener process)[52](Kim and Mandalla, 1998:75).

[49] The *power* of a test is denoted as the probability of not committing a type II error, i.e. the probability of rejecting a false null hypothesis.

[50] More details can be found in Enders, 2010:234 et seq.

[51] Dickey and Fuller (1979) conducted simulations to provide critical values for the Dickey Fuller test for unit roots (Enders, 2010:202). These critical values are also valid for the Augmented Dickey Fuller Test (Kim and Mandalla, 1998:72

[52] The coefficient of a unit root converges at a faster rate than the coefficient of a stationary series. The limiting distributions of the coefficient of the non-stationary and of the stationary series are very different and thus, normal test statistics can no longer be used. In the limit, the distribution of a non-stationary process $\{\triangle y_t\}$ converges to random functions of Brownian motions. For more details, see: Kim and Mandalla

The power of the ADF Test to discriminate between near-unit root processes and actual unit roots, is very low. This implies a high type II error of the ADF Test, which means that the test often fails to reject the false null hypothesis of a unit root, even if there is no unit root in the data generating process. Thus, the test too often falsely indicates the presence of a unit root in the series (Enders, 2010:234).

Table 4.5: Null hypothesis' of the three different ADF-specifications

5) Model with trend and intercept ($\delta \neq 0$): $\triangle \mathbf{y_t} = \mathbf{m} + (\rho - \mathbf{1})\mathbf{y_{t-1}} + \mathbf{dt} + \boldsymbol{\varepsilon_t}$, where $m = (1-\rho)\,\alpha$ and $d = \delta(1-\rho)$
$\mathbf{H_0^1}: \rho = 1$ ($\implies d = 0$ and $m = \delta$) versus: $\mathbf{H_1^1}: \lvert\rho\rvert < 1$ ($\implies d \neq 0$)
$\Rightarrow$ Non-stationary, i.e. I(1), with drift, versus trend stationary
3) Model with intercept ($\alpha \neq 0, \delta = 0$): $\triangle \mathbf{y_t} = \mathbf{m} + (\rho - \mathbf{1})\mathbf{y_{t-1}} + \boldsymbol{\varepsilon_t}$, where $m = (1-\rho)\,\alpha$
$\mathbf{H_0^2}: \rho = 1$ ($\implies m = 0$) versus: $\mathbf{H_1^2}: \lvert\rho\rvert < 1$ ($m \neq 0$)
$\Rightarrow$ I(1) without drift, versus stationary with expected value unequal to zero
1) Model without trend and intercept: $\triangle \mathbf{y_t} = (\rho - \mathbf{1})\mathbf{y_{t-1}} + \boldsymbol{\varepsilon_t}$
$\mathbf{H_0^3}: \rho = 1$ versus: $\mathbf{H_1^3}: \lvert\rho\rvert < 1$
$\Rightarrow$ I(1) without drift, versus stationary with expected value equal to zero

General equation:	**model 5**	**model 3**	**model 1**
$\triangle y_t = m + by_{t-1} + dt + \varepsilon_t$,	$m \neq 0$	$m \neq 0$	$m = 0$
where $b = (\rho - 1)$	$b = 0$	$b = 0$	$b = 0$
	$d \neq 0$	$d = 0$	$d = 0$

Source: Hassler (2000:4).

There are three different specifications of the (Augmented) Dickey Fuller Test[53]. One which includes an intercept and a trend term (model 5), a second just with an intercept (model 3) and a third without any of both (model 1). The ADF-Test employs these three model specifications to test the time series for unit roots. All three model specifications and the relating null hypothesis' can be found in table 4.5[54].

The first null and alternative hypothesis in table 4.5 relate to the model with intercept and trend term (model 5). Under the null, the process contains a unit root ($\rho = 1$) with drift ($m = \delta$), i.e. is non-stationary and the time trend is zero ($d = 0$). Under the alternative,

(1998:50 et seq.)

[53]The only difference between the "Augmented" Dickey Fuller and the standard Dickey Fuller Test is that the former includes *more than just one* lag of the dependent variable in the test regression, which is the case in the standard DF-Test.

[54]The hypothesis and the model specifications are taken from: Hassler 2000:4 et seq.

the process is stationary ($|\rho| < 1$) around a linear trend ($d \neq 0$).
The second pair of hypotheses relates to the model with an intercept (model 3). If the null cannot be rejected, then the process contains a unit root ($\rho = 0$) without drift ($m = 0$). If the null can be rejected, the process is stationary with an expected value unequal to zero under the alternative ($m \neq 0$).
The third pair of hypothesis belongs to model without intercept and trend (model 1). As before, the process contains a unit root without drift under the null. Under the alternative, it is stationary with an expected value different from zero.
In practice, one often does not know which of the above listed three models is appropriate to test a series for unit roots, since one does not know the true data generating process. To overcome this problem, several testing strategies with these three model variants have been suggested. For the purpose of testing the series used for the estimation of export and import demand for unit roots, I used two of these testing strategies, namely the strategy of Elder and Kennedy (2001) and the one of Enders (2010). Enders sequential strategy follows the general-to-specific principle. Starting off with a model like model 5) in table 4.5 in the course of the testing procedure significance tests on the trend and intercept terms are performed, by reducing the number of parameters until a model like model 3) is reached, and the null H_0^3 is rejected or not.
On the contrary, Elder and Kennedy's strategy is based on just one test. Exploiting a priori information about the growth pattern of the series, e.g. knowing that the series contains a deterministic trend, they divide their strategy in three cases: (i) there exists prior information that the series is growing, or (ii) that it isn't growing, or (iii) the case that there is no prior information about the growth pattern (Elder and Kennedy, 2001:140 et seq.). Using these prior restrictions allows to remove inappropriate models in advance. Thus, a repeated testing of the same hypothesis, as in Ender's strategy, can be avoided.
Hacker and Hatemi (2010) evaluate the unit root testing procedure suggested by Enders and by Elder and Kennedy, conducting Monte Carlo experiments. They find that the Elder and Kennedy's strategy produces more powerful results than Enders' strategy. This isn't only due to the fact that Elder and Kennedy exploit a priori information of the series. Even if there is no prior knowledge about the groth pattern of the series, Elder and Kennedy's strategy produces more robust results than that of Enders. The problem with Enders' strategy is that it allows repeated testing of the unit root hypothesis, which can cause mass significance problems (Hacker and Hatemi, 2010:17).
Hacker and Hatemi (2010:5) suggest six different model formulations as outcome of Enders' testing procedure, and four for the strategy of Elder and Kennedy, as they rule out two of these six strategies. The exact formulation of these six models and of both testing procedures can be found in section B.1 of the the appendix.
Besides the problem of finding the appropriate model, a second issue is the question how

many lags of the dependent variable to include in the ADF-Test regression. Some papers found that the size and power properties of the ADF Test depend upon the number of included lagged terms ($p - j$). Also for this problem, guidelines have been suggested (Kim and Mandalla, 1998:77). For the thesis, the choice of the adequate lag length was left over to the statistical program *Eviews 6*.
In the next subsection, the second test used in the thesis, the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) Test, will be introduced.

4.3.2 The Kwiatkowski-Phillips-Schmidt-Shin Test

One of the major differences between the ADF-Test and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) Test lays in the formulation of the null hypothesis. The null of the ADF Test suggests the presence of a unit root (i.e. non-stationary process) in the data generating process, whereas the null of the KPSS-Test is formulated in terms of a stationary process. One reason to assume a stationary data generating process under the null, was the low power of unit root tests using the null of a unit root, as the ADF Test. The low power of these tests leads to an under-rejection of the false null hypothesis of a unit root (high type II error). To circumvent such problems, the KPSS-Test uses the null of a stationary process.
Kwiatkowski, Phillips, Schmidt and Shin (1992) formulated the model as follows (taken from Kim and Mandalla, 1998:120):

$$y_t = \delta t + \gamma_t + \varepsilon_t, \quad t = 1, 2, ..., T. \tag{4.6}$$

where ε_t is a stationary process with expected value zero, and γ_t is a random walk given by

$$\gamma_t = \gamma_{t-1} + u_t, \quad u_t \sim iid\,(0, \sigma_u^2) \tag{4.7}$$

Under the null $H_0 : \sigma_u^2 = 0$, or formulated differently, that γ_t is a constant, it holds that $H_0 : y_t = \delta t + \gamma_0 + \varepsilon_t$, that is, y_t is stationary. Under the alternative, $\gamma_t > 0$, the parameters follow a random walk. The test statistic is given by a Langrange-Multiplier (LM) Test statistic. For the validity of the original asymptotic distribution of LM test statistic (which has been derived by Nabeya and Tanaka), the errors of the process under consideration have to be independent and identically distributed (*iid*).
Kwiatkowski, Phillips, Schmidt, Shin modified the test statistic of the KPSS-Test, as it has been done by Phillips (1987) and Phillips and Perron (1988) (as cited by Kim and Mandalla, 2010:121), so that it is valid even if a general, non-*iid* error process is assumed. If the errors are *iid*, the estimate of the expected error variance converges to the true value of the long-run error variance. If the errors are not *iid*, an estimate of the long-run error

variance is used for the construction of the test statistic[55] (Kim and Mandalla, 2010:121). Even if the KPSS-Test has often been used as an alternative to the ADF-Test, or other tests with the null of non-stationarity, Kim and Mandalla (1998) do not recommend its use. They find, that "(...) it has the same low power problems as the ADF- and the PP [Phillips and Perron] tests."(Kim and Mandalla, 1998:45). Rather, they suggest to use the KPSS-Test as *confirmatory analysis* in conjunction with the ADF-Test, although they doubt that power of two tests with low power can be substantially increased when using a combination of both.
However, to test the series for export and import demand for unit roots, I use both, the ADF-Test and the KPSS-Test, in combination to conduct such a *confirmatory analysis*, as it has been (among others) suggested by Kwiatkowski, Phillips, Schmidt and Shin (Kim and Mandalla, 1998:126).
In the next subsection, the unit root tests results of the time series used for the estimation of Austrian and Dutch extra- and intra-EMU export and import demand will be presented.

4.3.3 Unit Root Test Results of the Time-Series Used for the Estimation of Austrian and Dutch Export and Import Demand

The times series used for the estimation of export and import demand were tested for unit roots by using the ADF- and the KPSS-Test. Besides these two tests, the series were also analyzed graphically and with regard to their autocorrelation function (ACF).
Of all 54 variables for the estimation of Austrian and Dutch intra-EMU trade (each 27 variables), about 96.2% of all series (round 25 for each country) exhibit a trending behaviour in their graphs (compare table 4.6). According to their autocorrelation function (ACF), about 70.4% of the Austrian and only 51.9% of the Dutch series seem to have a unit root. The ACF of a stationary process has a short memory and declines rapidly, whereas the ACF of a non-stationary process persists and shows no tendency to decay.
Using the ADF- and the KPSS-Test to test for the number of unit roots in the series, all of the Austrian and about 96.3% of the Dutch series are proved to contain one, or even two unit root(s). However, both tests show for 18.5% of all Austrian and 25.9% of all Dutch variables contradictory results. This means that while the ADF-Test might find that a variable contains one unit root, the KPSS-Test indicates two unit roots and vice versa.

These results are better for all 30 extra-EMU variables, of which 13 are for Austria and 13 for the Netherlands, while four of the variables are the same for both countries. Here, the results of the ADF- and KPSS-Test are conflicting only in 15.4% of all Austrian and 7.7% of all Dutch variables. The results of the four common variables are contradictory in 2 cases. About 84.6% graphs of all Austrian and Dutch variables show a trending behaviour, and even all of the four common variables. All 30 variables contain a unit root

[55] For more details about the estimation of the error variance, see Kim and Mandalla, 1998:121.

Table 4.6: Summary: Results of Unit Root Tests for Austrian and Dutch Intra-/ Extra-EMU Variables

in %	Total # of vars.	Series trending[1]	ACF: unit root[2]	Series with one or two unit root(s) ADF-Test	Series with one or two unit root(s) KPSS-Test	Conflicting results: ADF-/ KPSS-Test
Intra-EMU						
Austria	27	92.6	70.4	100.0	100.0	18.5
Netherlands	27	92.6	51.9	96.3	96.3	25.9
Extra-EMU						
Austria	13	84.6	100.0	100.0	100.0	15.4
Netherlands	13	84.6	100.0	100.0	100.0	7.7
$Extra-EMU\ variables_{(AT\|NL)}$	4	100.0	100.0	100.0	50.0	50.0

Source: Own calculations.

[1] Trending behaviour according to the graph of the series.

[2] Unit root according to # of singificant spikes of the autocorrelation function (ACF) of the series.

according to their ACFs.

If we re-consider the doubts of Kim and Mandalla (1998:45) concerning the use of two unit root test with differing null hypothesis in conjunction, i.e. for a *confirmatory analysis*, then we can conclude that our results of the ADF- and KPSS-Test can be considered as quite satisfactory. Both tests produced more analogous, than contradictory results.

Applying the testing procedures of Enders (2010) and Elder and Kennedy (2001), mostly models with a unit root (model 1), a unit root and intercept (model 3), or models which contain a unit root with intercept and time trend (model 5) were suggested for intra-and extra-EMU variables, as it can be seen in table 4.7.

The detailed tables of the results of the unit tests and the strategies of Enders (2010) and Elder and Kennedy (2001) for all intra- and extra-EMU variables can be found in tables B.5, B.7 and B.9 in the appendix.

In this section, the basic concept of non-stationary processes and the related issues and problems were raised. Two tests for unit roots, the ADF- and the KPSS-Test were introduced and employed to test the intra- and extra-EMU variables for unit roots and their order of integration. Further, along with the ADF-Test, two testing procedures of Enders (2010) and Elder and Kennedy (2001) were used in order to detect the adequate model specifications for the data generating process of the variables for export and import demand.

Table 4.7: Strategies of Enders (2010) and Elder and Kennedy (2001): Most frequently suggested model specifications (according to ADF-Test)

	Model suggested most of the times by the method of:		
	Enders (2010)	**Elder and Kennedy (2001)**	
Intra-EMU			
Austria	model 1 (55.6%)	model 3 (96.3%)	
Netherlands	model 1 (44.4%)	model 3 (77.8%)	
Extra-EMU			
Austria	model 5 (61.5%)	model 1 (84.6%)	
Netherlands	model 5 (46.2%)	model 1 (92.3%)	
common extra-EMU variables	model 1 (75.0%)	model 1 (100.0%)	
General equation	**model 1**[1]	**model 3**[1]	**model 5**[1]
$\triangle y_t = m + by_{t-1} + dt + \varepsilon_t$, where $b = (\rho - 1)$	$m = 0$ $b = 0$ $d = 0$	$m \neq 0$ $b = 0$ $d = 0$	$m \neq 0$ $b = 0$ $d \neq 0$

Source: Hacker and Hatemi (2010:5), own calculations.

The results of the unit root tests and the employed testing procedures are quite satisfactory. Nearly all intra- and extra-EMU variables contain one or two unit root(s). Furthermore, the majority of the models which were suggested following the strategies of Enders (2010) and Elder and Kennedy (2001) contain a unit root. With these results, we can start off to the next section, in which the Johansen Procedure and the results of the estimation of intra- and extra-EMU export and import demand will be presented.

4.4 Theoretical Concepts and Prerequisites for the Estimation of Export and Import Demand

In this subsection of the thesis, the theoretical concepts, the prerequisites and necessary steps for the estimation of export and import demand will be explained in detail. Before introducing the three-step *Johansen procedure* and discussing the results received from this procedure, the concept of cointegration and the relationship between vector autoregressive (VAR) and vector error correction (VEC) models will be explained in the following subsections.

4.4.1 The Concept of Cointegration

Consider two variables y_t and x_t which are integrated of the same order, $I(d)$[56]. Then y_t and x_t are said to be co-integrated of order d, b, denoted $\{y_t, x_t\} \sim CI(d, b)$, if there exists a vector $\beta(\neq 0)$ so that, $u_t = y_t - \beta x_t$, is integrated of order $I(d - b)$, $b > 0$ (Engle and Granger, 1987:253). Such a vector β is called *co-integrating vector*. Put differently, if y_t and x_t are cointegrated, they share the same stochastic trend (Enders, 2010:364). Suppose for example that all three variables of an export demand model, namely exports, a price and a demand variable are found to be non-stationary and $I(1)$ (unit root). If there exists a β such that a linear combination of these variables becomes stationary, i.e. is integrated of order $I(0)$, then these variables are said to be co-integrated.

In general, if y_t and x_t are cointegrated, then there exists a long-run equilibrium relationship between both series, meaning that they will not drift too far apart from each other over time. If however, y_t and x_t are not cointegrated, then a linear combination between both series $y_t = \beta x_t + u_t$, will be $I(1)$ too, and y_t and x_t will drift apart from each other over time. The results received from such a regression will be spurious[57](Kim and Mandalla, 1998:26).

In the next subsection, the relation between VAR- and VEC-Models will be explained.

4.4.2 Vector Autoregressive (VAR), Vector Error Correction (VEC) Models and Cointegration

Consider the k'th-order vector autoregressive VAR(p)-process x_t[58]:

$$x_t = x_0 + \Pi_1 x_{t-1} + \cdots + \Pi_p x_{t-p} + \Phi D_t + \varepsilon_t, \quad t = 1, ..., T; \tag{4.8}$$

for fixed values of $x_{-k+1}, ..., x_0$, and with the error term $\varepsilon_t \sim iid, N_p(0, \Omega)$, Ω positive definite, and the deterministic term D_t[59].

The k'th-order vector autoregessive process x_t can be written in vector error correction (VEC) form, i.e. in terms of (lagged) differences and and levels of the process:

$$\triangle x_t = \Pi x_{t-m} + \sum_{i=1}^{k-1} \Gamma_i^{(m)} \triangle x_{t-i} + \Phi D_t + \varepsilon_t, \quad t = 1, ..., T, \tag{4.9}$$

[56]Where d denotes the order of integration

[57]Indicative for a spurious regression are a high R^2 and a low Durbin-Watson (DW) statistic.

[58]The following VAR and VEC formulations are taken from: Johansen (1995:11; 1995:45) and Juselius and Hendry (2000:49 et seq.).

[59]The stability condition for covariance stationarity of the AR(p) process at lag p can be formulated in terms of its characteristic polynomial: $\Phi(z) = I - \sum_{i=1}^{k} \Pi_i z_i$. The roots ζ_i of the characteristic polynomial must be all be situated outside the unit circle, i.e. $|\zeta_i| < 1$.

where m is an interger value, $1 \leq m \leq k$, and $\Pi = \sum_{i=1}^{k-1} \Pi_i - I$, and $\Gamma_i = -\sum_{j=i+1}^{k} \Pi_j$ [60], where with Π and $\Gamma_i, i = 1, ...k-1$ are nxn matrices.

The VAR-model is the stacked version of stationary autoregressive AR(p)-models (Kim and Mandalla, 1998:34), and the VEC-model the stacked version of stationary error-correction models (ECMs). As stated by Kim and Mandalla (1998:35): "The main characteristic of ECMs as compared with the VARs is the notion of an equilibrium long-run relationship and the introduction of past disequilibrium as explanatory variables in the dynamic behaviour of current variables." The coefficients measuring the long-run relationship of the variables, are called *co-integrating vectors*, those which measure the response of the dependent variable to previous periods' $(t - i)$ deviations from the long-run equilibrium *speed of adjustment coefficients*; both are contained in Π.

The *Granger Representation Theorem* states that any set of $I(1)$ variables, which are co-integrated, can be modeled by an error correction model. Thus, "*the restrictions necessary to ensure that the variables are CI(1,1) guarantee that an error-correction model exists*" and that for such a set of variables error correction and co-integration are equivalent representations (Enders, 2010:372).

Consider the VEC-model 4.9. The rank of the matrix Π corresponds to the number of cointegrating vectors of the system. If the rank of Π equals zero, each element of $\Pi = 0 \implies \Pi = \sum_{i=1}^{k-1} \Pi_i - I = 0$; and also $\Pi x_{t-m} = (\sum_{i=1}^{k-1} \Pi_i - I) x_{t-m} = 0$. Then, the VEC-model 4.9 degenerates to a normal VAR-model in first differences and there is no cointergration among the variables, and thus there exists no error correction representation. If Π has full rank, i.e. $rank(\Pi) = n$, then there are n linearly independent co-integrating vectors in the system, which all cointegrate and thus become stationary and cannot be $CI(1, 1)$. In case $1 \leq rank(\Pi) < n$, there can be $1 \leq r < n$ linearly independent cointegrating vectors. In this case, the conditions to ensure that an error-correction representation of the system of cointegrated variables exists, are met (Enders, 2010:374 et seq).

The determination of the rank of Π is one of the steps of the Johansen procedure to test a system of variables for cointegration. This procedure will be described in the next section.

4.4.3 The Johansen Procedure

The Johansen procedure is a method to determine the number of cointegrating vectors in a system of equations and, in case there exists cointegration among the variables, to find an adequate (vector) error-correction representation of this system.

The procedure basically consists of three steps. The first step is to set up a VAR-model for the system of equations under consideration and to choose the adequate lag length. In a

[60] Γ_i can be re-formulated as: $\Gamma = I - \sum_{i=1}^{k-1} \Gamma_i$.

second step, the VAR-model is estimated in order to determine the rank of the matrix Π[61] and thus the number of cointegrating vectors. Finally, a VEC-model is set up to estimate the long- and short-run coefficients of the system. All three steps will be described in more detail in the following[62].

4.4.3.1 Finding an adequate VAR-representation for the system of equations

Before starting off, one should pre-test the variables in the system of equations for their order of integration, as it has been done in the previous section (unit root tests). All variables, which have been found to be non-stationary and integrated of the same order, can be used to set up the VAR-model.

First, the adequate number of lags in a VAR-model for the system of equations has to be determined. Therefore, a VAR-model with the undifferenced data is estimated. Starting with the shortest lag-length, one has to test, if the number of lags can be increased until the maximal plausible number of lags has been reached. On one hand, a high number of lags implies a loss in degrees of freedom, as more parameters have to be estimated, while the number of observations remains constant. On the other hand, the number of included lags must not be too low. In both cases, of a too or too low number of included lags, the regression could produce inconsistent results. For the purpose of the thesis, a maximal lag length of eight lags was chosen, since the data used for estimation is quarterly data. Thus, by including eight lags in the test VAR-model, I allow the system to react to events, which could have happened two years back.

In order to test for the number of lags, one can employ tests which use the likelihood ratio test statistic, or can use the *Akaike Information Criterion (AIC)* or the *Schwarz Information Criterion (SC)*. To find the adequate number of lags in the VARs estimated for the thesis, I used the AIC, SC and *the Hannan and Quinn Information Criterion (HQC)*[63]. Secondly, it must be verified, that the residuals of the VAR-model are normally distributed (*iid*, Gaussian) and free of autocorrelation. These two conditions are basic assumptions of the VAR-model to guarantee unbiased estimation results.

To test the errors for normality, I employ the multivariate test of Lutkepohl applying the Cholesky decomposition to the variance-covariance matrix of the errors. Under the null, the residuals are multivariate normally distributed. In order to find out if there is autocorrelation among the errors, I use the Langrange Multiplier (LM) Test for serial correlation in the errors with the null of no serial (auto-) correlation in the errors.

[61] As is was mentioned in the previous subsection, the number of cointegrating vectors depends on the rank of the matrix Π of the vector error correction model.

[62] Thereby, I mainly follow the test procedure suggested by Enders (2010:77).

[63] I thereby follow the choice of Strauß (2002). For a short overview of the test statistics and the relations among these tests, see Strauß 2002:56 et seq.

4.4.3.2 Determination of the number of cointegrating vectors

To find the number of cointegrating vectors, one has to determine the rank of Π, which corresponds to the number of cointegrating relations of the system of equations. This is done by estimating the VAR-model from the first step.

As we saw in the previous section, there are basically three options how the rank of Π relates to the number of cointegrating vectors[64]:

1. If $rank(\Pi) = 0$, then there is no cointegration among the number of $I(1)$-variables. Then a VAR-model in first differences can be estimated for $\triangle x_t$.
2. If $rank(\Pi) = n$, all n vectors in the system *self-cointegrate* and thus X contains only stationary variables. A normal VAR-model should be used to estimate the system of equations.
3. If $1 \leq rank(\Pi) < n$, there can be $1 \leq r < n$ cointegrating vectors, which have a corresponding a VEC-model representation (*Granger Representation Theorem*).

The rank of the matrix Π is determined with the help of sequences of *trace tests*, which result form the *canonical correlations* of x_{t-1} and $\triangle x_t$ (for more details see Johansen (1995:93 et seq.)).
The *trace*-statistic J_r is used to apply a sequential testing procedure with the null H_{0r} : $rank(\Pi) \leq r$ against the alternative H_{ar} : $rank(\Pi) > r$. If H_{00} : $rank(\Pi) = r = 0$ cannot be rejected, there is no cointegration (case 1) and the test procedure stops. If H_{01} : $rank(\Pi) = r = 1$ can be rejected, the null H_{02} : $rank(\Pi) = r = 2$ ist tested (the alternative: H_{ar} : $rank(\Pi) > r$ applies). This sequential testing procedure continuous until H_{0r} : $rank(\Pi) = r$ cannot be rejected. Then, the *trace test* indicates r significant cointegrating vectors in the system. If H_{0n} : $rank(\Pi) = r = n$ cannot be rejected all system variables self-cointegrate (case 2). The distribution of J_r only depends on $n-r$ and since the Johansen procedure is the multivariate generalization of the Dickey Fuller-Test, the distribution of J_r under the null is a function of integrals over functions of Brownian motions (Kunst, 2011:25).
This is the general formulation of the above listed steps 1.-3. Besides the *trace tests*, also a maximum eigenvalue test can be used to determine the rank of Π. For the purpose ofthe thesis, I only used the *trace tests*.
Let the maximum number of ranks of Π be r, i.e.Π is of full rank iff $rank(\Pi) = r$. If the matrix (Π) is of reduced rank, i.e. $rank(\Pi) < r$, it can be separated as follows: $\Pi = \alpha\beta$,

[64] As taken from Kunst (2011:24)

where α is a *nxr* matrix and β' is *rxn* matrix; thus,$\alpha\beta'$ is a *nxn* matrix. Then we have that $\beta' x_{t-m}$ denotes the number of r cointegrated variables, β' the coefficient *matrix of cointegrating vectors*, and α is the matrix of error-correction terms, or *speed of adjustment coefficients* (Kim and Mandalla, 1998: 166). The solution for α and β are results of the testing procedure in case #3, if $1 \leq rank(\Pi) < n$.
Thus, if the rank of the matrix Π is known, i.e. $rank(\Pi) = r$, then the VEC-model from the previous section can be re-written as:

$$\triangle x_t = \alpha\beta' x_{t-m} + \sum_{i=1}^{k-1} \Gamma_i^{(m)} \triangle x_{t-i} + \Phi D_t + \varepsilon_t, \quad t = 1, ..., T, \tag{4.10}$$

The results for β' are a result of the testing procedure. To find the solution for the *canonical correlations* problems of x_{t-1} and $\triangle x_t$, an eigenvalue problem must be solved. These eigenvalues are also needed for the calculation of the *trace test statistics* J_r. The eigenvectors corresponding to the non-zero eigenvalues are estimates for the columns of β'. By replacing β' in equation 4.10 by its estimate $\hat{\beta}'$, this can be considered a *multivariate regression system*, yielding estimates for the other coefficients of the system, e.g. α, D_t etc. (Kunst, 2011:26).
As an example, consider the VAR-model from the previous section with two lags:

$$x_t = \Pi_1 x_{t-1} + \Pi_2 x_{t-2} + \Phi D_t + \varepsilon_t, \implies (I_p - \Pi_1 L - \Pi_2 L^2) x_t = -\Pi x_t + \Phi D_t + \varepsilon_t. \tag{4.11}$$

Re-parameterizing model, this gives 4.11 in error-correction form:

$$x_t - x_{t-1} = (\Pi_1 + \Pi_2 - I_p) x_{t-1} + \Pi_2 (x_{t-2} - x_{t-1}) + \Phi D_t + \varepsilon_t,$$

$$\implies \triangle x_t = \Pi x_{t-1} + \Gamma_1 \triangle x_{t-1} + \Phi D_t + \varepsilon_t. \tag{4.12}$$

If the characteristic polynomial:

$$\Pi(\lambda) = I_p - \lambda\Pi_1 - \lambda^2\Pi_2 = (1 - \lambda) I_p - \Pi\lambda - \Gamma_1 \lambda(1 - \lambda) \tag{4.13}$$

has a unit root, then it holds that: $|\Pi(\lambda)| = 0$ if $\lambda = 1$ and $\Pi(1) = -\Pi = -\alpha\beta'$, i.e. there exists a cointegrating vector and thus the error-correction model can bet written as:

$$\triangle x_t = \alpha\beta' x_{t-1} + \Gamma_1 \triangle x_{t-1} + \Phi D_t + \varepsilon_t. \tag{4.14}$$

After estimating Π, one can test for the number of cointegrating vectors, i.e. the rank of Π, in order to get the corresponding eigenvalues. To determine the number of characteristic roots that are different from zero, one then has to set the eigenvalues in an order

$\lambda_1 > \lambda_2 > ... > \lambda_k$. For example, if $rank(\Pi) = 0$ (case 1.) implies that all characteristic roots are zero $\implies$ $ln(1 - \lambda_i) = 0$ $\implies$ $\lambda_i = 1 \forall i$. If however, $rank(\Pi) = 1$, i.e. there exists one cointegrating vector, then $0 < \lambda_1 < 1$ $\implies$ $ln(1 - \lambda_1) < 0$ and $ln(1 - \lambda_2) = ln(1 - \lambda_3) = \cdots \ln(1 - \lambda_k) = 0$. Then, the *trace test* is used to test for the number of cointegrating vectors. Therefore, the *trace test statistic* uses the number of characteristic roots.

While testing for the number of linearly independent cointegrating vectors, one has to choose the specification of the VAR-model, with which the rank of Π is determined. In most statistical software packages, there are different options for the model specification. For the estimation of the export and import demand equations, I used the software *Eviews 6*. To test the export and import demand models for cointegration, I chose the two following specifications of the VAR-model, which both allow for a deterministic trend in the data: (i) with intercept and no trend in the cointegrating equation and test VAR (option 3 in *Eviews 6*), (ii) with intercept and trend in the cointegrating equation and no trend in the VAR (option 4 in *Eviews 6*). I tested each model for cointegration, by increasing number of lags sequentially form one to seven lags in differences.

As mentioned earlier, each model specification for imports and exports was specified with and without the proxy for globalization. Adding a proxy in the models has consequences for the choice of the model specification used to test for cointegration. Both specifications, (i) and (ii), were used to test for cointegration among the variables in the models without the globalisation proxy. To test for cointegration in the models including the globalization proxy, only the specification (i), which doesn't include trend, was employed. The globalization proxy is treated a substitute for a linear trend, as in model (ii). Thus, only model (i), which includes an intercept term and no linear trend, is an adequate to test export and import demand models including the proxy for cointegration.

For the estimation of import or export demand, we are only interested in the cointegrating relation between exports or imports, the price, the activity variable and the globalization proxy, in case it enters the model. Thus, the expected number cointegrating relations (cointegrating equations) among the variables is *one*. However, in practice it is very likely that there are more than just one cointegrating relation among the variables. This is also the case for most Austrian or Dutch export or import demand models.

If the number of hypothesized cointegrating relations in a system of variables is one, then usually, the framework of single-equation error-correction models (SEECMs) is used to test for the number of cointegrating relations. In the literature, there are several approaches to test for cointegration in the single-equation framework[65]. On the contrary, the

[65] As for example Hendry's dynamic regression method (1992), Saikkonen's dynamic ordinary least squares (DOLS) (1991), Phillips and Loretan's nonlinear least squares (NLS)(1991), Stock and Watson's dynamic generalized least squares (DGLS) (1993) or Inder's fully parametric least squares (FPLS) (as described by Kim and Mandalla, 1998:162-164).

Johansen procedure is mostly used to test for *multiple cointegrating relations*. The advantage of the Johansen procedure is that all cointegration relations in a system of variables are identified, which isn't the case in the single-equation framework[66].

4.4.3.3 Estimating the VEC-Model

If the VAR(p)-model of the first step was found to be optimal[67] at p lags, then the corresponding VEC-model has to be estimated at $p-1$ lags. As with the VAR-model, the residuals of the VEC-model must be normally distributed and free of autocorrelation. In order to determine the efficiency of the single VEC-models and to compare these models with one another, goodness of fit measures, as the R^2, AIC, BIC, etc., must be used.
As most empirical studies estimating import and export demand, I use the framework of single-equation error-correction models (SEECMs) to estimate Austrian and Dutch exports or imports, with exports (imports) as dependent variable and the price and demand variables as explanatory variables. Therefore, the long-run (cointegrating) coefficients of the system are normalized with respect to exports or imports, and thus price and income variables are estimated in terms of exports or imports.
As mentioned earlier, the single-equation framework is applied if the number hypothesized cointegrating relations among the variables is *one*. If however, there *are more than one* cointegrating relations among the variables, the single-equation framework doesn't account for these additional relations. Then, the estimates of the single equation framework could capture some effects of the other cointegrating relations and thus be spurious. Among the variables of the Austrian and Dutch import and export demand models, often, more than *one* cointegrating relation is found. In this case, the estimates received from a single-equation framework could be spurious. However, according to Johansen (1992), the framework of single-equation error-correction models (SEECMs) can also be applied for systems of variables with more than one cointegrating relation *iff* all other variables, except that for which the system has been normalized for, are significantly proven to be *weakly exogenous*. A variable in a cointegrated system is considered to be *weakly exogenous*, if it does not respond to discrepancies of this system from it's long-run equilibrium. Thus, the concept of *weak exogeneity* implies that the speed of adjustment coefficient of the variables, which are considered as exogenous, α_i, must be zero (Enders, 2010:407). Hence, if all variables but the dependent variable are found to be *weakly exogenous*, then there is no loss of information "(...) in the analysis of the partial system

[66] Here, it is only tested is the hypothesis of one cointegrating relation among the variables is true or not. If however, there were two cointegrating relations, these would not be detected by the single-equation based cointegration test. In this case, the estimates of the single equation framework could also capture some effects of the second cointegrating relation and thus be spurious. More on this will be explained in the next paragraph.

[67] According to the AIC, BIC, HQC, with normally distributed residuals and without autocorrelation in the residuals.

[i.e. SEECM] as long as we are only interested in the coefficients in the partial system."(Johansen, 1992:401).

Thus, even if there is more than just one cointegrating relation among the variables, the use of SEECMs also produces efficient results, as long as the other system variables (prices and the activity variable) are proven to be *weakly exogenous*. This means that the number of cointegrating relations and of *weakly exogeneous* loading coefficients are interrelated. To fix ideas, consider the following VEC-model for export or import demand:

$$\begin{bmatrix} \triangle x_t \\ \triangle p_t \\ \triangle y_t \end{bmatrix} = \Gamma_1 \begin{bmatrix} \triangle x_{t-1} \\ \triangle p_{t-1} \\ \triangle y_{t-1} \end{bmatrix} + \begin{bmatrix} \alpha^x_{11} & \alpha^x_{12} \\ \alpha^p_{21} & \alpha^p_{22} \\ \alpha^y_{31} & \alpha^y_{31} \end{bmatrix} \begin{bmatrix} \beta^x_{11} & \beta^p_{21} & \beta^y_{31} \\ \beta^x_{12} & \beta^p_{22} & \beta^y_{32} \end{bmatrix} \begin{bmatrix} x_{t-1} \\ p_{t-1} \\ y_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{bmatrix} \tag{4.15}$$

where: $\Pi = \begin{bmatrix} \alpha^x_{11} & \alpha^x_{12} \\ \alpha^p_{21} & \alpha^p_{22} \\ \alpha^y_{31} & \alpha^y_{32} \end{bmatrix} \begin{bmatrix} \beta^x_{11} & \beta^p_{21} & \beta^y_{31} \\ \beta^x_{12} & \beta^p_{22} & \beta^y_{32} \end{bmatrix} = \alpha\, \beta'$ contains the cointegration coefficients, β', and speed of adjustment coefficients, α; and x_t could be either exports or imports, p_t the price variable, y_t the demand variable and ε_t a white-noise error term.

According to Johansen (1992), in order to guarantee an efficient estimation of import or export demand, the loading coefficients of the price and activity variable have to satisfy the following condition of *weak exogeneity*: $\alpha^p_{21} = \alpha^p_{22} = \alpha^y_{31} = \alpha^y_{32} = 0$ (and $\alpha^x \neq 0$). If this condition is satisfied, then the cointegrating vectors corresponding to α^p and α^y don't enter the elements of $\triangle p_{t-1}$ and $\triangle y_{t-1}$ and these variables are *weakly exogeneous* to the system. Then, the above system of equations reduces to:

$$\triangle x_t = \Gamma_0 \ \triangle x_{t-1} + \tilde{\Gamma}_1 \triangle z_{t-1} + \tilde{\alpha}\, \beta z_{t-1} + \tilde{\varepsilon} \tag{4.16}$$

where $\tilde{\Gamma}_1$ is a $(1x3)$ matrix and $\tilde{\alpha}$ is singular.

So to speak, in a system of equations, the test for weak exogeneity of the variables has the "last word" in the decision of the actual number of cointegrating relations. This implies, that the notion of *weak exogeneity* is a stronger condition to determine the actual number of cointegrating equations of a system of equations than the results received by the Johansen test or any other cointegration test. If for example, the Johansen test identifies two cointegrating relations in a system with three variables. And if then, it turns out that the loading coefficients of both "explanatory variables" (here prices and the activity variable) are jointly equal to zero, i.e. *weakly exogeneous*, there seems to be one instead of two cointegrating relations and one can estimate the SEECM without loss of efficiency.

Thus, to guarantee the efficiency of the estimates for Austrian and Dutch export and import demand, received by employing the single-equation framework, I have to verify that

the loading coefficients of the price and income variables fulfill the condition of *weak exogeneity*[68].

In the beginning of this subsection the concept of cointegration, and the basics of VAR- and VEC-models were introduced. In the third part, the Johansen procedure was introduced, along with the necessary concepts to understand the three-step approach to test for cointegration and to find an adequate model for the system of cointegrated variables. Also, some comments on the single steps of the procedure with reference to the testing environment of the thesis were made.
In the next subsection, the results of each single step of the Johansen procedure will be presented for intra- and extra-EMU export and import demand models separately.

4.5 Applying the Steps for the Estimation of Export and Import Demand

In the previous section I introduced the three-step Johansen procedure theoretically. In this section, I will present the results of applying it to the models for the estimation of Austrian and Dutch intra- and extra-EMU export and import demand. In addition, I also employ a model selection strategy which omits the first step of the Johansen procedure. That is, instead of first selecting a VAR-model with the adequate number of lags, and normally distributed residuals, without autocorrelation, I directly start off testing for the number of cointegration relations among the variables in the models (2nd step of the Johansen procedure). In fact, skipping this first step, I discovered that there were a lot more relevant VEC-model specifications meeting all requirements of the Johansen procedure, than if I had gone through each of the three steps. Thus, there were significantly more VEC-models which wouldn't have been considered relevant for the estimation of export and import demand by just applying the Johansen procedure, although they actually are-as we will see later. Hence, the number of models selected by the Johansen procedure is a subset of the number of models selected by this alternative method, which will be called "coint-to-VECM" in the following.

Theoretically speaking, it must hold that if a VAR-model meets all necessary requirements, such as normality and no autocorrelation of the residuals, at a certain number of lags p, then the corresponding VEC-model, as VAR-model in first differences, must also fulfill these properties at $p-1$ lags. However, it seems, there are exceptions from this theoretical considerations, as it will be shown by the alternative "coint-to-VECM" selec-

[68] And in case a globalization proxy is included in the model, it loading coefficient also has to fulfill the condition of weak exogeneity.

Table 4.8: Model selection procedure

	Johansen procedure (1.Step -3.Step)	**Coint-to-VECM** (2.Step-3.Step)
1.Step:	# of lags in VAR-model chosen according to: (i) Akaike Info Criterium (AIC) (ii) Schwarz Info Criterium (SC) (iii) Hannan and Quinn Info Criterium (HQC) (iv) Test for normality of residuals, and (v) Test for autocorrelation of residuals	**1.Step:** not applied.
	↓ ↓	↙ ↙
2. Step:	- # of cointegrating vectors ($rank(\Pi)$)? - Specification with intercept (no trend) or with intercept&trend?	
	↓ ↓	
3. Step:	- # of $(p-1)$ lags in VEC-model, corresponding to VAR-model with p lags? a) Cointegrating coefficient (β') and loading coefficient for exports/imports (α^x) significant? b) Loading coefficients of: price and income variable, and of proxy if included in model, weakly exogenous: $\alpha^p = \alpha^y (= \alpha^{proxy}) = 0$, i.e. jointly zero? c) Do cointegrating coefficients (β') have expected sign?	
	↓ ↓	
	Final Model:	
	Exclusion of all insignificant lags of the variables from the VEC-model Selected according to:	
	↙ ↘	
	Johansen procedure?	**to coint-to-VEC?**

Source: Own description.

tion method in the following. An exact listing of the single steps of both model selection methods (Johansen and coint-to-VECM) can be found in table 4.8. These steps will be explained in more detail next.

4.5.1 The Model Selection Procedure in a Nutshell

For a better understanding of the model selection procedure (combination of the Johansen and the coint-to-VEC procedure), this paragraph contains a detailed description of each of the three single steps listed in table 4.8.

First Step

In the *first step* of the Johansen procedure, VAR-models with varying lag length are set up to find the most adequate specification for the different export and import demand models. Thereby, the (i) Akaike Info Criterium (AIC), the (ii) Schwarz Info Criterium (SC) and the (iii) Hannan an Quinn Info Criterium (HQC) are used to decide upon the adequate number of lags of a particular VAR-model specification. In addition, the (iv) residuals must be normally distributed and (v) free of autocorrelation until the included number of lags.

Since I use quarterly data for the estimation of export and import demand, a maximum number of eight lags is considered adequate for the model specifications. The maximal number of eight included lags allows accounting for reactions of the system to changes in the variables, which happened maximally two years back in the past. As mentioned, this first step is skipped in the coint-to-VECM selection method.

Second Step

In the *second step* of the Johansen procedure the number of cointegrating relations ($rank(\Pi)$) is determined. This second step of the Johansen procedure is the first step of the alternative coint-to-VECM method. Both procedures suggest different ways to test for the number of cointegrating relations. The Johansen procedure takes the VAR-model specification from the first step as a starting point to test for the number of cointegrating equations. For the coint-to-VECM method on the contrary, each export and import demand model is tested for the number of cointegrating equations at varying numbers of lags. Both methods start testing for cointegration with one lag in differences. Then, the number of lags is increased step-by-step until seven lags in differences ($p - 1 = 8 - 1 = 7$ lags), which corresponds to eight lags in levels ($p = 8 lags$), are reached.

To test for the number of cointegrating equations, I used two different model specifications: one with intercept (no trend) and the other with (linear) trend and intercept. It is expected that there is one cointegrating relation among the variables in the export and import demand models.

Third Step

In the *third step* VEC-models are tested for their adequacy to be used for the estimation of export and import demand. Therefore, both, the Johansen procedure and the coint-to-VECM method go different ways to find an adequate VEC-model.

The Johansen procedure takes the VAR-model specifications meeting all requirements (i) to (v) of the first step, with a significant number of cointegrating relations from the second step, to find an adequate VEC-representation. Thereby, the VEC-models must have normal residuals free of autocorrelation (as the VAR-models).

The coint-to-VECM method, on the contrary, chooses all VEC-models with significant cointegration equations and normally distributed residuals free of autocorrelation in addition to the VEC-models selected by the Johansen procedure. Thus, the coint-to-VECM method basically selects the same VEC-models as the Johansen procedure and, on top of these, all other VEC-models with normal residuals free of autocorrelation.

To ease the structuring of the results, this third step will be subdivided into two further subdivisions:

i) The first subdivision contains all models which meet the requirements of normal residuals free of autocorrelation. Tables 4.9 and 4.10 contain the results of the three-step procedure. This subdivision will be labelled ”3. Step i)”.

ii) Regardless if the models had been selected according to the Johansen or the coint-to-VECM procedure, all chosen VEC-models had to fulfill three additional requirements a)-c), which will be explained in the following. All models meeting these three additional requirements a)- c) will be summarized under the second subdivision of the third step. It will be labelled ”3. Step ii)”. The results can be found in tables 4.9 and 4.10.

For the three additional requirements a)- c) consider model 4.15 from the previous section. In this model, the following conditions/restrictions must hold:

a) $\alpha^x \neq 0$ and the coefficients of the error correction terms x_{t-1}, p_{t-1} and y_{t-1} must be significant according to the t-test. In addition,

b) the restriction on the loading coefficients of price and income variable (eventually of the globalization proxy): $\alpha^p = \alpha^y (= \alpha^{proxy}) = 0$ must be fulfilled to guarantee that the price and income variables (the globalization proxy) are *weakly exogenous*. Meaning that prices and income (globalization) do not respond to discrepancies of the system from it's long-run equilibrium between exports/imports, prices and income (influences due to increased globalization). Hence the SEECM (compare model 4.16) with exports/imports as dependent variable can be used for the estimation of export or import demand without loss of efficiency.

c) In the SEECM with exports/imports as dependent variables, the cointegrating coefficients (error correction terms) must have the expected signs. That is, an increase in prices

must have a negative, and an increase in income a positive effect on exports/imports.
If a model fulfilled all conditions/restrictions of the previous steps, a very last step comprises the exclusion of all insignificant lags of the variables from the VEC-model. This doesn't affect the coefficients of the long-run equilibrium, but causes changes in the coefficients of determination. If a model meets even this very last requirement, then it was considered adequate for the estimation of export and import demand.
In the next subsection, I will present the overall results of the Johansen procedure and the coint-to-VECM method for intra- and extra-EMU trade and the final models, meeting all demanded requirements.

4.5.2 Results of the Model Selection Procedure

One important point to be mentioned first is, that in order not to go too much into details, only the overall results of each of the three steps of the previous section will be presented in this section. The exact listing of the VAR-models of the first step, the cointegrating relations of the second step and the final VEC-models of the third step can be found in section B.3.3 in the appendix.
A second important point concerns the definition of the term *model specification* in this section. In this section, we speak of two distinct *model specifications* of the same import or export demand *model* (with the same idenure number), if they are different with respect to the number of included lags, if they are set up with a linear trend and a constant or only a constant and if they include the globalization proxy or not. This definitional difference between *model* and *model specification* concerns table 4.8 in particular. Here, the results only refer to the number of *model specifications*, not of *models*. As such, no direct comparisons between the original number of *models* for export and import demand and the actual number of *model specifications* which meet all demanded requirements can be made.
In the following, the results of the model selection procedure for the intra-EMU and extra-EMU export and import demand models will introduced. Then, the estimation results of all models which fulfill the requirements of the three-step-procedure will be presented for Austria and the Netherlands. All tables with the detailed test results of all single steps can be found in the subsection A.3.2 to A.3.4 in the appendix.

4.5.2.1 Models for Intra-EMU Export and Import Demand

In this subsection, the results of the model selection procedure for the intra-EMU export and import demand models will be presented.
Of all Austrian intra-EMU export and import demand models, a total of 17 VAR-model specifications meet the requirements (i) to (v) of the *first step* of the Johansen procedure.

Table 4.9: Intra-EMU Models: Results of Model Selection Methods: Johansen and coint-to-VECM Procedure

Models for Intra-EMU Export and Import Demand			
Models for:	**EX-Demand**	**IM-Demand**	**total**
First Step (with proxy*)			
Austria	8 (4*)	9 (7*)	**17 (11*)**
Netherlands	16 (10*)	14 (8*)	**30 (18*)**
Third Step i) (with proxy*)			
Austria	3 (2*)	3 (3*)	**6 (5*)**
Selected according to:			
Johansen	3	3	**6**
coint-to-VECM	-	-	-
Netherlands	9 (5*)	5 (- *)	**14 (5*)**
Selected according to:			
Johansen	5	1	**6**
coint-to-VECM	4	4	**8**
Third Step ii) (with proxy*)			
Austria	2 (1*)	-	**2 (1*)**
Selected according to:			
Johansen	2		**2**
coint-to-VECM	-	-	-
Netherlands	-	3 (- *)	**3 (-*)**
Selected according to:			
Johansen	-	1	**1**
coint-to-VECM	-	2	**2**

Source: Own results.

Thereof, eight VAR-specifications are for export demand, four with and four without proxy for globalization (compare table 4.9). Nine VAR- models are for Austrian import demand, of which seven include the proxy for globalization and three don't.
For the estimation of Dutch intra-EMU export and import demand even 30 model specifications meet the requirements (i) to (v) of the *first step*. Among these, about 16 VAR-models are for the estimation of export demand, of which 10 include the proxy for globalization. The other 14 VAR-models are for the estimation import demand, of which eight models contain the proxy.
In the *second step* of the model selection procedure, only the number of cointegrating equations of the model specifications from the *first step* (Johansen) and of all other remaining models (coint-to-VECM) will be tested. In the *second step*, significant cointegration relations are found among the variables of nearly all models, also all VAR-models from the first step (at different lags, with or without globalization proxy).
Only the model specifications with normal residuals and without autocorrelation passed the first subdivision ("3. step i)"), of the *third step*. For Austria, less than half of the model specifications from the *first step* have a corresponding VAR-model specification, and thus made it through this subdivision of the *third step*: only six model specifications fulfill the requirement of normal residuals without autocorrelation, one half for export (of which two with proxy), the other half for import demand (three with proxy). All six specifications were chosen according to the Johansen procedure.
The same is true for the Dutch model specifications which made it through the first subdivision of the *third step*: only 14 specifications fulfill the requirement of normal residuals without autocorrelation; nine (five with proxy) for export and five for import demand. Most (eight) of these specifications were chosen according to the coint-to-VEC procedure.
Finally only two Austrian model specifications fulfilled the requirements a)- c) of the second subdivision ii) of the *third step* ("3. step ii)"). Both are export demand model specifications, one with and one without proxy. One of these two specifications is consumer-based, the other producer-based. Both were selected according to the Johansen procedure.
A slightly better result is achieved in the Dutch case. Here, three import demand model specifications fulfill the requirements of the second subdivision of the *third step*, of which one was chosen by the Johansen, and two by the coint-to-VECM procedure. All three specifications are consumer-based import demand models.
The detailed results of these models for Austrian export and Dutch import demand, which satisfied the requirements of all three steps, will be presented in more detail after the introduction of the results for the extra-EMU models.

Table 4.10: Extra-EMU Models: Results of Model Selection Methods: Johansen and coint-to-VECM Procedure

Models for Extra-EMU Export and Import Demand			
Models for:	**EX-Demand**	**IM-Demand**	**total**
First Step (with proxy*)			
Austria	4 (3*)	2 (2*)	**6 (5*)**
Netherlands	3 (3*)	6 (6*)	**9 (9*)**
Third Step i) (with proxy*)			
Austria	2 (2*)	1 (1*)	**3 (3*)**
Selected according to:			
Johansen	2	1	**3**
coint-to-VECM	-	-	-
Netherlands	1 (1*)	3 (3*)	**4 (4*)**
Selected according to:			
Johansen	1	3	**4**
coint-to-VECM	-	-	-
Third Step ii) (with proxy*)			
Austria	-	-	-
Selected according to:			
Johansen	-	-	-
coint-to-VECM	-	-	-
Netherlands	-	1 (1*)	**1 (1*)**
Selected according to:			
Johansen	-	1	**1**
coint-to-VECM	-	-	-

Source: Own results.

4.5.2.2 Models for Extra-EMU Export and Import Demand

The results of the model selection procedure for the extra-EMU export and import demand models look a lot poorer than those for intra-EMU demand. They will be presented next.

For Austrian extra-EMU trade, only six (five with globalization proxy) model specifications meet the requirements of the *first step*, of which four are for the estimation of Austrian export demand (three with proxy) and two for import demand (both with proxy) (compare table 4.10). Again, significant cointegration relations are found among the variables of nearly all VAR-models in the *second step* of the selection procedure. And, although about three (all with proxy) of the VEC-model specifications corresponding to the VAR-models form the first step meet the requirements of normal residuals without autocorrelation, none fulfills all requirements of the *third step*.

With nine model specifications, there are slightly more models for the estimation of Dutch extra-EMU trade, which make through the *first step*. Thereof, three specifications are for export demand and six for import demand. All nine specifications include the proxy for globalization. From these nine models, only one import demand model specification meets all requirements of the *third step*. It has been chosen according to the Johansen procedure, includes the globalisation proxy and is producer-based.

In the next section, I will present the two model specifications for Austrian export demand and the three Dutch import demand model specifications for the estimation of intra-EMU trade, as well as the Dutch import demand model for extra-EMU trade in more detail.

4.5.3 Final Import and Export Demand Models

In this subsection, the results of the final models for Austrian and Dutch import and export demand will be presented and interpreted. Despite the initially large number of models used for the estimation of Austrian and Dutch import end export demand, the number of models remaining after applying the steps of the model selection procedure, is rather small. Of 48 models, for Austrian and Dutch intra-EMU trade, only two of the Austrian and three of the Dutch models fulfilled all necessary requirements. In the following paragraph, first the Austrian export demand model and then the three Dutch import demand models will be presented.

4.5.3.1 Final Export Demand Models for Austria

As a result of the selection procedure described in the previous section, two model specifications for the estimation of Austrian export demand, and none for import demand, fulfilled all imposed requirements. One model specification, $1a_ii$, is formulated in terms of the consumer-based approach. It includes seven lags in differences and the proxy for glob-

Table 4.11: Austria: Models for intra-EMU trade

Intra-EMU, Exports		
Model #	**1_a_ii**	**7a**
# of lags	7	5
# of cointegrating vectors	3	3
Specification	with proxy	with trend
Vector error correction term		
EX_{EMU}	1.00	1.00
$REER^{ex}_{CPI}$	8.48	
$[t-value]$	[2.06]	
$REER^{ex}_{ULC}$		6.52
$[t-value]$		[8.13]
$final_consumption_{EMU}$	-2.87	
$[t-value]$	[-9.30]	
IP_ind_{EMU}		-0.81
$[t-value]$		[-3.05]
Proxy	0.34	-
$[t-value]$	[2.44]	
Trend	-	- 0.01
$[t-value]$		[-4.74]
Constant	-8.86	-35.69
Loading coefficients		
α^x	- 0.55	-0.49
$[t-value]$	[-2.90]	[-2.90]
α^p	- 0.01	-0.06
$[t-value]$	[-0.87]	[-1.60]
α^y	- 0.00000273	-0.15
$[t-value]$	[-0.00014]	[-1.92]
α^{proxy}	-0.23	-
$[t-value]$	[-1.76]	
$\alpha^p = \alpha^y = \alpha^{proxy} = 0$		
Chi-square	7.53	4.45
$(p-value)$	(-0.06)	(-0.11)
$adj.R^2$	0.5482	0.5983

Source: Own results.

alization (compare table 4.11). The model specification contains three significant cointegration relations at seven lags in differences. The loading coefficients of all variables, except that for exports, fulfill the condition for weak exogeneity, i.e. $\alpha^p = \alpha^y = \alpha^{proxy} = 0$. Thus, a SEECM, with only exports as dependent variable, can be used to get efficient estimation results for export demand with this specification. The demand for Austrian exports to the EMU is explained by the REER based on consumer prices, as price variable, the final private household consumption of Austria's trading partners as income variable and the proxy for globalization to account for the globally increased division of labour. The coefficients of the error-correction terms of these variables and the loading coefficient for exports, α^x, are all significant and show the expected positive (income variable) or negative (price variable) signs.

The second model for export demand, $7a$, is formulated in terms of the producer-based approach. It includes five lags in differences and a linear trend. There are two significant cointegrating equations, and thus $rank\ \Pi < n$. As in the previous model, the loading coefficients of all variables, except that for exports, also fulfill the condition of weak exogeneity (compare table 4.11). Meaning, that also for this model, a SEECM can be fitted without loss of efficiency. In this producer-based model, the price component is modeled by the REER based on unit labour costs, while the index for industrial production of all trading partners serves as income variable. A simple linear trend, instead of the proxy for globalization, serves as component to account for effects on export demand, which are not captured by the other two variables. As in the first model, also all error-correction terms of the second model and the loading coefficient for exports, α^x, are all significant and have the expected positive or negative signs. As described in table 4.8, the very final step of the model selection procedure comprises the exclusion of all insignificant lags of the variables from the VEC-model. The results of this very last step will be shortly presented in the following part.

After excluding all insignificant lags of the first model ($1a_ii$) and running the reduced regression, most of the remaining included lags become insignificant as well. In particular, the loading coefficient on exports, α^x, becomes insignificant. This implies, that now none of the included variables has a significant influence on the long-run equilibrium and the model specification becomes useless. Thus, model $1a_ii$ is not considered anymore. Unlike the first model $1a_ii$, the second model specification, $7a$, produces significant results after the exclusion of all insignificant lags, and re-running the regression. I get the following result: (*see next page*)

Model 7*a* with seven lags:

$$
\begin{aligned}
\triangle EX_{EMU} \;=\; & -0.49\,(EX_{EMU_{t-1}} + 6.52\,REER^{ex}_{ULC_{t-1}} - 0.81\,IP_ind_{EMU_{t-1}} \\
& \quad [-3.80] \\
& -0.01\,trend(95Q1) - 35.69) \;\; + 2.55\;\triangle REER^{ex}_{ULC_{t-1}} + 2.64\;\triangle REER^{ex}_{ULC_{t-2}} \\
& \qquad\qquad\qquad\qquad\qquad\qquad [3.24] \qquad\qquad [3.13] \\
& +2.30\;\triangle REER^{ex}_{ULC_{t-3}} + 1.37\;\triangle REER^{ex}_{ULC_{t-4}} + 1.08\;\triangle REER^{ex}_{ULC_{t-5}} \\
& \quad [3.36] \qquad\qquad [2.39] \qquad\qquad [2.17] \\
& -0.72\;\triangle IP_ind_{EMU_{t-5}} + 0.02 \\
& \quad [-3.83] \qquad\qquad [3.88]
\end{aligned}
$$

$adj.R^2$: 0.5454, DW: 1.66

The dummies to correct for seasonal irregularities do not enter the reduced-form model. As expected, the exclusion of the insignificant lags hasn't changed the coefficients of the long-run relation in the model. The loading coefficient of exports, α^x, is highly significant at the 1%-level[69](t-value:$|t|$= 3.8) and negative. It indicates that exports adjust quite quickly to deviations from the long-run equilibrium. Almost 50% of the adjustment is completed after one quarter. Prices and industrial production, as well as unobserved components captured by the linear trend, have a significant effect on the long-run equilibrium. Thereby, prices have an more-than-proportional influence on exports in the long run: an increase of the relative unit labour costs by 1% reduces Austrian exports to the EMU-area by 6.52%. The effect of the income component is more moderate: an increase in the industrial production of all other EMU-member states, except Austria, by 1% increases Austrian exports to the EMU-area by about 0.81%. Unobserved components, captured by the linear trend, have with 0.01% a very low effect on Austrian exports.

In the short-run, Austrian exports to the EMU are positively influenced by the wages price dynamics of the previous five quarters. Also, the dynamics of the industrial production of all trade partners, five quarters back in time have a positive effect on Austrian exports. Nearly all coefficients of the differenced terms are significant at the 1%-level[70].

The adjusted R-squared is slightly lower than before excluding the insignificant lags[71],

[69] Model 7*a* has 56 degrees of freedom (64 observations per variable- 8 estimated parameters=56), which, at the 1%-level corresponds to a critical value of the t-distribution of about 2.66 (two-sided test).

[70] Except that of the fifth lag of the differenced unit labour cost term, which is significant only on the 5%-level, which corresponds to a critical value of the t-distribution of about 2.00 (two-sided test, 56 degrees of freedom)

[71] $adj.R^2_{all\ lags}$: 0.5983 vs. $adj.R^2_{less\ lags}$: 0.5454.

which is most likely a consequence of the exclusion of a huge number of lags. The Durbin-Watson (DW) test statistic doesn't allow any conclusion about the presence of autocorrelation of the residuals[72]. According to the Portmanteau Autocorrelation test however, as in the specification with all lags, the residuals of the reduced specification aren't autocorrelated and also normally distributed[73].
The high price elasticity of the REER based on unit labour costs in the model specification $7a$ is striking. According to the model theoretical assumptions, this elasticity should lie between zero and one, and according to the results of other empirical studies not higher than -2.5. While the income elasticity lies within the expected range, the reasons for this extremely high price elasticity are very likely to be due to data problems or in the construction of the REERs. Before going into details at this point, I will first present the results of the Dutch models, which have similar problems, as it can be seen in the next section. A possible reasoning for the high elasticities will follow in the section thereafter.

4.5.3.2 Final Import Demand Models for the Netherlands

All in all, four Dutch model specifications meet all requirements of the model selection procedure of the previous section- three for the estimation of intra-EMU and one for the estimation of extra-EMU import demand. Two of the three intra-EMU import demand model specifications are different versions of the same model, $1b_ii$. One specification of this model includes five, the other seven lags in differences (compare 4.12). The third model specification, $2d$, includes seven lags in differences. For all three models specifications, there is exactly one significant cointegrating relation. All three intra-EMU specifications for import demand are formulations of the consumer-based approach. Thus, all three models include a real effective exchange rate based on consumer prices as price variable. Both specifications of the same model, $1b_ii$, use final consumption of all EMU-countries' households, but Dutch, the third intra-EMU model specification, $2d$, gross domestic domestic product (GDP) of all EMU-countries, except of the Netherlands, as income variable. The coefficients of the error-correction terms and the loading coefficients on exports are significant in all three model specifications (criterion a)) and show the expected signs (criterion c). The zero-restriction on the loading coefficients of the price and income variable can't be rejected in all three intra-EMU specifications (criterion b), and thus a SEECM can be used for the estimation of these specifications. Among all intra-EMU model specifications, the third specification $2b$ has with 79.69% the highest adjusted R^2. Of both specifications from model $1b_ii$, the specification with seven lags

[72]The value of 1.66 lies exactly in the range between the upper (1.726) and lower (1.114) bound of the critical values of the DW statistic. Thus, the null hypothesis of no autocorrelation of the residuals (serially independent) can neither be rejected, nor not rejected. The test is inconclusive.

[73]As before, in the test for normality of the residuals (Cholesky of covariance (Lutkepohl)), the null of multivariate normal residuals cannot be rejected.

Table 4.12: Netherlands: Models for intra- and extra-EMU trade

Intra-EMU, Imports				**Extra-EMU, Imports**
Model #	**1b_ii**	**1b_ii**	**2b**	**7d**
# of lags	5	7	7	7
# of cointegrating vectors	1	1	1	2
Specification	-	-	-	with proxy
Vector error correction term				
IM_{EMU}	1.00	1.00	1.00	-
$IM_{extra-EMU}$	-	-	-	1.00
$REER^{im}_{CPI}$	5.14	5.14	5.50	-
$[t-value]$	[4.15]	[8.85]	[8.25]	
$REER^{im}_{ULC}$	-	-	-	0.32
$[t-value]$				[5.55]
$final_consumption_{(NL)}$	-2.30	-2.78	-	-
$[t-value]$	[-10.24]	[-21.28]		
$GDP_{(NL)}$	-	-	-2.50	-1.94
$[t-value]$			[-19.05]	[-20.62]
Proxy	-	-	-	-0.16
$[t-value]$				[-2.99]
Trend	-	-	-	-
Constant	-7.5848	-2.10	-6.23	10.83
Loading coefficients				
α^x	-0.30	-0.68	-0.57	-0.96
$[t-value]$	[-3.51]	[-4.11]	[-2.71]	[-2.45]
α^p	0.01	0.02	-0.01	-1.40
$[t-value]$	[1.36]	[0.79]	[-0.43]	[-0.98]
α^y	-0.01	0.03	-0.03	-0.08
$[t-value]$	[-0.91]	[0.81]	[-0.62]	[-0.87]
α^{proxy}	-	-	-	0.16
$[t-value]$	-	-	-	[0.20]
$\alpha^p = \alpha^y = \alpha^{proxy} = 0$				
Chi-square	3.95	1.31	0.50	1.55
$(p-value)$	(-0.14)	(-0.52)	(-0.78)	(-0.67)
adj. R-squared	0.6857	0.7326	0.7969	0.8114
F-statistic	8.01	7.47	5.34	3.50
Akaike AIC	-3.58	-3.68	-3.40	-3.59
Schwarz SC	-2.90	-2.77	-2.49	-2.43

Source: Own results.

has with 73.26 a slightly higher adjusted R^2 than that with five lags with an adjusted R^2 of 68.57. According to the Akaike Info Criterion (AIC), the specification with five lags, and according to the Schwarz Criterion (SC) that with seven lags should be preferred.
While the AIC prefers that model of the sample, which fits the data best and thus minimizes the loss of information, the SC, on the contrary, tries to find the model, which minimizes the loss of information and fits the theoretical assumptions best. It has been shown that the AIC should be preferred over the SC from a theoretical and practical stance[74].
As the AIC, also the F-test indicates that the model with five lags should be favoured over that with seven lags. We will come back to these facts after the last step of excluding all insignificant lags.
The model for the estimation of extra-EMU import demand, $7d$, is formulated according to the producer-based approach. It includes seven lags in differences (compare 4.12). The Johansen test indicates two significant cointegrating relations at these seven included lags. In addition, this model specification contains the proxy for globalization. In this specification, the real effective exchange rate based on unit labour costs serves as price, and the GDP of all extra-EMU trade partners as income variable. As for intra-EMU imports, the specification for extra-EMU imports meets all additional requirements a) to c). All coefficients of the error-correction terms and α^x are significant and have the expected signs. Also, the weak exogeneity condition holds for this model specification. Thus, a SEECM can be used to estimate import demand without loss of efficiency.
Also for these model specifications, the final step of the model selection procedure, the exclusion of all insignificant lags of the variables from the VEC-model, was applied. The results will be presented in the following.
As in case of the Austrian model specifications, in the final step of the model selection procedure, all insignificant lags of the explanatory variables were excluded. Then, the reduced model was re-estimated. If all variables in the reduced form model were significant, the exclusion procedure stopped. Otherwise, the insignificant lags were again excluded and the model again re-estimated.
After the first round of excluding all insignificant lags, only the reduced-form versions of the two intra-EMU specifications of the same model, $1b_ii$, showed significant results. The loading coefficient of imports, α^x, of the other two specifications, $2b$ and $7d$ and most of the other included lags became insignificant. Thus, none of the included variables has a significant influence on the long-run equilibrium. Both models, $2b$ and $7d$, were not considered further. The results and interpretation of the remaining two specifications will be presented next.

[74] As it has been argued and shown for example by Anderson and Burnham (2002:298), who performed simulation s to compare both criteria. Their theoretical and their practical simulation results show, that the AIC has better properties the SC.

Model $1b_ii$ **with five lags:**

$$\begin{aligned}
\triangle IM_{EMU} \;=\; & -0.26\,(IM_{EMU_{t-1}} + 5.14\,REER^{im}_{CPI_{t-1}} - 2.30\,final_consumption_{NL_{t-1}} - 7.59) \\
& \quad [-4.70] \\
& +0.31\;\triangle IM_{EMU_{t-1}} - 0.23\;\triangle IM_{EMU_{t-4}} + 5.34\;\triangle REER^{im}_{CPI_{t-3}} \\
& \quad [3.06] \qquad\qquad [-2.42] \qquad\qquad [4.52] \\
& +1.14\;\triangle final_consumption_{NL_{t-2}} + 1.28\;\triangle final_consumption_{NL_{t-3}} \\
& \quad [3.62] \qquad\qquad\qquad\qquad [3.29] \\
& +2.17\;\triangle final_consumption_{NL_{t-4}} - 0.08\;D2 \\
& \quad [5.51] \qquad\qquad\qquad\qquad [-4.63]
\end{aligned}$$

$adj.R^2$: 0.6857, DW: 1.96

Model $1b_ii$ **with seven lags:**

$$\begin{aligned}
\triangle IM_{EMU} \;=\; & -0.28\,(IM_{EMU_{t-1}} + 5.14\,REER^{im}_{CPI_{t-1}} - 2.78\,final_consumption_{NL_{t-1}} - 2.10) \\
& \quad [-3.99] \\
& +0.48\;\triangle IM_{EMU_{t-1}} + 5.41\;\triangle REER^{im}_{CPI_{t-3}} + 0.81\;\triangle final_consumption_{NL_{t-2}} \\
& \quad [4.53] \qquad\qquad [4.02] \qquad\qquad [2.46] \\
& +1.38\;\triangle final_consumption_{NL_{t-4}} - 0.09\;D2 \\
& \quad [3.92] \qquad\qquad\qquad\qquad [-5.83]
\end{aligned}$$

$adj.R^2$: 0.5857, DW: 2.08

The first of the two final specifications of the model $1b_ii$ is includes five lags in differences, the second seven lags. In both specifications, the dummy for the second quarter to correct for seasonal irregularities enters the model. As before, the exclusion of the insignificant lags hasn't changed the coefficients of the long-run equilibrium in the specifications. The speed of adjustment coefficient of imports is in both model specifications negative and significant at the 1%-level[75] (t-value first model: $|t|$=4.70, of the second model: $|t|$=3.99). The speed of adjustment coefficients indicate that both in specifications the imports react quite similar to deviations from the long-run equilibrium: about 26% of the adjustment in the first (with five lags) and round 28% in the second (with seven

[75]Model $7a$ has 56 degrees of freedom (64 observations per variable- 8 estimated parameters=56), which, at the 1%-level corresponds to a critical value of the t-distribution of about 2.66 (two-sided test).

lags) specification is completed after one quarter. Thus, the speed of adjustment of Dutch imports is significantly lower than that of Austrian exports.

All explanatory variables, the real effective exchange rate and final consumption have a significant effect on the long-run equilibrium. This time, the price and income variable in both specifications have a more-than-proportional effect on exports. An increase of the relative consumer prices by 1% reduces Dutch imports from the EMU by 5.14% in both model specifications[76]. And an increase of the final consumption expenditure in the Netherlands increases Dutch imports from the EMU by 2.30% in the first and by 2.78% in the second model. Thus, the income elasticity of import demand in the second specification is slightly higher, while the price elasticity is the same in both specifications.

In the short-run, Dutch imports from the EMU in the first model specification are positively influenced by the dynamics of the intra-EMU imports from the previous quarter and negatively by the dynamics of the intra-EMU imports four quarters ago. The short-run dynamics of the first specification are positively influenced by the final consumption expenditure two, three and four quarters back in time. Also, the short-run changes in prices three quarters back influence Dutch imports from the EMU positively. The parameters of all differenced terms are significant at the 1%-level.

The short-run dynamics of the second model specification look pretty much alike that of the first: Dutch imports from the EMU in are positively influenced by the dynamics of the intra-EMU imports from the previous quarter, by the relative consumer prices three quarters back and by the final consumption expenditure two and four quarters back in time. Also in the second specification, the parameters of almost all differenced terms are significant at the 1%-level[77]. In both specifications, the dummy for the second quarter to correct for seasonal irregularities has a significantly (1%-level) negative effect on Dutch intra-EMU imports. The short-run dynamics of all other lagged variables do not have an significant effect on Austrian exports.

As in the Austrian case, the value of the adjusted R-squared of the second model specification lies below the value of the unreduced model[78] after the exclusion of all insignificant lags. This isn't the case for the first specification. Here, the the value of the adjusted R-squared before and after the lag-exclusion is exactly the same[79]. As before the exclusion of all insignificant lags, the Durbin-Watson (DW) statistic indicates no serial autocorrelation among the residuals of both model specifications[80], which is confirmed by the

[76] Looking at the decimal places, there is a slight difference between the price elasticities of both model specifications. The specification with five lags depicts a minimally higher price elasticity than that with seven lags.

[77] With the exception of the second lag of the differenced term of final consumption in the second model, which is only significant at the 5%-level.

[78] $adj.R^2_{all\ lags}$: 0.7326 vs. $adj.R^2_{less\ lags}$: 0.5857.

[79] $adj.R^2_{all\ lags}$: 0.6857 vs. $adj.R^2_{less\ lags}$: 0.6857.

[80] The DW-values of both models lie above the upper bound of the critical values of the DW-statistic.

Portmanteau Autocorrelation test. Also, the residuals of both specificatios are normally distributed[81].
As in the Austrian export demand model, the price elasticities of the Dutch import demand models, and in addition, the income elasticities of the Dutch models, are extraordinarily high, compared to the results of other empirical studies. Thus, it is reasonable to conclude that possible causes for these irregularities could lie in the construction of the REERs or could be due to data problems. These possible causes will be discussed next.

4.5.4 Discussion of the Estimation Results

The striking result of extraordinarily high price elasticities for Austrian and Dutch export and import demand models at the same time doesn't appear to be in line with those of other empirical studies. It seems self-evident to conclude that these high elasticities might have reasons which are special to this study, and thus aren't comparable with the "regular" complications of the studies estimating export and/or import demand[82]
Since the construction of the variables was carried out in line with the methods of other empirical studies[83], the only possible reason for these high elasticities in mine eyes, lies in the problems caused by the bad data unavailability of some time series- in particular in case of the data used for the estimation of intra-EMU trade and even more particular, in case of the price indices for the construction of the REERs for intra-EMU trade.
In the data section, I already mentioned that, due to data availability problems, I had to shorten the observation period by five years, from 1990 to 1995. This reduction occurred mainly due to the data problems of the price indices. Mostly in case of the bigger and less of the smaller EMU-countries, these indices weren't consistently available from one fixed date onwards. So that it wouldn't even have made sense to restrict the entire sample to the biggest EMU-countries, since the same problems would have been persisting. For example, the producer price index for the entire industry wasn't even available since 1995 for: Belgium (from 2001Q1), Cyprus (from 2000Q1), France (from 2005Q1), Italy (from 2002Q1), Malta (from 2005Q1), Slovak Republic (from 2003Q1), Slovenia (from 1998Q1) and Spain (from 2000Q1). These data problems were mainly present in case of the producer price indices, less in case of the consumer price and unit labour cost indices. Unfortunately, these data problems were present in case of all three data sources used, namely the OECD, EUROSTAT and the IMF databases.
One restriction resulting from these data unavailabilities concerned the length of the es-

The upper bound critical value for the first model is 1.726, for the second 1.639. Both are smaller than the DW-values of both models (first model: 1.96, second model: 2.08).

[81] As again indicated by the Cholesky of covariance of Lutkepohl.

[82] Such as complications due to unobserved effects, which aren't captured by the price and activity variable, or which are due to functional restrictions, etc.

[83] In particular the study of Stephan (2005).

timation period. In order not to loose too many observation points, and thus degrees of freedom, I had to guarantee a observation period of all variables, which was as long as possible. There was a trade-off between the number of available time series for as many countries as possible at the chosen starting point and of loosing degrees of freedom by shortening the observation period for the estimation of import and export demand models. Thus, on one hand, I had to ensure that at the chosen starting date, all time series were available for most, and preferably the biggest, EMU-countries. On the other hand I had to pay attention to keep the time period of the time series as long as possible in order not to loose too many degrees of freedom. This was one restriction I had to face.
Another restriction resulted from different definitions and thus scopes of the price indices. For example, the producer price index for the industry provided by EUROSTAT is available for the prices of all goods produced for the domestic and the export sector (or the export sector separately), while the price index of the IMF (IFS database) is only available for all goods produced for the domestic market. Thus, it wasn't always possible to combine the time series of the price indices in order to get a complete sample, at least for the biggest EMU-countries, which started from 1995.
At the finally chosen starting date, 1995Q1, still not always all time series were available for all countries, as for example in case of the producer price index for the entire industry[84]. In mine eyes, these data unavailabilities of the time series of some EMU-countries could be the cause for the high price, and partly for the income, elasticities. If, as for example in case of the aforementioned producer price index for the entire industry, the price indices of some (bigger) countries started at later dates than 1995Q1, then these later starting points could cause sudden increases in the scale of the REERs and thus lead to irregularities in the estimated elasticities. This could be the case, since for the construction of the different REERs, the individual price indices of all trade partners are needed. If then for some partner countries, these price indices (especially of the bigger countries) aren't available from 1995Q1 onwards, but start a few years later, they cause sudden increases in the scale of the REERs and thus could bias the estimation results.
Although a large number of import and export demand models contained the REERs based on producer prices as price variable, none of these models made it through all model selection criteria. In addition, the problem of data unavailability was in particular true for the producer price indices. Taking these two facts together, I think that the cause for the high elasticities lies in the data unavailabilities and thus later starting points of the time series of some countries mentioned in the previous paragraph.
If this is true, then there are only three possible solutions in order to get consistent results for the estimation of export and import demand models. One is to find a way to data,

[84]Here, the price indices for France and Ireland from EUROSTAT were replaced by the price indices from the OECD.

which isn't publicly available to users of the IMF, OECD or EUROSTAT database. A second solution is to wait some more years to get larger time series. A third possible solution would be to reduce the number of EMU-countries used for the estimation of export and import demand. But, this doesn't prevent the researcher from facing the above described trade-off between finding a common starting point for all variables which dates as far back in time as possible and having a complete set of time-series which is available from this very starting point onwards, for preferably all countries (or at least the majority of countries).
Apart from the above mentioned data problem, one could assume that another reason for the large elasticities could lie in the insufficient number of degrees of freedom, due to a rather short observation period of 16 years (1995-2011). Since quarterly data is used for the estimation of Austrian and Dutch import and export demand, this corresponds to 64 degrees of freedom. The final Austrian export demand model and the Dutch import demand models contain on average, nine to ten parameters. Thus, these models still have 54 to 55 degrees of freedom, which should suffice to get consistent results of the estimated parameters. Hence, it is very unlikely, that the rather short observation period caused the high elasticities.

In this chapter, the results of the model selection procedure for Austrian and Dutch import and export demand models were presented. Of the initially large number of models, only one model specification for Austrian export demand and two for Dutch import demand fullfilled all criteria of the selection procedure. Because of their high price elasticities, and partly their high income elasticities, even these three model specifications do not allow drawing any serious conclusions for Austrian and Dutch import and export demand.

5 Conclusion

The purpose of the thesis was to analyze the determinants of intra- and extra-EMU import and export demand for Austria and the Netherlands- in particular the price and income effects of demand. As part of the large-scale EMU-project of the Macroeconomik Policy Institute (IMK), the analysis of Austrian and Dutch import and export demand should help to explain the causes for the huge divergences in the external sectors of the EMU-countries.

Looking at the results for price and income elasticities obtained from the previous sections, no exact statement can be made about the effects of these determinants on import or export demand. Not to speak of conclusions for future developments of Austrian or Dutch imports and exports resulting from changes in these variables. The striking point is that, of the initially large number of import and export demand models, only very few met all requirements of the model selection criteria. Of 48 models, for Austrian and Dutch intra-EMU trade, only one of the Austrian and two of the Dutch models fulfilled all necessary requirements. Other studies (as for ample Stephan (2005)) have shown higher success rates in terms of significant models. It is however difficult to draw conclusions for the results received for Austrian and Dutch import and export demand, since there are no studies on the EMU-area which are of comparable scope as this thesis. Consequently, a final judgment, if the number of successful import and export demand models is small or large, is hard to render. In addition, despite the fact that three models, namely the Austrian model for export demand and the two models for Dutch import demand, fulfilled all requirements of the testing procedure, the high elasticities in all three models cast doubts on their explanatory power and reliability. Thus, the bottom line of this thesis is, that, notwithstanding all the efforts invested in the formulation and estimation of import and export demand models, the outcome of this process is rather meager.

As mentioned in the previous subsection, the I guess that the reason for this meager outcome is a data problem- in particular of the data for intra-EMU trade. Namely, the data problem arising from the unavailability of some important time-series, as for example the price indices needed for the construction of the REERs. The data unavailability makes it hard to find a common starting date for all variables, since there is a trade-off between the length of the observations period used for the estimation of import and export demand models and the question if there is enough data for all countries at the chosen starting date in order to get consistent estimates. This data unavailability can become a problem for the entire project of the IMK, since many time-series used for Austria and the Netherlands will also be needed for the estimation of the import and export demand of the other EMU-countries.

The only possible solutions in mine eyes are either to find access to time-series for all

EMU-countries, which reaches back further in time than those employed in this study. Or, if such data isn't available at all, to wait some years to get data with enough observation points for a decent estimation analysis for all EMU-countries. A third solution would be a reduction of the number of countries used for the estimation of import and export demand. This however, doesn't necessarily prevent the researcher from facing the same above mentioned data problems (as it was argued in the previous section).
The above described data problem is in line with the results of at least two previous studies on the EMU-area, namely that conducted by the Banco de Espana (2003) and Allard et al. (2005). Despite the fact that both studies use much longer time-series (starting in the 1970ies) than this study, they get similar inconclusive results. This could mean two things. Either, that these two studies had to face the same problem of not having complete sets of time-series for all countries in the sample at the same starting point in time (the length of the overall time period wasn't a problem this time). Or, that the empirical method, of estimating import and export demand, as such has to be questioned. This conclusion is reasonable, since, apart from the two above mentioned, there exists a number of empirical studies in the literature which give further reasons for these kinds of doubts.
Alternatively, one could analyze the imports and exports of all EMU-countries and all involved variables qualitatively, as it has been done in the third chapter. This way, one can also learn a lot about the possible causes of the huge divergences in the external sectors of the EMU-countries. However, also such an descriptive analysis has its limitations, since it doesn't allow any *ceteris paribus* conclusions of the effects possible determinants are having on import and export demand. Therefore, a statistical analysis must be performed.
Because of the rather disappointing results of this study, it would be interesting to see the estimation results of the import and export demand models for the remaining EMU-countries. And to see if, in fact, the import and export demand models for the other EMU-countries gave approximately equivalent results, or if these meager outcome is unique to this study.

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A Appendix

A.1 Overview of Studies Analyzing the Export and Import Demand of the EMU, Results of the Estimated Price and Income Elasticities

In this subsection of the appendix, an overview of studies analyzing the export and import demand of the EMU, as well as the the results of the estimated price and income elasticities will be presented.

Table A.1: Overview: Studies of EMU- EU Export-/ Import Demand I

Author(s)	Model for	EX/IM of	Estimation Method	Countries (Sample)
Intra- and Extra-EMU				
Banco de Espana (2003)	EX-demand	EX of goods	ECM[1]-model	EMU-11 (AT, BE, FI, FR, GER, GR, IR, IT, NL, PT, SP)
Aim(s): Provide empirical evidence for sensitivity of the EMU-countries' EX-demand; understand reasons for divergences of Euro-Area. **Finding(s):** Behaviour of the determining variables does not satisfactorily explain the marked differences in export growth.				
di Mauro and Maurin (2005)	EX-demand	EX of goods & services	ECM[1]-model	EMU, FR, GER, IT, NL, SP
Aim(s): Formal investigation of the explanatory power of price competitiveness and foreign demand for EX-demand. **Finding(s):** Growth of world demand is most important determinant of export growth over the sample period (1992-2003); increase in the Euro areas export deflator partly counterbalances the rise in competitors prices due to the protracted Euro depreciation; two country-groups: profiteurs (high price competitiveness -¿ high demand), "losers" (vice versa)				
Allard et al. (2005)	EX- and IM demand	Goods & services (separately)	ECM[1]-model	FR, GER, IT, SP
Aim(s): Assess the effect of traditional determinants of exports and imports (demand and cost& price competitiveness) on trade volumes 2001-2004. **Finding(s):** Traditional factors to explain import and export demand go a long way in explaining differences across countries EX/IM; unexplained residuals → unobservable/omitted factors remain.				
Anderton et al. (2005)	IM-demand	IM of goods	Simultaneous equation framework using 3SLS[3]	EMU-9 (BE, FR, GER, IR, IT, LUX, NL, PT, SP)
Aim(s): Understanding of the key determinants of intra- and extra-Euro area imports. **Finding(s):** Significant substitution effects between intra- and extra-Euro area imports due to changes in their relative prices; exchange rate volatility decreases trade vis--vis regions characterized by volatility and leads to substitution of trade away from higher-volatility regions towards lower-volatility regions.				

Source: Own compilation.

[1] Error correction model.

[2] Fixed effect regression.

[3] Three-stage least squares.

[3] Error correction model with an unobserved component term.

Table A.2: Overview: Studies of EMU- EU Export-/ Import Demand II

Author(s)	Model for	EX/IM of	Estimation Method	Countries (Sample)
Intra- and Extra-EMU				
Ca'Zorzi and Schnatz (2007)	EX-demand	EX of goods & services	ECM[1]-model	EMU
Aim(s): Find the ideal indicator of international cost and price competitiveness that best explains and helps forecast export developments; systematical comparison of the properties of the alternative cost and price competitiveness measures of the Euro-area. **Finding(s):** No indicator consistently outperforms the other in terms of explaining and forecasting Euro-area exports; measures based on consumer and producer prices are good approximations of Euro-area price and cost competitiveness.				
Hervé K. et al. (2010)	EX- and IM demand	Goods & services	ECM[1]-model	EMU, JAP, OECD, USA
Aim(s): Estimate trade volume equations as part of the new global model. **Finding(s):** Exports from Japan and the non-OECD economies, especially in Asia, are found to be more sensitive to movements in relative prices; for most countries, import volumes are typically less sensitive to relative prices than export volumes; export volumes are typically faster to adjust than imports, though there are some exceptions.				
Bayoumi, Harmsen, Turunen (2011)	EX-demand	EX of goods	Country FE-regression[2]	EMU-11 (AT, BE, FI, FR, GER, GR, IR, IT, NL, PT, SP)
Aim(s): Analyzing export growth within the Euro area peripheral countries with respect to their competitiveness. **Finding(s):** (i) Long-term price elasticities for intra-Euro area exports are at least double those for extra-Euro area exports; traditional real effective exchange rate indexes may overstate the effectiveness of Euro depreciation in restoring exports growth in the Euro-area periphery; (ii) there are surprisingly wide divergences across alternative relative price measures and even when relative price data suggest a steady loss in intra- (and extra-) Euro-area competitiveness, the pace of deterioration depends on the measure of relative prices used.				

Source: Own compilation.

[1] Error correction model.

[2] Fixed effect regression.

[3] Three-stage least squares.

[3] Error correction model with an unobserved component term.

Table A.3: Overview: Studies of EMU- EU Export-/ Import Demand III

Author(s)	Model for	EX/IM of	Estimation Method	Countries (Sample)
Intra- and Extra-EMU				
Deutsche Bundesbank, Montly Report, July 2011, p. 32	EX-demand	EX of goods	n.n.	EMU-10 (AT, FI, FR, GER, GR, , IR, IT, NL, PT, SP)
Aim(s): Estimation of EX-demand to supplement the statistical analysis of export growth components in the EMU 4 of the report. **Finding(s):** Results confirm findings of report.				
Algieri (2011)	EX-demand	EX of goods & services	ECM-model with UC[4]; Discrete-time stochastic State Space Model	EMU, FR, GER, IT, NL, SP, JAP, UK, USA
Aim(s): Analysis of external sector for the Euro Area and its major competitors, quantifying key determinants of trade to export volume behaviour; in addition to price and foreign demand variables, an unobserved component in the form of a time-varying trend to capture underlying non-price competitiveness enters the export equations. **Finding(s):** The findings confirm that stochastic trends are present as a result of technical change and other exogenous factors driving export ows, and that a failure to account for these trends will lead to biased estimates of long-run price elasticities.				
Intra-EMU				
n.n.				
Extra-EMU				
Anderton et al. (2004)	EX- and IM demand	IM and EX of goods	ECM[1]-model	FR, GER, IT, SP
Aim(s): Quantifying the possible impact of external shocks on the Euro-area originating from trade developments; shed light on the factors behind the trends in the goods balance described paper. **Finding(s):** Estimation results very sensitive to the price and income factors used to explain EX/IM.				
Quarterly Report on the Euro-Area (2004, Vol. 3, No.1)	EX-demand	EX of goods & services	ECM[1]-model	EMU
Aim(s): Assessing the relative importance of trade and exchange rate effects. **Finding(s):** Obtained elasticities are consistent with estimates in the literature.				

Source: Own compilation.

[1] Error correction model.

[2] Fixed effect regression.

[3] Three-stage least squares.

[3] Error correction model with an unobserved component term.

Table A.4: Overview: Long-run Price- and Income (Production) Elasticities of Export and Import Demand I

Country	$REER_{EX}$	$REER_{IM}$	Y_{EX}	Y_{IM}	Estimation Period	Estimation Method
World Trade						
Austria	-1.21 to -0.93	-1.37 to -0.82	1.08 to 2.04	1.04 to 1.08	-	-
Netherlands	-2.72 to -0.88	-1.65 to -0.02	0.65 to 1.91	1.35 to 2.04	-	-
Source: Goldstein and Khan (1985:1076 et seq.)						
Austria	-6.33 to -1.14	-0.53 to -0.03	-4.93 to 1.43	1.96 to 2.04		
Netherlands	-0.27 to 1.06	-0.96 to 0.19	1.44 to 1.96	1.24 to 1.66		
Source: Bahmani-Oskooee and Niroomand (1998:107)[1]					1960 - 1992	ECM
Austria		0.08		0.88	1960 - 1993	OLS
Source: Senhadji and Montenegro (1998:266) [2]						
Austria	-0.84	1.50	1.43	1.20		
Netherlands	-0.84	-0.13	1.40	1.38		
Source: Camarero and Tamarit (2003:364 et seq.)[2]					1981-1998	DOLS
Netherlands		-0.35				
Euro area		-0.58				
Source: di Mauro and Maurin (2005:20 et seq.)[1]					1992-2003	ECM[3]-model

Source: Own compilation.

[1] The elastcities are estimated for *total* imports and exports.
[2] The elastcities are estimated only for imports and exports of manufactures.
[3] Error correction model.

Table A.5: Overview: Long-run Price- and Income(Production) Elasticities of Export and Import Demand II

Country	$REER_{EX}$	$REER_{IM}$	Y_{EX}	Y_{IM}	Estimation Period	Estimation Method
Euro area	0.3 to 0.4		0.75 to 0.8			
Source: Ca'Zorzi and Schnatz (2007:11)[1]					1992-2006	ECM[3]-model
EMU	-0.55 to -0.39		0.52 to 0.66			
Source: Deutsche Bundesbank, Montly Report, July 2011, p. 32 [2]					2000-2010	n.n.
Extra-EMU Trade						
EMU	0.5	0.81	1.0	2.77	1989-2001	ECM[3]-model
Source: Anderton et al. (2004:21 et seq.)[1]						
EMU		-0.26		0.85	1991-2003	ECM[3]-model
Source: Quarterly Report on Euro-Area (2004, Vol. 3, No.1, p. 24)[1]						
Intra- and Extra-EMU Trade						
Total EMU	-0.60 to 0.008		1.68 to 1.93			
Intra-EMU	-0.30 t -0.1		1.58 to 1.86			
Extra-EMU	-1.30 to 0.39		1.36 to 1.51			
Source: Bayoumi, Harmsen and Turunen (2011:13)[2]					1980-2009	Country FE-regression[4]

Source: Own compilation.

[1] The elastcities are estimated for *total* imports and exports.
[2] The elastcities are estimated only for imports and exports of manufactures.
[3] Error correction model.
[4] Fixed effect regression.

A.2 Variables and Models Used for the Estimation of Austrian and Dutch Intra- and Extra-EMU Import and Export Demand

Table A.6: Variables Used for the Estimation of Intra-EMU Trade

Label of Variable	Variable Specification
Exports, Imports	
EX_{EMU}	log of real goods exports to the EMU
IM_{EMU}	log of real goods imports to the EMU
Demand Variables	
$final_consumption_{EMU}$	EMU*: log of total final real consumption expenditure
$final_consumption_{(AT/NL)}$	AT/NL: log of total final real consumption expenditure
$HH_consumption_{EMU}$	EMU*: log of household real final consumption expenditure
$HH_consumption_{(AT/NL)}$	AT/NL: log of household real final consumption expenditure
GDP_{EMU}	EMU*: log of real GDP
$GDP_{(AT/NL)}$	AT/NL: log of real GDP
$GFCF_{EMU}$	EMU*: log of real gross fixed capital formation
$GFCF_{(AT/NL)}$	AT/NL: log of real gross fixed capital formation
IP_ind_{EMU}	EMU*: log of the industrial production index
$IP_ind_{(AT/NL)}$	AT/NL: log of the industrial production index of total industry
IP_manuf_{EMU}	EMU*: log of the industrial production index of total manufacturing industries
$IP_manuf_{(AT/NL)}$	AT/NL: log of the industrial production index of total manuf. industries
Price Variables	
$REER^{ex}_{CPI}$	real effective exchange rate for EX based on consumer price index
$REER^{ex}_{PPI_ind}$	real effective exchange rate for EX based on producer prices of total industry
$REER^{ex}_{PPI_ind_ext}$	real effective exchange rate for EX based on producer prices for export goods of total industry
$REER^{ex}_{PPI_manuf}$	real effective exchange rate for EX based on producer prices of manuf. industries
$REER^{ex}_{PPI_manuf_ext}$	real effective exchange rate for EX based on producer prices for export goods of manuf. industries
$REER^{ex}_{ULC}$	real effective exchange rate for EX based on unit labour costs
$REER^{im}_{CPI}$	real effective exchange rate for IM based on consumer price index
$REER^{im}_{PPI_ind}$	real effective exchange rate for IM based on producer prices of total industry
$REER^{im}_{PPI_ind_ext}$	real effective exchange rate for IM based on producer prices for export goods of total industry
$REER^{im}_{PPI_manuf}$	real effective exchange rate for IM based on producer prices of manuf. industries
$REER^{im}_{PPI_manuf_ext}$	real effective exchange rate for IM based on producer prices for export goods of manuf. industries
$REER^{im}_{ULC}$	real effective exchange rate for IM based on unit labour costs
EMU*:	Stands for European Monetary Union without the country for which the variable is specified, i.e. EMU-Austria, or EMU-Netherlands

Source: Own description.

[1] Logarithm of household and non-profit institutions serving households (NPISH) real final consumption expenditure

Table A.7: Variables Used for the Estimation of Extra-EMU Trade

Label of Variable	Variable Specification
Exports, Imports	
$EX_{extra-EMU_(AT\|NL)}$	log of real goods exports to countries outside the EMU
$IM_{extra-EMU_(AT\|NL)}$	log of real goods imports to countries outside the EMU
Demand Variables	
$consumpt_{extra-EMU}$	extra-EMU*: log of total real private final consumption expenditure
$consumpt_{(AT/NL)}$	AT/NL: log of total real private final consumption expenditure
$GDP_{extra-EMU}$	extra-EMU*: log of real GDP
$GDP_{(AT/NL)}$	AT/NL: log of real GDP
$GFCF_{extra-EMU}$	extra-EMU*: log of real gross fixed capital formation
$GFCF_{(AT/NL)}$	AT/NL: log of real gross fixed capital formation
$IP_{(extra-EMU)}$	extra-EMU*: log of the industrial production index
$IP_{(AT/NL)}$	AT/NL: log of the industrial production index
Price Variables	
$REER^{ex}_{CPI_(AT\|NL)}$	real effective exchange rate for EX based on consumer price index
$REER^{ex}_{PPI_(AT\|NL)}$	real effective exchange rate for EX based on producer prices of total industry
$REER^{ex}_{ULC_(AT\|NL)}$	real effective exchange rate for EX based on unit labour costs
$REER^{im}_{CPI_(AT\|NL)}$	real effective exchange rate for IM based on consumer price index
$REER^{im}_{PPI_(AT\|NL)}$	real effective exchange rate for IM based on producer prices of total industry
$REER^{im}_{ULC_(AT\|NL)}$	real effective exchange rate for IM based on unit labour costs
EMU*:	Stands for European Monetary Union without the country for which the variable is specified, i.e. EMU-Austria, or EMU-Netherlands

Source: Own description.

Table A.8: Most Important Austrian and Dutch Extra-EMU Trading Partners

Total number of countries :	**17**
Countries:	Australia, Canada, China, Czech Republic, Denmark, Hungary, Israel, Japan, Korea, Norway, Poland, Russian FED, Sweden, Switzerland, Turkey, United Kingdom, United States

Source: Own calculations (based on DOTS data (IMF)).

A.3 Construction of the Variables Used for the Estimation of Austrian and Dutch Intra- and Extra-EMU Import and Export Demand

In this section, the construction of the variables for Austrian and Dutch import and export demand will be explained in more detail. All variables are formulated in real terms. Theoretically speaking, this makes sense, since we assume that the economic agents do not underly the money illusion. In addition to the detailed explanation of the way the variables were constructed, also the data sources will be mentioned in the following subsections.

Imports and Exports

Austrian and Dutch intra-EMU goods imports and exports (with all remaining 16 member countries) are taken from the *Direction of Trade Statics (DOTS)* database of the IMF. The National Currency Unit (NCU)-Dollar conversion rates from the IMF's *International Financial Statistics (IFS)* database for each EMU-country were used to calculate an overall Euro-Dollar conversion rate in order to convert imports and exports from Dollar to Euro[85]. Then, the export and import price deflator (from OECD) was used to deflate Austrian and Dutch goods imports and exports.
To get Austrian and Dutch extra-EMU imports and exports, intra-EMU goods imports and exports were subtracted from the aggregate of real Austrian and Dutch intra- and extra-EMU goods imports and exports (compare table A.9).

Real Effective Exchange Rate (REER)

For the estimation of Austrian and Dutch import and export demand I basically use three different real effective exchange rates (REERs) as price variables. One is based on consumer prices, another on producer prices and a third on unit labour costs. For the construction of all three REERs, consumer and producer price indices, as well as unit labour cost indices of all Austrian and Dutch extra- and intra-EMU trade partners are used. Import or export demand models which contain the REER based on consumer prices as price variable are formulated after the consumer-based approach. Models which

[85]Therefore, the fixed Euro-NCU conversion rates of each EMU-country were used to calculate the Euro-NCU conversion rate back for those years in which the respective country didn't yet belong to the EMU or the EMU didn't yet existed. Thus, either to calculate the exchange rates back for the years before 1999 or, if the country joined the EMU later, to calculated them back until the entry date. In a second step, the conversion rates of all 16 EMU-countries, without respectively Austria or the Netherlands, were weighted according to their share in Austrian or Dutch imports or exports.

Table A.9: Austrian and Dutch Intra- and Extra-EMU Imports and Exports

Variable	Description	Source
Intra-EMU Imports and Exports		
EX_{EMU}	Intra-EMU goods exports, in real terms.	Direction of Trade Statics (DOTS) database (http://elibrary-data.imf.org/)
IM_{EMU}	Intra-EMU goods imports, in real terms.	Direction of Trade Statics (DOTS) database (http://elibrary-data.imf.org/)
Extra-EMU Imports and Exports		
$EX_{extra-EMU}$	Extra-EMU goods exports, in real terms.	OECD (http://stats.oecd.org)
$IM_{extra-EMU}$	Extra-EMU goods imports, in real terms.	OECD (http://stats.oecd.org)

Source: Own description.

contain the REER based on producer prices or on unit labour costs are formulated after the producer-based approach[86].

All REERs are trade-weighted, geometric indices, which means that the national price indices of all trade partners are weighted according to their share in Austrian or Dutch exports or imports. This way, more weight is given to those countries which have a larger share in Austrian or Dutch exports or imports. Consequently, there are separate REERs for the estimation of exports and imports, which makes sense since these shares differ for exports and imports. In order to built the respective REER, the trade-weighted price indices of all trade partners are set into relation to the Austrian or Dutch price indices.

For the construction of the REERs used for the estimation of export demand, the Austrian or Dutch price index is divided by the product of the trade-weighted price indices of all trading partners:

$$\frac{p_{(AT|NL)}}{p^*_{(trade\ partner)}} \tag{A.1}$$

Thus, the export prices of all Austrian or Dutch export goods are measured in terms of the prices of all trade partners.

For the construction of the REERs for the estimation of import demand, the product of the trade-weighted price indices of all trading partners is divided by the Austrian or Dutch price indices:

$$\frac{p^*_{(trade\ partner)}}{p_{(AT|NL)}} \tag{A.2}$$

And thus, the prices of the import goods of all trade partners are measured in terms of Austrian or Dutch domestic goods prices.

For the estimation of intra-EMU import and export demand, there are four different formulations of the REERs based on producer prices. While for the REERs based on consumer prices and unit labour costs there is just one formulation for each REER. Each of

[86]More details about the consumer- and producer-based approach can be found in the introduction.

these six different REERs for Austria and the Netherlands is formulated for the estimation of intra-EMU exports and imports.
For extra-EMU import and export demand, only the three basic REER versions based on consumer prices, on producer prices and on unit labour costs are used.
More details on the different REERs can be found in table A.10.

Activity Variables

For the estimation of export and import demand, two different formulations of each sort of activity variable are needed: one formulation for Austria or the Netherlands and one for the aggregate of all trade partners. The formulation for Austria or the Netherlands was used as activity variable in the import demand models, and the other formulation for the aggregate of all trade partners as activity variable in the export demand models (for more details, see the beginning of the fourth section).
For the estimation of intra-EMU export and import demand basically, five different sorts of activity variables were used for the estimation of export and import demand. For the models formulated in terms of the consumer-based approach, real final consumption and real household consumption, as well as real GDP were used. For the models of the producer-based approach, two different versions of the industrial production index, as well as gross fixed capital formation (GFCF) and also real GDP were employed.
For extra-EMU export and import demand, only four different sorts of activity variables were employed: real consumption, real GDP, the index of industrial production for the entire industry and gross fixed capital formation. While the activity variables in the export demand models are formulated for the aggregate of all Austrian and Dutch extra-EMU trading partners, those for the import demand models remain the same as for the estimation of intra-EMU import demand. More details of the single variables can be found in table A.11.

Table A.10: Description of the Real Effective Exchange Rates (REERs) for Export and Import Demand

Variable	Description	Source
Intra-EMU REERs		
$REER^{ex}_{CPI}$	REER based on consumer prices. Prices of consumption	OECD (http://stats.oecd.org)
$REER^{im}_{CPI}$	goods for the domestic and export market.	
$REER^{ex}_{PPI_ind}$	REER based on producer prices for the entire industry.	EUROSTAT (http://epp.eurostat.ec.europa.eu/portal/
$REER^{im}_{PPI_ind}$	Prices of goods for the domestic and export market.	page/portal/statistics/search_database)
$REER^{ex}_{PPI_ind_ext}$	REER based on producer prices for the entire industry.	EUROSTAT (http://epp.eurostat.ec.europa.eu/portal/
$REER^{im}_{PPI_ind_ext}$	Prices of goods for the export market.	page/portal/statistics/search_database)
$REER^{ex}_{PPI_manuf}$	REER based on producer prices for the manufacturing industries.	EUROSTAT (http://epp.eurostat.ec.europa.eu/portal/
$REER^{im}_{PPI_manuf}$	Prices of goods for the domestic and export market.	page/portal/statistics/search_database)
$REER^{ex}_{PPI_manuf_ext}$	REER based on producer prices for the manufacturing industries.	EUROSTAT (http://epp.eurostat.ec.europa.eu/portal/
$REER^{im}_{PPI_manuf_ext}$	Prices of goods for the export market.	page/portal/statistics/search_database)
$REER^{ex}_{ULC}$	REER based on unit labour costs. Labour cost of personnel	EUROSTAT (http://epp.eurostat.ec.europa.eu/portal/
$REER^{im}_{ULC}$	producing goods for the domestic and export market.	page/portal/statistics/search_database)
Extra-EMU REERs		
$REER^{ex}_{CPI}$	REER based on consumer prices. Prices of consumption	OECD (http://stats.oecd.org)
$REER^{im}_{CPI}$	goods for the domestic and export market.	
$REER^{ex}_{PPI}$	REER based on producer prices for the entire industry.	IFS database of the IMF (http://elibrary-data.imf.org/
$REER^{im}_{PPI}$	Prices of goods for the domestic and export market.	FindDataReports.aspx?d=33061&e=169393)
$REER^{ex}_{ULC}$	REER based on unit labour costs. Labour cost of personnel	OECD (http://stats.oecd.org)
$REER^{im}_{ULC}$	producing goods for the domestic and export market.	

Note: All price indices used for the construction of the REERs have the year 2005 as base-year (2005=100).

Source: Own description.

Table A.11: Description of the Activity Variables for Export and Import Demand

Variable	Description	Source
Intra-EMU Activity Variables		
$HH_consumption_{AT\|NL}$	Real consumption of all Austrian or Dutch households.	EUROSTAT (http://epp.eurostat.ec.europa.eu/)
$HH_consumption_{EMU}$	Aggregate real consumption of the households of all Austrian or Dutch intra-EMU trading partners.	EUROSTAT (http://epp.eurostat.ec.europa.eu/)
$final_consumption_{(AT\|NL)}$	Austrian or Dutch real final consumption.	EUROSTAT (http://epp.eurostat.ec.europa.eu/)
$final_consumption_{(EMU)}$	Aggregate real final consumption of all Austrian or Dutch intra-EMU trading partners.	EUROSTAT (http://epp.eurostat.ec.europa.eu/)
$GDP_{(AT\|NL)}$	Austrian or Dutch real GDP.	EUROSTAT (http://epp.eurostat.ec.europa.eu/)
$GDP_{(EMU)}$	Aggregate real GDP of all Austrian or Dutch intra-EMU trading partners.	EUROSTAT (http://epp.eurostat.ec.europa.eu/)
$IP_ind_{(AT\|NL)}$	Austrian or Dutch index of industrial production, entire industry; for domestic and exporting market.	EUROSTAT (http://epp.eurostat.ec.europa.eu/)
$IP_ind_{(EMU)}$	Index of industrial production, entire industry, of all Austrian or Dutch intra-EMU trading partners; for domestic and exporting market.	EUROSTAT (http://epp.eurostat.ec.europa.eu/)
$IP_manuf_{(AT\|NL)}$	Austrian or Dutch index of industrial production, manufacturing industries; for domestic and exporting market.	EUROSTAT (http://epp.eurostat.ec.europa.eu/)
$IP_manuf_{(EMU)}$	Index of industrial production, manufacturing industries, of all Austrian or Dutch intra-EMU trading partners; for domestic and exporting market.	EUROSTAT (http://epp.eurostat.ec.europa.eu/)
$GFCF_{(AT\|NL)}$	Austrian or Dutch real gross fixed capital formation (GFCF).	EUROSTAT (http://epp.eurostat.ec.europa.eu/)
$GFCF_{(EMU)}$	Aggregate real gross fixed capital formation (GFCF) of all Austrian or Dutch intra-EMU trading partners.	EUROSTAT (http://epp.eurostat.ec.europa.eu/portal/
Extra-EMU Activity Variables		
$consumption_{(extra-EMU)}$	Real consumption of all Austrian or Dutch extra-EMU trade partners.	OECD (http://stats.oecd.org)
$GDP_{(extra-EMU)}$	Real GDP of all Austrian or Dutch extra-EMU trade partners.	OECD (http://stats.oecd.org)
$IP_{(extra-EMU)}$	Industrial Production, entire industry, of all Austrian or Dutch extra-EMU trade partners; domestic and exporting markets.	OECD (http://stats.oecd.org)
$GFCF_{(extra-EMU)}$	Real gross fixed capital formation (GFCF) of all Austrian or Dutch extra-EMU trade partners.	OECD (http://stats.oecd.org)

Note: All price indices used for the construction of the REERs have the year 2005 as base-year (2005=100).

Source: Own description.

Proxy for Globalization

The globalization proxy for the intra-EMU trade was constructed by dividing total intra-EMU trade (imports plus exports) except Austria or the Netherlands by the real GDP of all EMU-countries except Austria or the Netherlands. The same was done for the construction of the globalization proxy for extra-EMU trade. This time, total trade (Imports plus exports) of all Austrian or Dutch extra-EMU trade partners was used and divided by their total real GDP. This way, the proxy should account for changes in the ratio of total trade to total income (measured by real GDP) of all Austrian and Dutch trade partners and thus account for factors, which aren't captured by the price and activity variables (compare A.12).

Table A.12: Globalization Proxy for Austrian and Dutch Intra- and Extra-EMU Trade

Variable	Description	Source
Intra-EMU trade		
$handelsint_{at}$	Proxy to account for other than price and income effects	EUROSTAT
$handelsint_{nl}$	on Austrian or Dutch intra-EMU imports and exports.	(http://epp.eurostat.ec.europa.eu)
Extra-EMU trade		
$handelsint_extra_{at}$	Proxy to account for other than price and income effects	OECD
$handelsint_extra_{nl}$	on Austrian or Dutch extra-EMU imports and exports.	(http://stats.oecd.org)

Source: Own description.

A.4 Graphs of the Variables Used for the Estimation of Austrian and Dutch Intra- and Extra-EMU Import and Export Demand

in the following subsections, the graphs of all variables used for the estimation of intra- and extra-EMU import and export demand will be presented.
The data for all variables comes from the three sources named in the previous section, namely the IMF, OECD and EUROSTAT.

A.4.1 Variables Used for the Estimation of Austrian Intra-EMU Import and Export Demand

This subsection contains the graphs of the variables employed for the estimation of Austrian intra-EMU import and export demand.

Figure A.1: Austrian Intra-EMU Exports

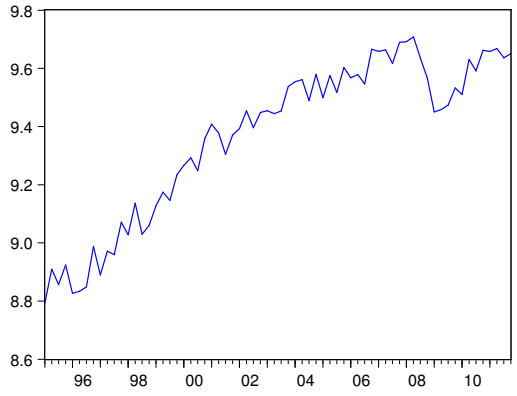


Figure A.2: Austrian Intra-EMU Imports

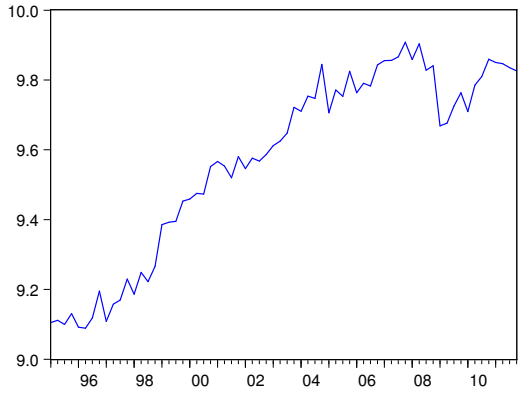


Figure A.3: Austrian Final Consumption

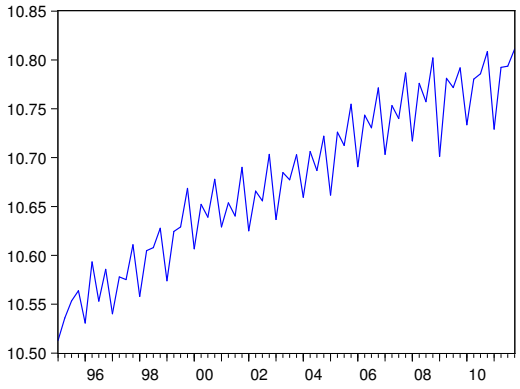


Figure A.4: Final Consumption of all EMU-countries except Austria

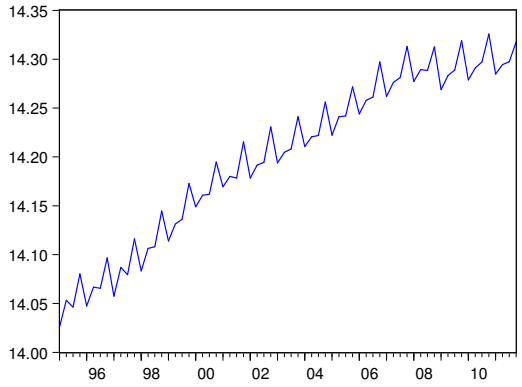


Figure A.5: Austrian Household Consumption

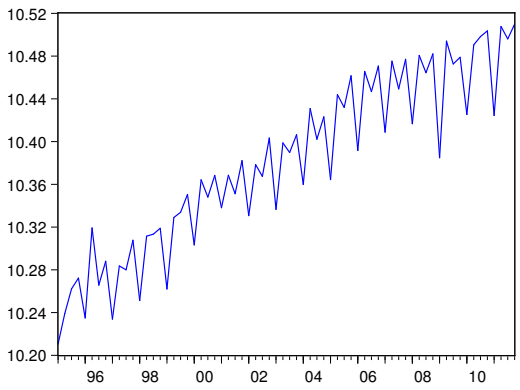


Figure A.6: Household Consumption of all EMU-countries except Austria

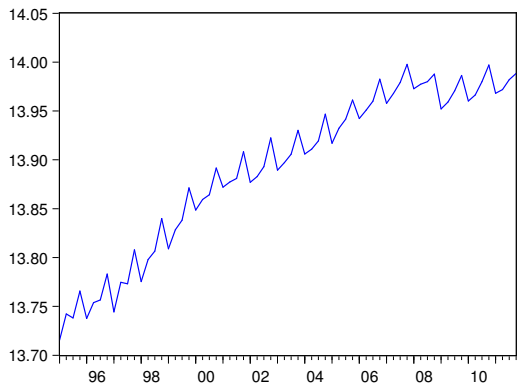


Figure A.7: Austrian Household Consumption

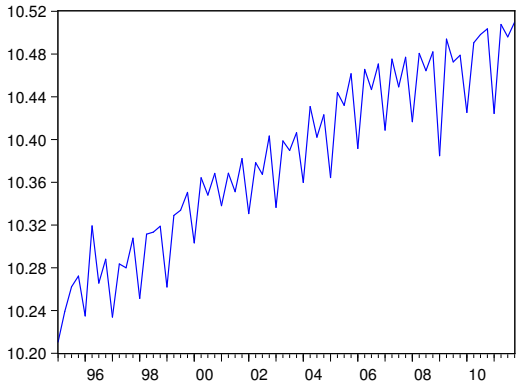


Figure A.8: Household Consumption of all EMU-countries except Austria

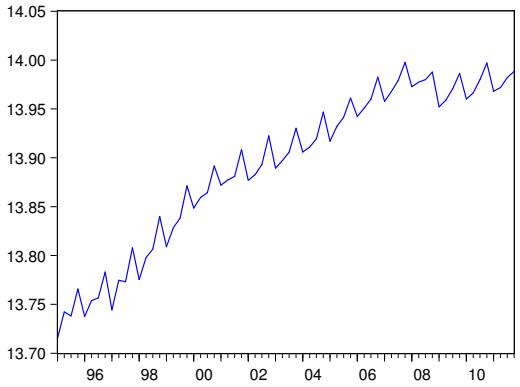


Figure A.9: Austrian Real GDP

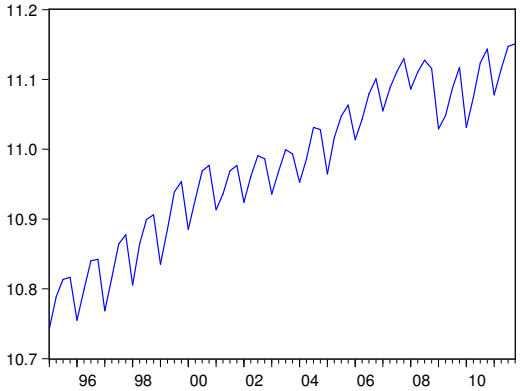


Figure A.10: Austrian Real GDP of all EMU-countries except Austria

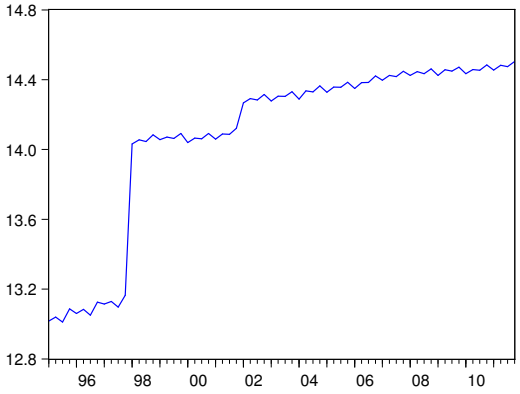


Figure A.11: Austrian Gross Fixed Capital Formation

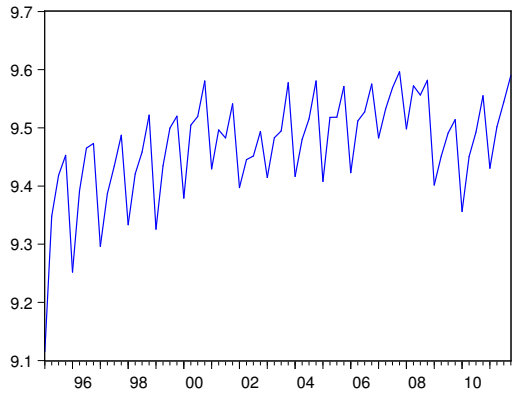


Figure A.12: Gross Fixed Capital Formation of all EMU-countries except Austria

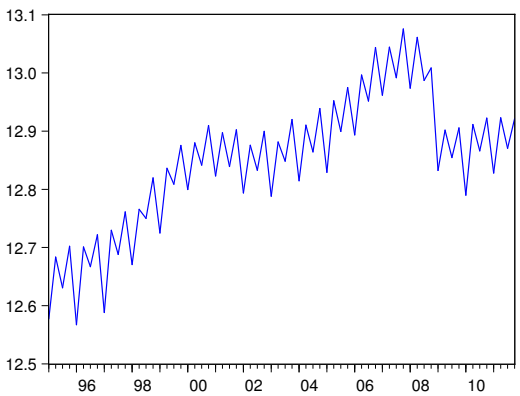


Figure A.13: Austrian Industrial Production, Entire Industry

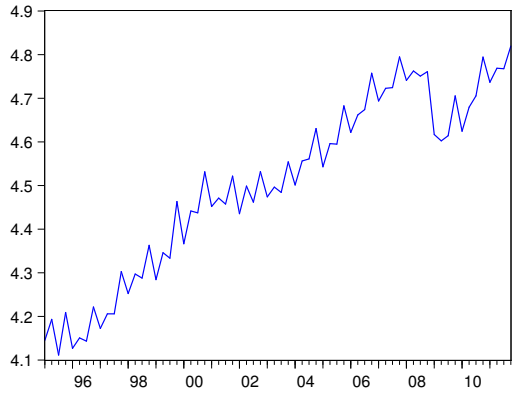


Figure A.14: Industrial Production of all EMU-countries except Austria, Entire Industry

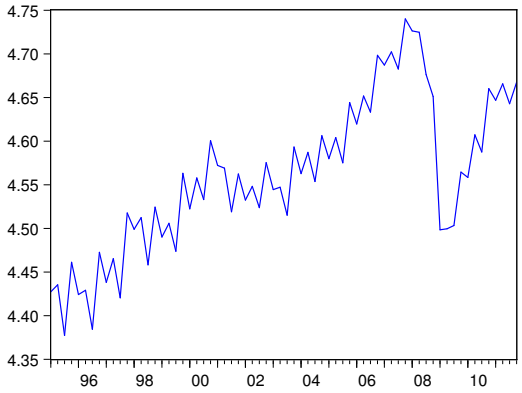


Figure A.15: Austrian Industrial Production, Manufacturing Industries

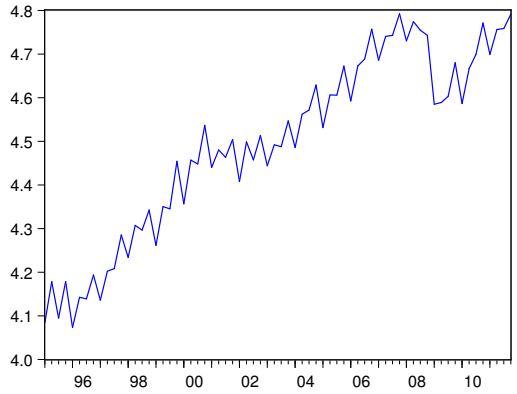


Figure A.16: Industrial Production, Manufacturing Industries of all EMU-countries except Austria

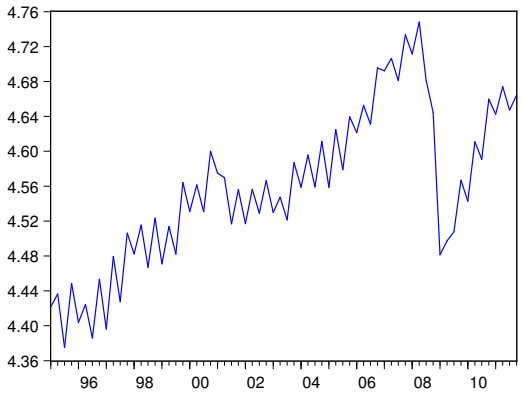


Figure A.17: Austrian Intra-EMU Exports: REER Based on Consumer Prices

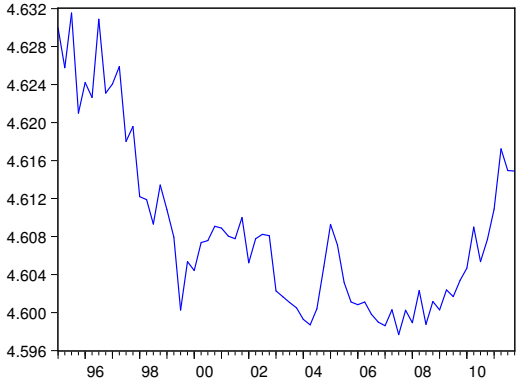


Figure A.18: Austrian Intra-EMU Exports: REER Based on Producer Prices, Entire Industry

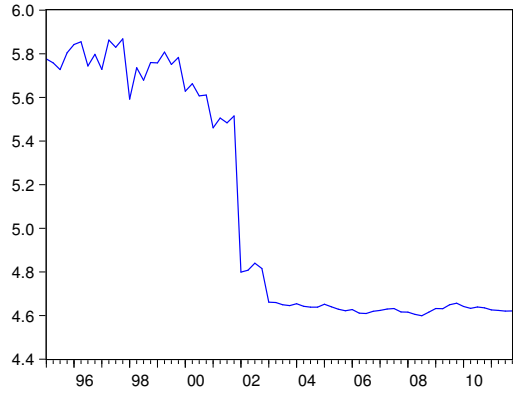


Figure A.19: Austrian Intra-EMU Exports: REER Based on Producer Prices of all Exporting Industries

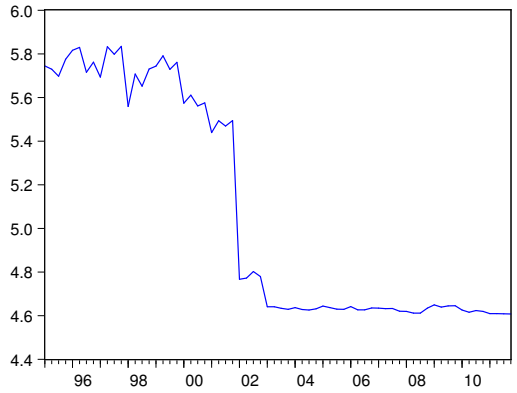


Figure A.20: Austrian Intra-EMU Exports: REER Based on Producer Prices, Manufacturing Industries

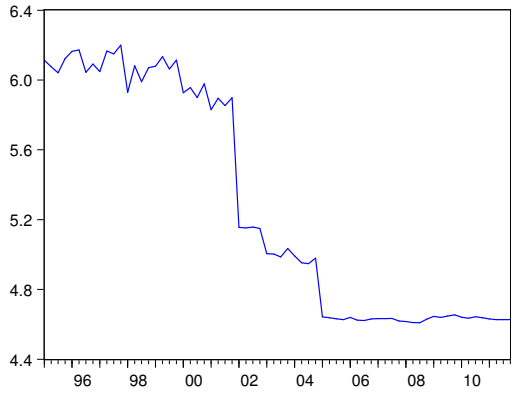


Figure A.21: Austrian Intra-EMU Exports: REER Based on Producer Prices of all Exporting Manufacturing Industries

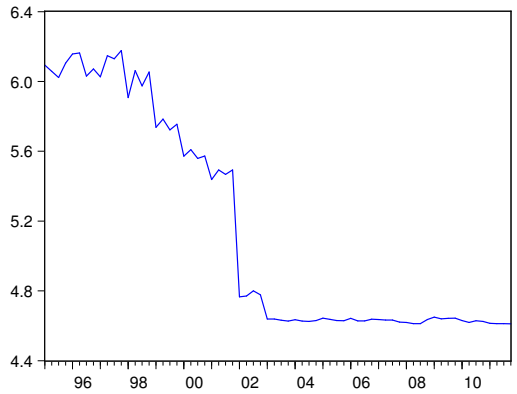


Figure A.22: Austrian Intra-EMU Exports: REER Based on Unit Labour Costs

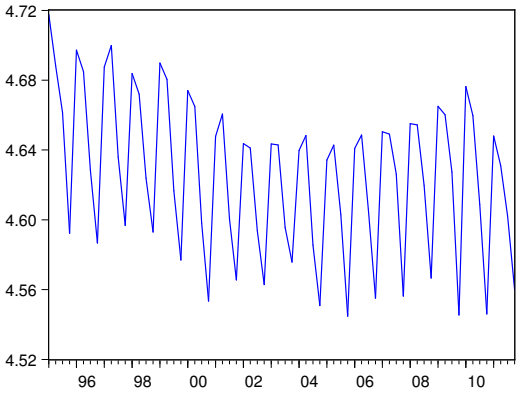


Figure A.23: Austrian Intra-EMU Imports: REER Based on Consumer Prices

Figure A.24: Austrian Intra-EMU Imports: REER Based on Producer Prices, Entire Industry

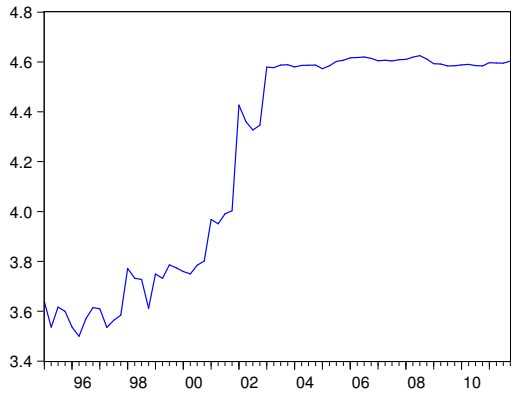


Figure A.25: Austrian Intra-EMU Imports: REER Based on Producer Prices of all Exporting Industries

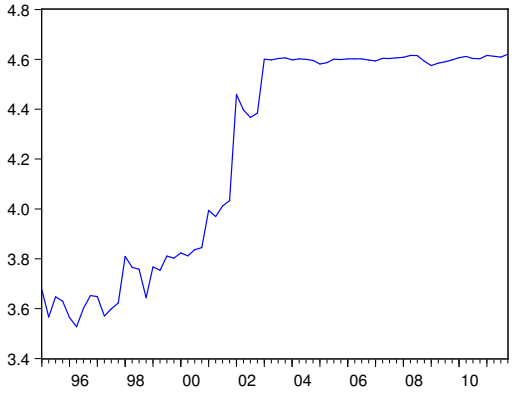


Figure A.26: Austrian Intra-EMU Imports: REER Based on Producer Prices, Manufacturing Industries

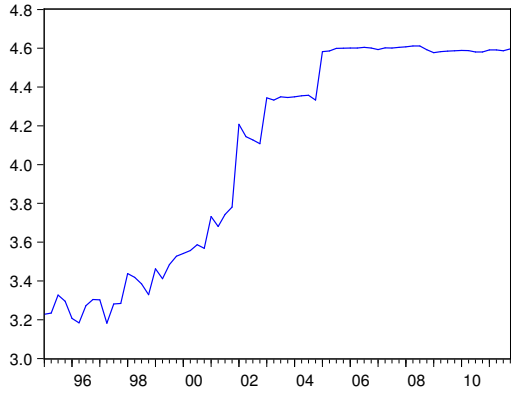


Figure A.27: Austrian Intra-EMU Imports: REER Based on Producer Prices of all Exporting Manufacturing Industries

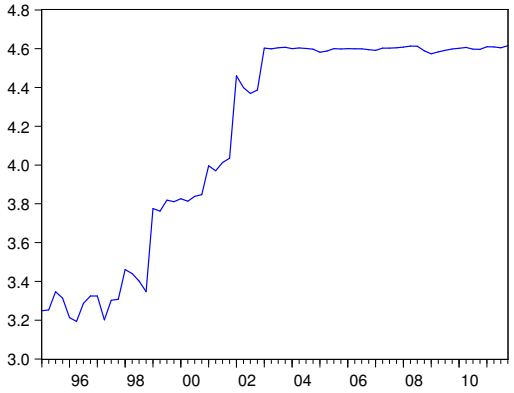


Figure A.28: Austrian Intra-EMU Imports: REER Based on Unit Labour Costs

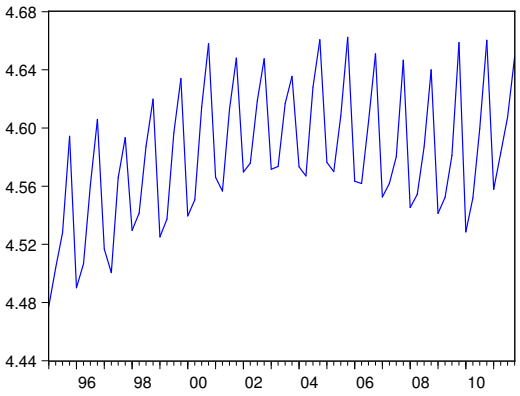
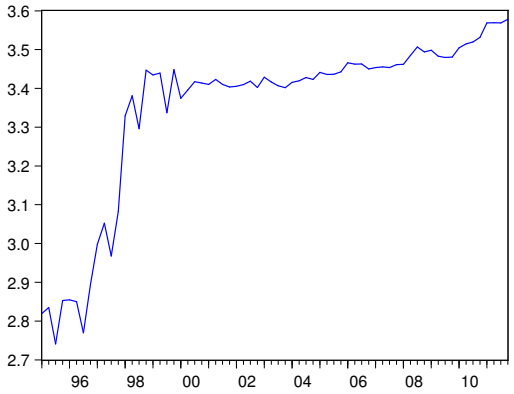


Figure A.29: Austrian Intra-EMU Trade: Proxy for Globalization



A.4.2 Variables Used for the Estimation of Dutch Intra-EMU Import and Export Demand

In this subsection, the graphs of the variables used for the estimation of Dutch intra-EMU import and export demand will be presented.
The data for all variables comes from the three sources: IMF, OECD and EUROSTAT.

Figure A.30: Dutch Intra-EMU Exports

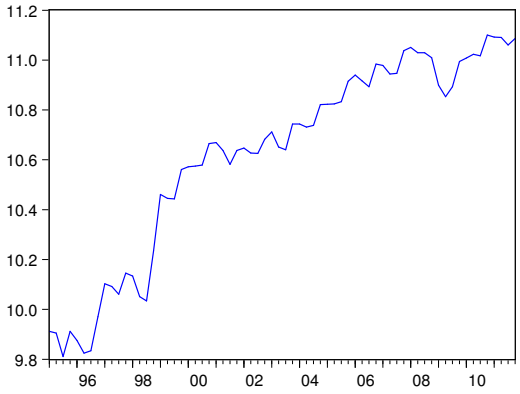


Figure A.31: Dutch Intra-EMU Imports

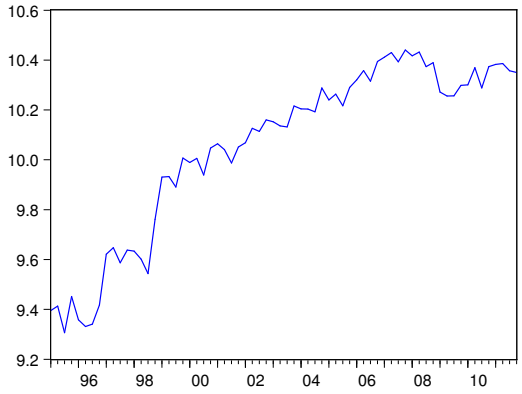


Figure A.32: Dutch Final Consumption

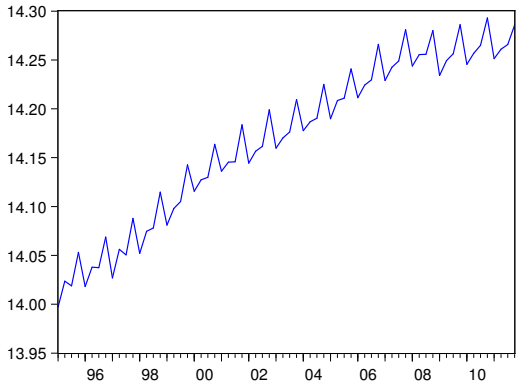


Figure A.33: Final Consumption of all EMU-countries except of the Netherlands

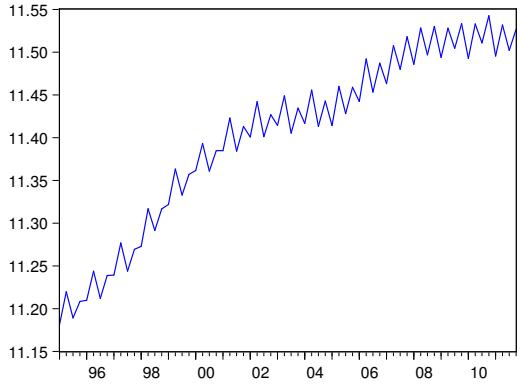


Figure A.34: Dutch Household Consumption

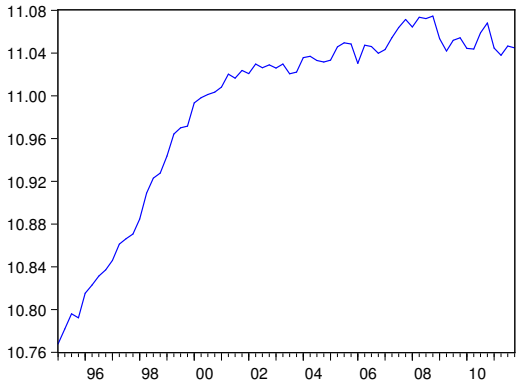


Figure A.35: Household Consumption of all EMU-countries except of the Netherlands

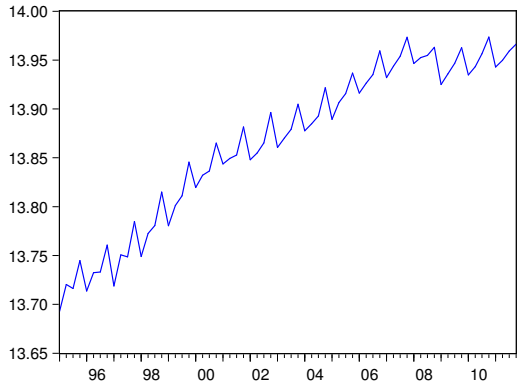


Figure A.36: Dutch Household Consumption

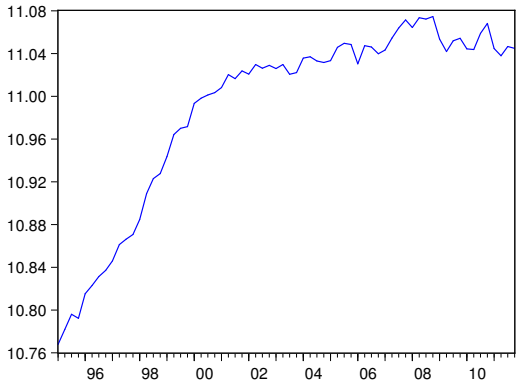


Figure A.37: Household Consumption of all EMU-countries except of the Netherlands

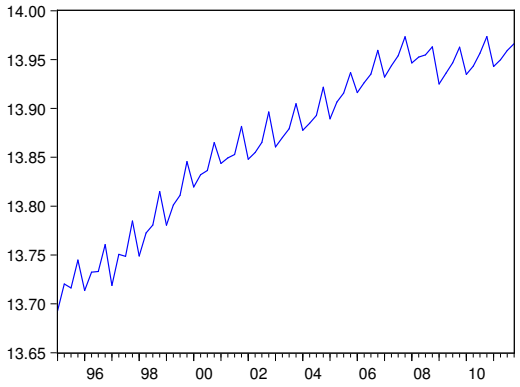


Figure A.38: Dutch Real GDP

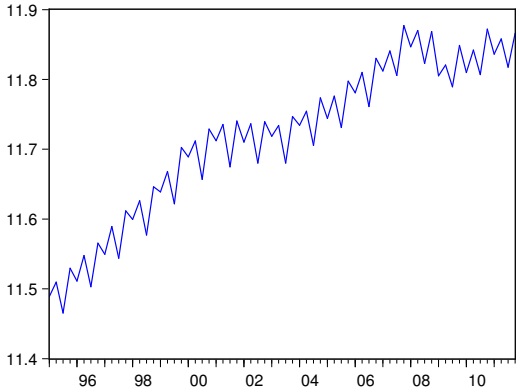


Figure A.39: Dutch Real GDP of all EMU-countries except of the Netherlands

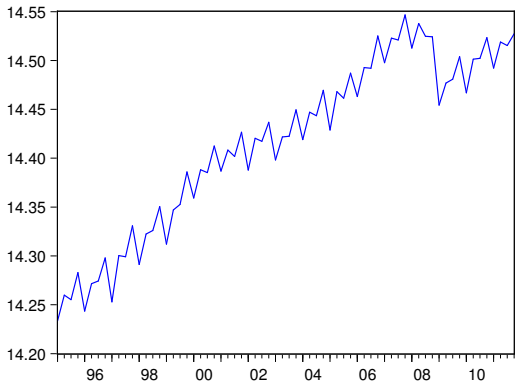


Figure A.40: Dutch Gross Fixed Capital Formation

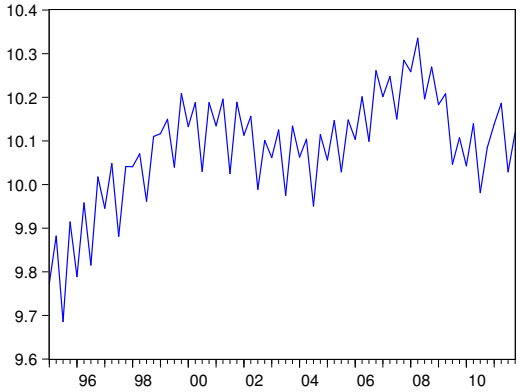


Figure A.41: Gross Fixed Capital Formation of all EMU-countries except of the Netherlands

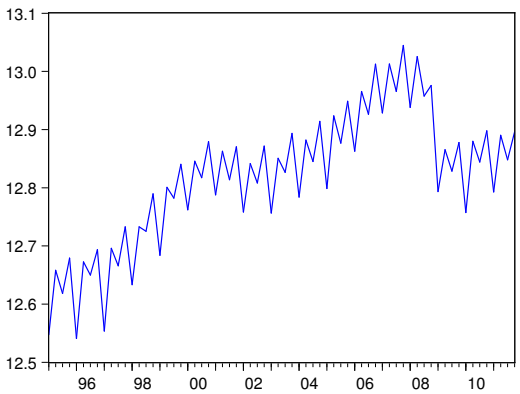


Figure A.42: Dutch Industrial Production, Entire Industry

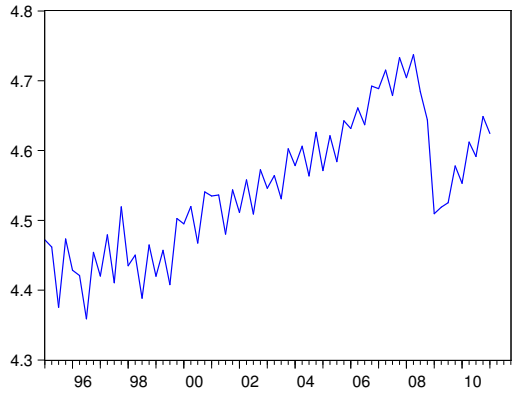


Figure A.43: Industrial Production of all EMU-countries except of the Netherlands, Entire Industry

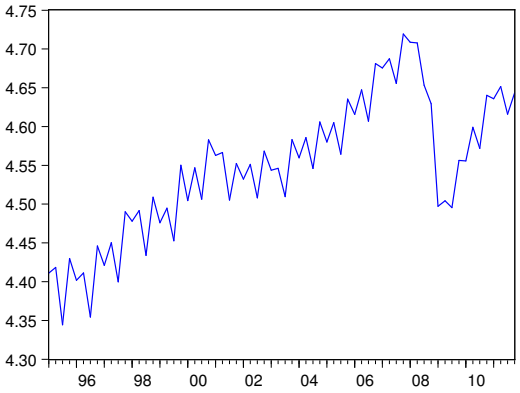


Figure A.44: Dutch Industrial Production, Manufacturing Industries

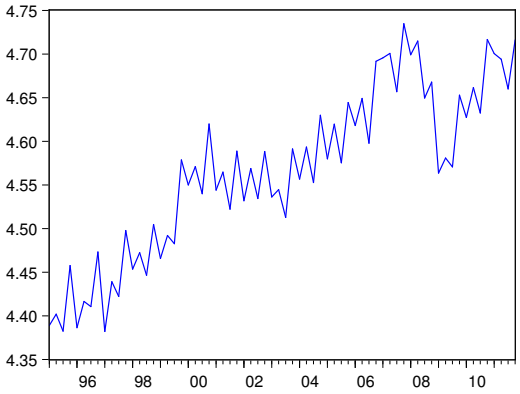


Figure A.45: Industrial Production, Manufacturing Industries of all EMU-countries except of the Netherlands

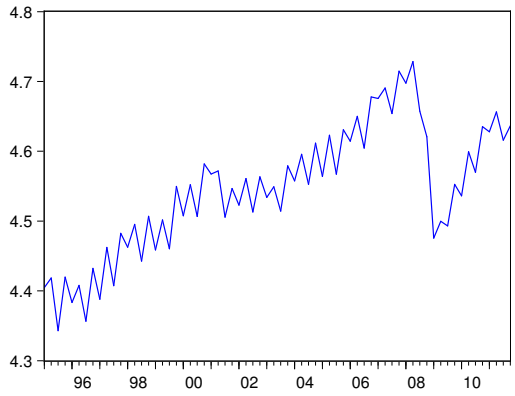


Figure A.46: Dutch Intra-EMU Exports: REER Based on Consumer Prices

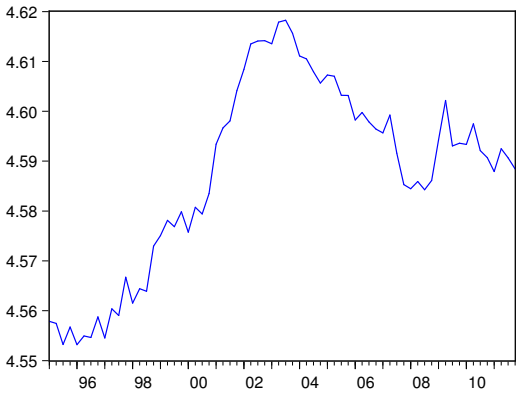


Figure A.47: Dutch Intra-EMU Exports: REER Based on Producer Prices, Entire Industry

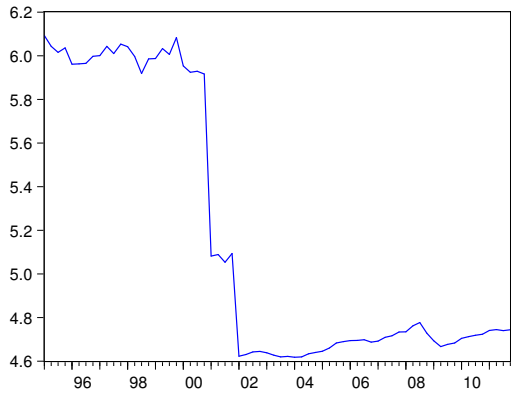


Figure A.48: Dutch Intra-EMU Exports: REER Based on Producer Prices of all Exporting Industries

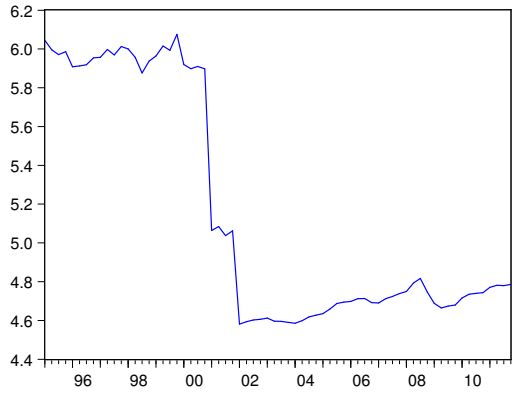


Figure A.49: Dutch Intra-EMU Exports: REER Based on Producer Prices, Manufacturing Industries

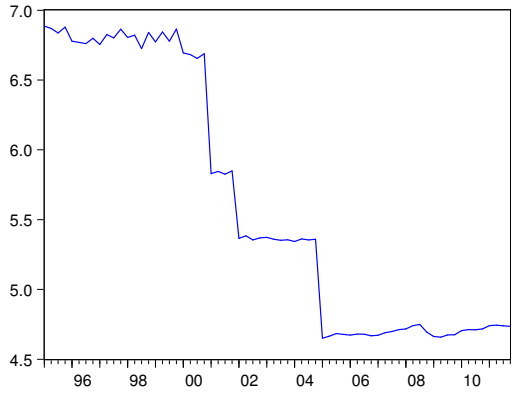


Figure A.50: Dutch Intra-EMU Exports: REER Based on Producer Prices of all Exporting Manufacturing Industries

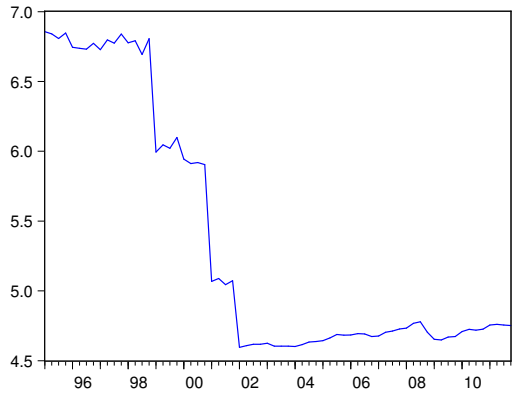


Figure A.51: Dutch Intra-EMU Exports: REER Based on Unit Labour Costs

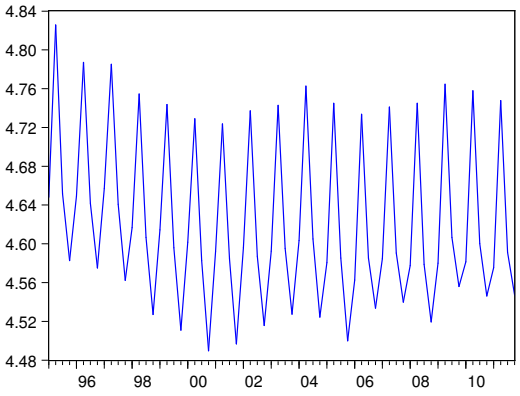


Figure A.52: Dutch Intra-EMU Imports: REER Based on Consumer Prices

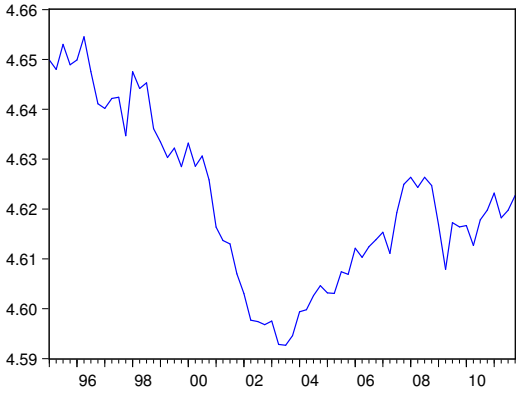


Figure A.53: Dutch Intra-EMU Imports: REER Based on Producer Prices, Entire Industry

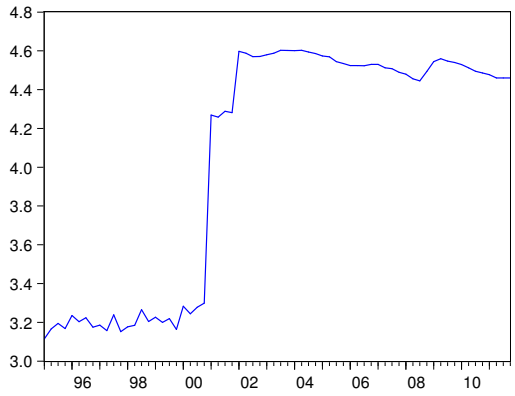


Figure A.54: Dutch Intra-EMU Imports: REER Based on Producer Prices of all Exporting Industries

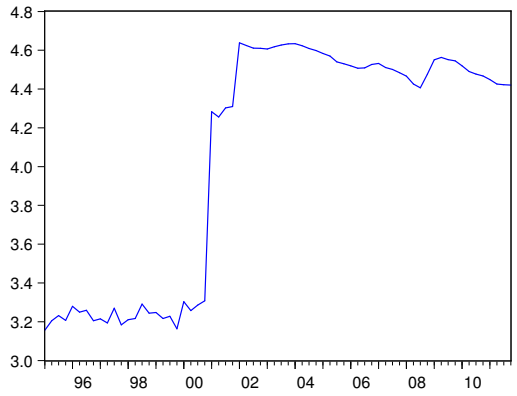


Figure A.55: Dutch Intra-EMU Imports: REER Based on Producer Prices, Manufacturing Industries

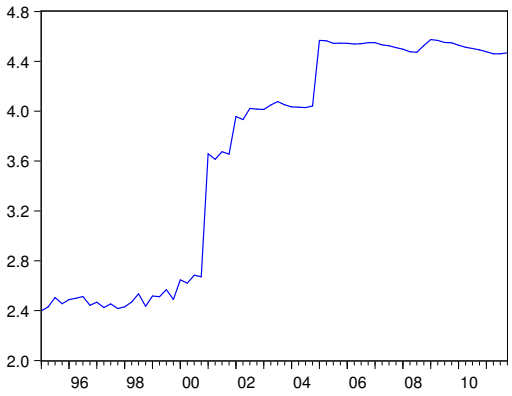


Figure A.56: Dutch Intra-EMU Imports: REER Based on Producer Prices of all Exporting Manufacturing Industries

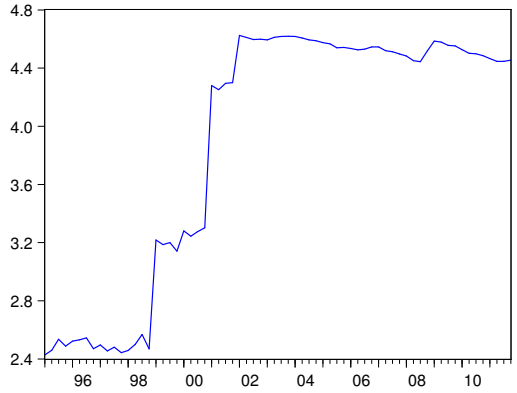


Figure A.57: Dutch Intra-EMU Imports: Imports: REER Based on Unit Labour Costs

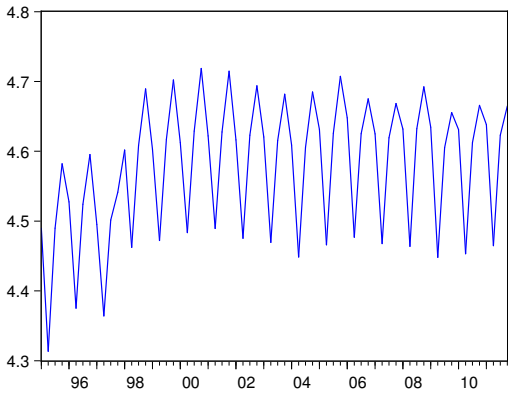
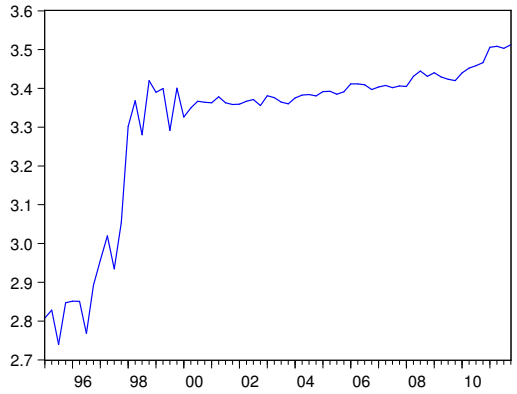


Figure A.58: Dutch Intra-EMU Trade: Proxy for Globalization



A.4.3 Variables Used for the Estimation of Austrian Extra-EMU Import and Export Demand

This subsection contains the graphs of the variables used for the estimation of Austrian extra-EMU import and export demand.
The data for all variables comes from the three sources: IMF, OECD and EUROSTAT.

Figure A.59: Austrian Extra-EMU Exports

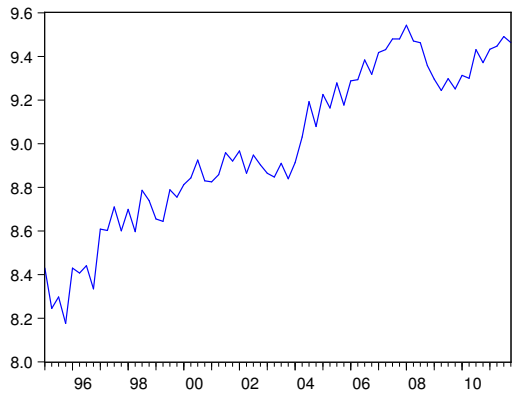


Figure A.60: Austrian Extra-EMU Imports

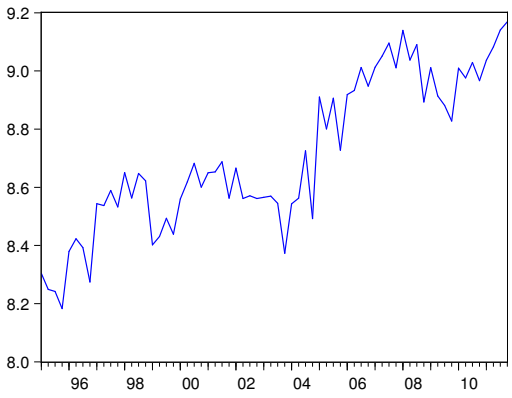


Figure A.61: Consumption of all Austrian Extra-EMU Trade Partners

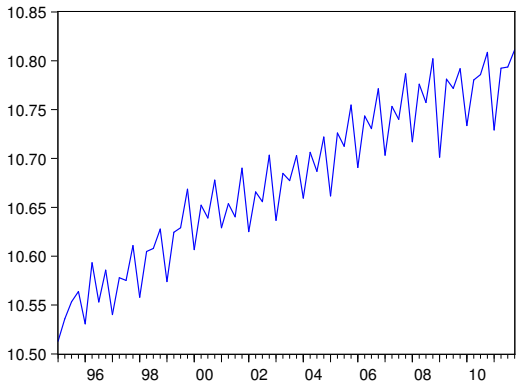


Figure A.62: Real GDP of all Austrian Extra-EMU Trade Partners

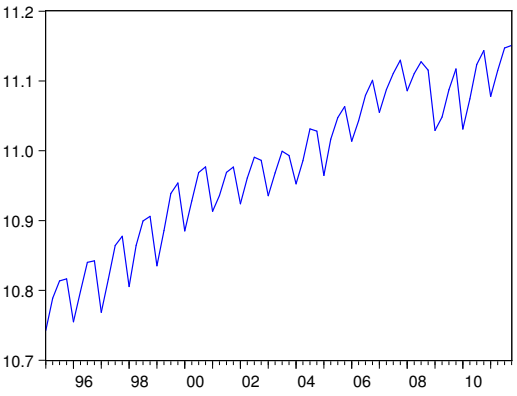


Figure A.63: Gross Fixed Capital Formation of all Austrian Extra-EMU Trade Partners

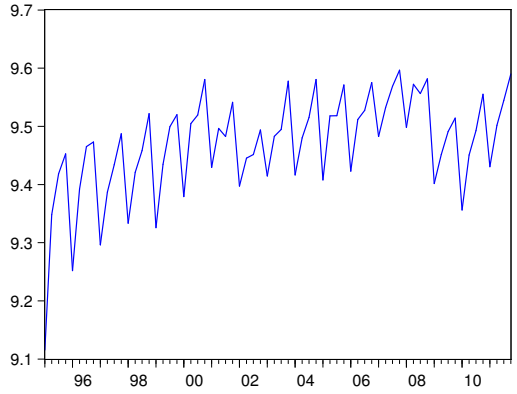


Figure A.64: Industrial Production of all Austrian Extra-EMU Trade Partners

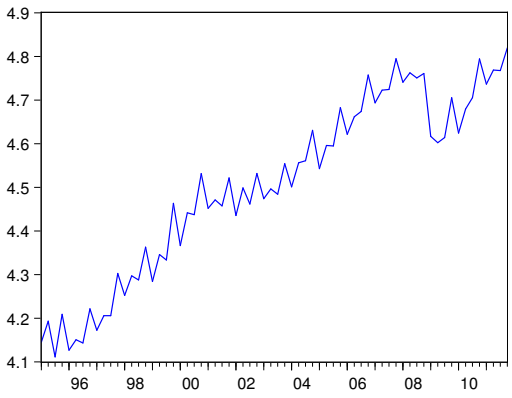


Figure A.65: Austrian Extra-EMU Exports: REER Based on Consumer Prices

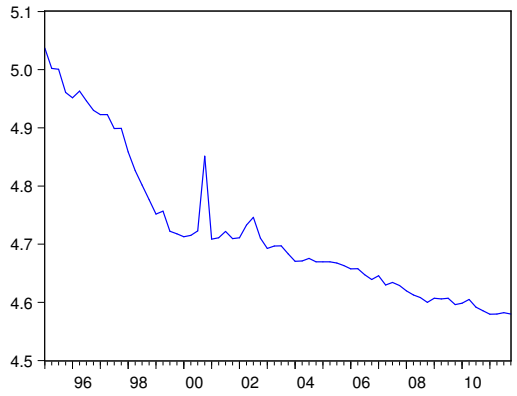


Figure A.66: Austrian Extra-EMU Exports: REER Based on Producer Prices

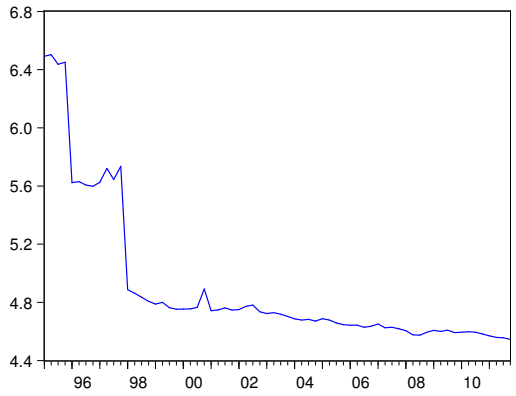


Figure A.67: Austrian Extra-EMU Exports: REER Based on Unit Labour Costs

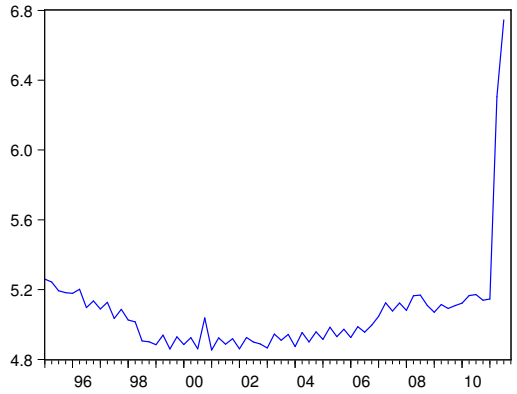


Figure A.68: Austrian Extra-EMU Imports: REER Based on Consumer Prices

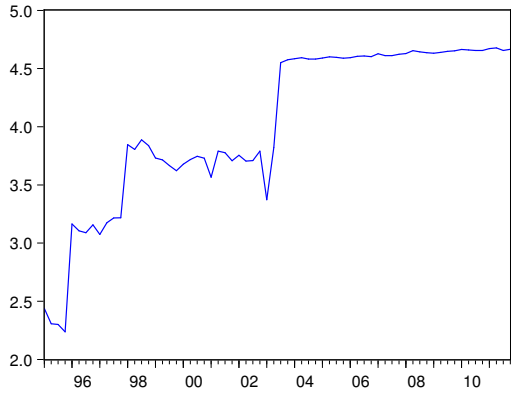


Figure A.69: Austrian Extra-EMU Imports: REER Based on Producer Prices

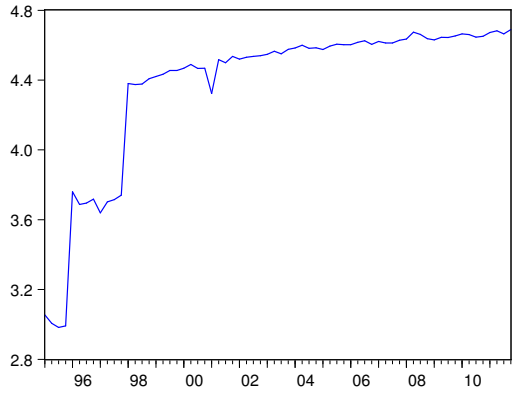


Figure A.70: Austrian Extra-EMU Imports: REER Based on Unit Labour Costs

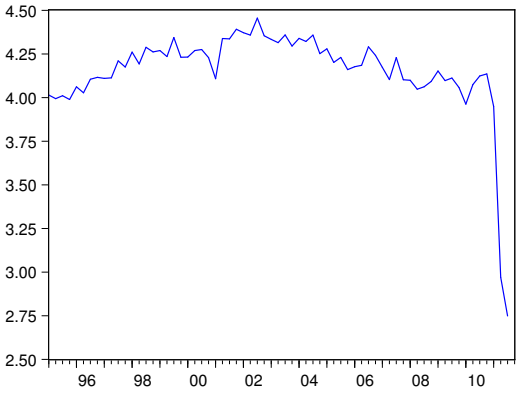
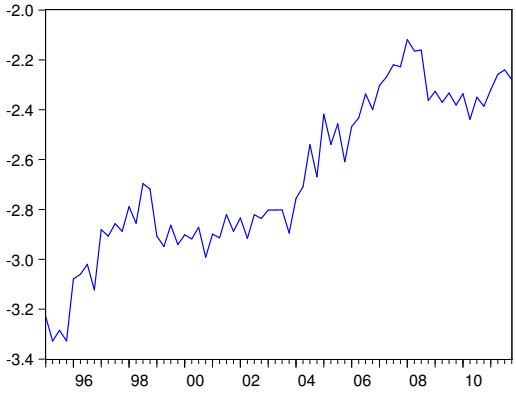


Figure A.71: Austrian Extra-EMU Trade:
Proxy for Globalization



A.4.4 Variables Used for the Estimation of Dutch Extra-EMU Import and Export Demand

In this subsection, the graphs of the variables used fr the estimation for Dutch extra-EMU import and export demand will be presented.
The data for all variables comes from the three sources: IMF, OECD and EUROSTAT.

Figure A.72: Dutch Extra-EMU Exports

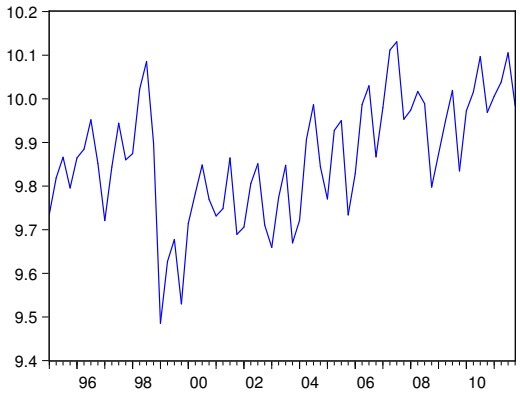


Figure A.73: Dutch Extra-EMU Imports

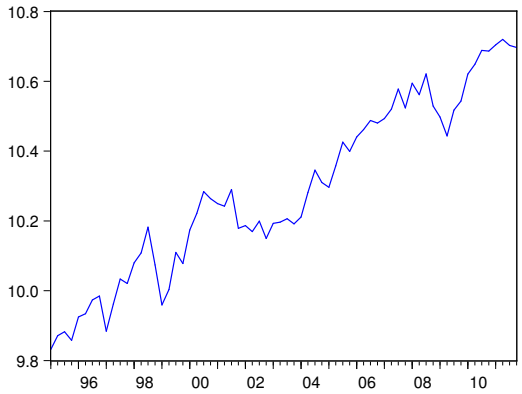


Figure A.74: Consumption of all Dutch Extra-EMU Trade Partners

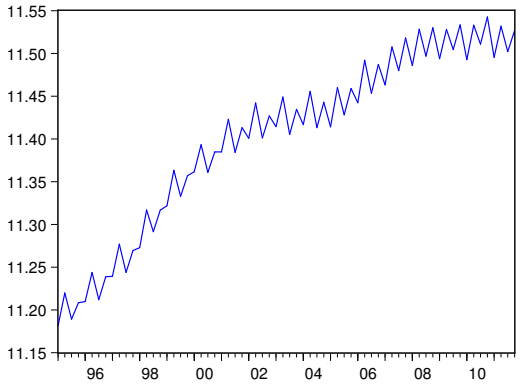


Figure A.75: Real GDP of all Dutch Extra-EMU Trade Partners

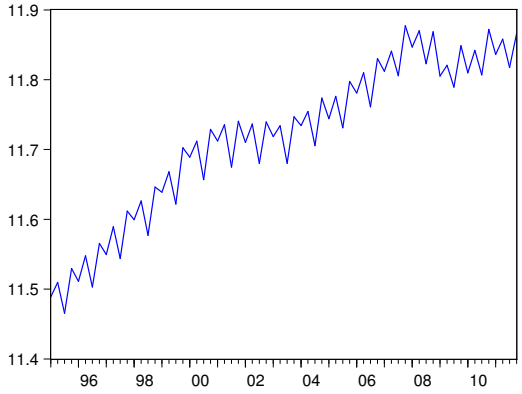


Figure A.76: Gross Fixed Capital Formation of all Dutch Extra-EMU Trade Partners

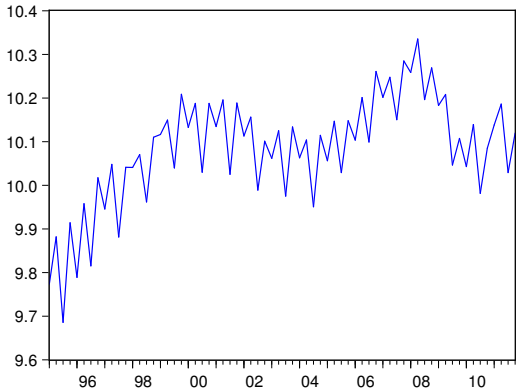


Figure A.77: Industrial Production of all Dutch Extra-EMU Trade Partners

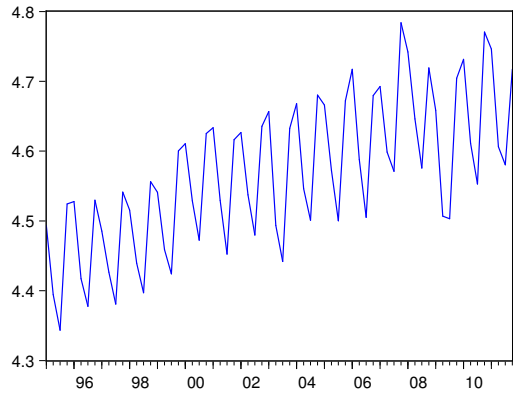


Figure A.78: Dutch Extra-EMU Exports: REER Based on Consumer Prices

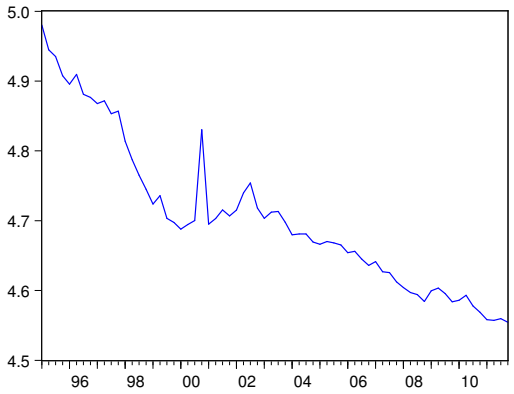


Figure A.79: Dutch Extra-EMU Exports: REER Based on Producer Prices

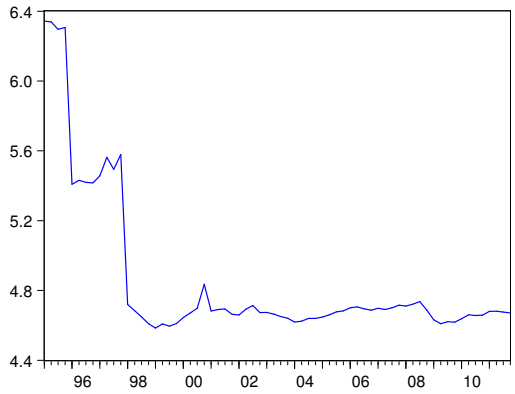


Figure A.80: Dutch Extra-EMU Exports: REER Based on Unit Labour Costs

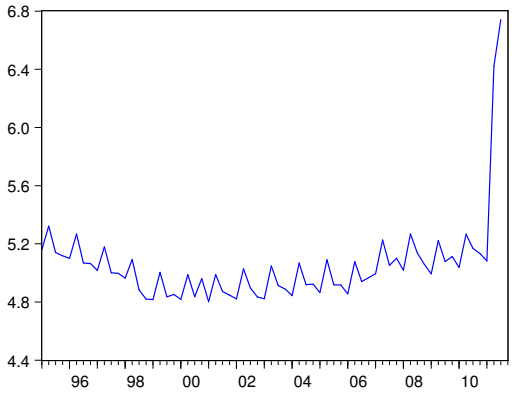


Figure A.81: Dutch Extra-EMU Imports: REER Based on Consumer Prices

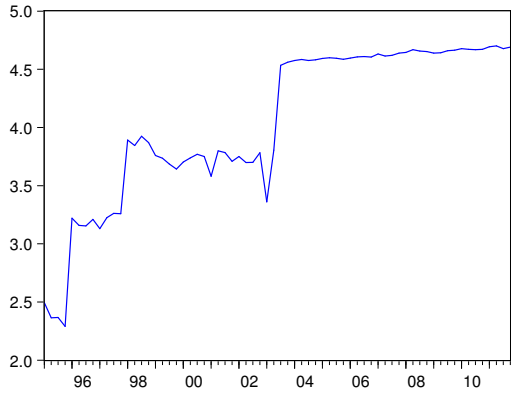


Figure A.82: Dutch Extra-EMU Imports: REER Based on Producer Prices

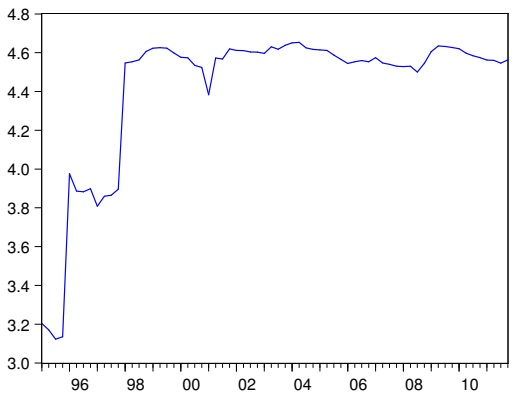


Figure A.83: Dutch Extra-EMU Imports: REER Based on Unit Labour Costs

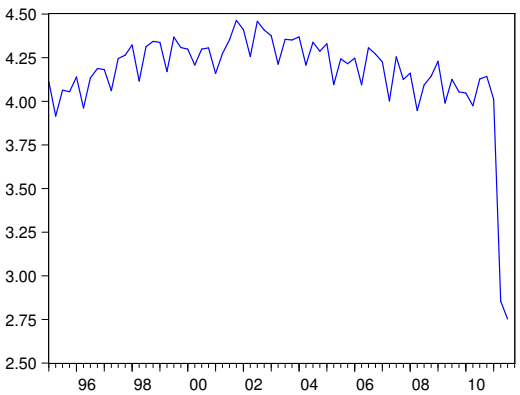
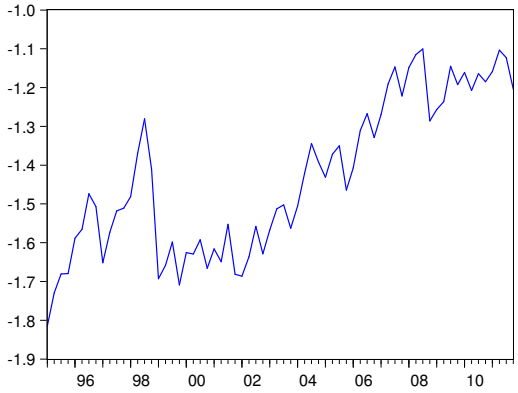


Figure A.84: Dutch Extra-EMU Trade: Proxy for Globalization



A.4.5 Variables Used for the Estimation of Austrian and Dutch Extra-EMU Import and Export Demand

In this subsection, the graphs of the common variables for Austrian and Dutch extra-EMU import and export demand will be shown.

Figure A.85: Consumption of all Austrian and Dutch Extra-EMU Trade Partners

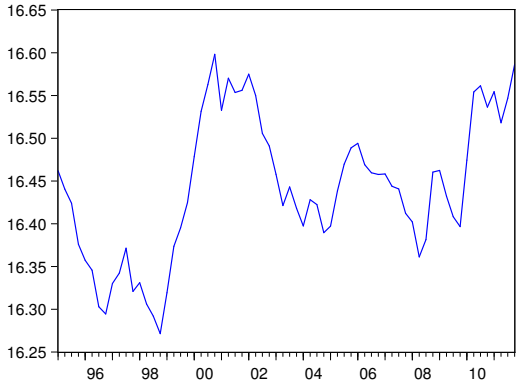


Figure A.86: Real GDP of all Austrian and Dutch Extra-EMU Trade Partners

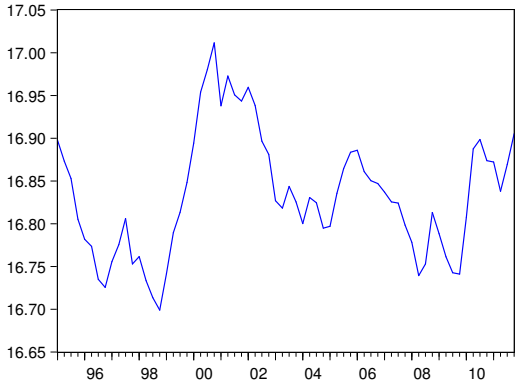


Figure A.87: Gross Fixed Capital Formation of all Austrian and Dutch Extra-EMU Trade Partners

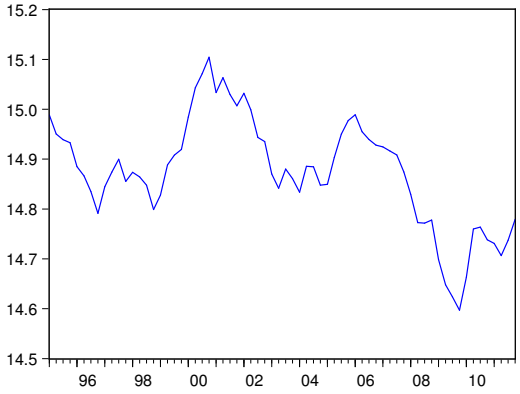
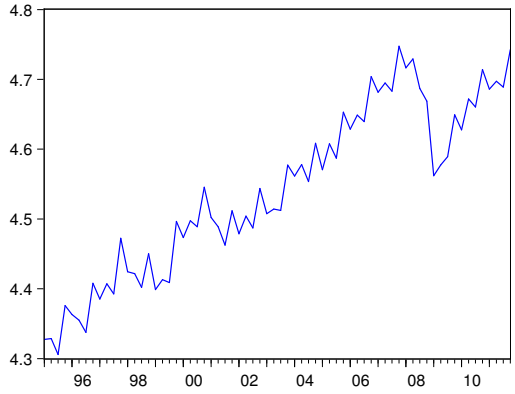


Figure A.88: Industrial Production of all Austrian and Dutch Extra-EMU Trade Partners



B Appendix

B.1 Strategies to Test for Unit Roots: Enders (2010) and Elder & Kennedy (2001)

Table B.1 contains the model formulations, as they are used to explain the testing procedure of Enders (2010) and Elder and Kennedy (2001) as listed in tables B.2 and B.3.

Table B.1: Models 1-6 used in Enders and Elder & Kennedy's Procedure to Test for Unit Roots

Basic Model:

$$\triangle y_t = m + by_{t-1} + dt + \varepsilon_t$$

Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
m = 0 b = 0 d = 0	m = 0 b < 0 d = 0	$m \neq 0$ b = 0 d = 0	$m \neq 0$ b < 0 d = 0	$m \neq 0$ b = 0 $d \neq 0$	$m \neq 0$ b < 0 $d \neq 0$
Unit root, no intercept, no time trend	Stationary around zero equilibrium	Unit root with drift	Stationary around non-zero constant equilibrium	Unit root with intercept and time trend	Deterministic trend, trend stationary

Source: Hacker and Hatemi (2010:5).

Table B.2: Enders (2010) Strategy to Test for Unit Roots

Enders Strategy

Estimate : $\triangle y_t = m + b * y_{t-1} + d * t + \varepsilon_t$

Can b = 0 be rejected using DF[1]critical values? ⇓ Yes

⇓No Decide no unit root (model (2), (4) or (6))

Can b = 0 and d = 0 be rejected using DF[1] critical values?

Can b = 0 be rejected using a normal distribution?

⇓No ⇓ No ⇓ Yes

Decide unit root (model 5) Decide no unit root (model 6)

Estimate : $\triangle y_t = m + b * y_{t-1} + \varepsilon_t$

Can b = 0 be rejected using DF[1] critical values? ⇓ Yes

⇓No Decide no unit root ((model (2) or (4))

Can m = 0 and b = 0 be rejected using DF[1]critical values?

Can b = 0 be rejected using a normal distribution?

⇓No ⇓ No ⇓ Yes

Decide unit root (model 3) Decide no unit root (model 4)

Estimate: $\triangle y_t = b * y_{t-1} + \varepsilon_t$

Can b = 0 be rejected using DF[1]critical values? ⇓ Yes

Decide has no unit root (model (2))

⇓No

Decide there is a unit root (model (1))

Source: Hacker and Hatemi (2010:6).

[1] DF stands for Dickey-Fuller. Each question about parameters is answered based on the last estimated equation before the question.

Table B.3: Elder & Kennedy's Strategy to Test for Unit Roots

Unit Root Testing Strategy with ith Prior Limitations
No Prior Knowledge of Growth in Variable

A. Estimate the equation: $\triangle y_t = m + b * y_{t-1} + d * t + \varepsilon_t$, and test whether b = 0 can be rejected using DF critical values. If it can be rejected, conclude no unit root, and if not, conclude there is a unit root.

B. If b = 0 can be rejected in step A, use standard t-test to determine whether d = 0 can be rejected (i.e. conclude model 6) or not (i.e. conclude model 4).

C. If b = 0 cannot be rejected in step A, estimate the equation $\triangle y_t = m + \varepsilon_t$, and test whether m = 0 can be rejected using standard t-statistic testing. If it can be rejected, conclude model (3), if not, conclude model (1).

If non-zero growth in the y variable is known a priori, the Elder and Kennedy's strategy becomes the same as step A above, with the conclusion of no unit root implying model (6) and the conclusion of unit root implying model (3) (neither step B nor step C need be done).
If zero growth in the y variable is known a priori, the Elder and Kennedy strategy becomes the same as step A above with $d * t$ excluded in estimation. The conclusion of no unit root would then imply model (4) and the conclusion of a unit root implying model (1) (neither step B nor step C need be done).

Source: Hatemi (2010:10 et seq.).

B.2 Unit Root Test Results

In following pages, the results of the unit root test will be presented for all variables used for the estimation of Austrian and Dutch intra- and extra-EMU import and export demand.

Table B.4: Unit Root Test Results Austria, Intra-EMU

Dependent variables	Series trending[1]	ACF: unit root[2]	Augmented Dickey Fuller Tests: Enders	Elders and Kennedy	Order of integration	Conclusion ADF	Order of integration	Final decision
EX_{EMU}	x	x	model 3	model 3	$I(1)^{n,d,t}$	$I(1)^{d}$, model 3	$I(1)^{d}$, $I(2)^{t}$	$I(1)^{d}$, model 3
IM_{EMU}	x	x	model 1	model 3	$I(1)^{n,d,t}$	$I(1)^{d}$, model 3	$I(1)^{d}$, $I(2)^{t}$	$I(1)^{d}$, model 3
Demand variables								
$final_consumption_{(AT)}$	x	x	model 3	model 3	$I(2)^{n,d,t}$	$I(2)^{d}$, model 3	$I(1)^{d,t}$	?
$final_consumption_{(EMU)}$	x	x	model 3	model 3	$I(1)^{d,t}$, $I(2)^{n}$	$I(1)^{d}$, model 3	$I(1)^{d,t}$	$I(1)^{d}$, model 3
$HH_consumption_{(AT)}$	x	x	model 3	model 3	$I(1)^{n}$, $I(2)^{d,t}$	$I(2)^{d}$, model 3	$I(1)^{d,t}$	?
$HH_consumption_{(EMU)}$	x	x	model 1	model 3	$I(1)^{d,t}$, $I(2)^{n}$	$I(1)^{d}$, model 3	$I(1)^{d,t}$	$I(1)^{d}$, model 3
$GDP_{(AT)}$	x	x	model 5	model 3	$I(1)^{d}$, $I(2)^{n,t}$	$I(2)^{t}$, model 5	$I(1)^{d,t}$	$I(1)^{d}$
$GDP_{(EMU)}$	x	x	model 3	model 3	$I(1)^{n,d,t}$	$I(1)^{d}$, model 3	$I(1)^{d,t}$	$I(1)^{d}$, model 3
$GFCF_{(AT)}$	x [3]	?	model 1	model 1	$I(1)^{n,d,t}$	$I(1)^{n}$, model 1	$I(1)^{d,t}$	$I(1)^{n}$, model 1
$GFCF_{(EMU)}$	x	?	model 3	model 3	$I(1)^{n}$, $I(2)^{d,t}$	$I(2)^{d}$, model 3	$I(1)^{d,t}$	?
$IP_ind_{(AT)}$	x	?	model 5	model 3	$I(1)^{n,d,t}$	$I(1)^{t}$, model 5	$I(1)^{d,t}$	$I(1)^{t}$, model 5
$IP_ind_{(EMU)}$	x	?	model 1	model 3	$I(1)^{n,d,t}$	$I(1)^{d}$, model 3	$I(1)^{d,t}$	$I(1)^{d}$, model 3
$IP_manuf_{(AT)}$	x	?	model 5	model 3	$I(1)^{n,d,t}$	$I(1)^{t}$, model 5	$I(1)^{d,t}$	$I(1)^{t}$, model 5
$IP_manuf_{(EMU)}$	x	?	model 5	model 3	$I(1)^{n,d,t}$	$I(1)^{t}$, model 5	$I(1)^{d,t}$	$I(1)^{t}$, model 5

Continued next page...

Source: Own results.

[1] Trending behaviour according to graph of the series.

[2] Unit root according to ACF of the series.

[3] Quadratic trend.

Table B.5: Unit Root Test Results Austria, Intra-EMU

Dependent variables	Series trending[1]	ACF: unit root[2]	Augmented Dickey Fuller Tests: Enders	Elders and Kennedy	Order of integration	Conclusion ADF	Order of integration	Final decision
Continued from previous page...								
Price variables								
$REER^{ex}_{CPI}$	x [3]	x	model 1	model 3	$I(1)^{n,d,t}$	$I(1)^{d}$, model 3	$I(1)^{d}$, $I(2)^{t}$	$I(1)^{d}$, model 3
$REER^{ex}_{PPI_ind}$	x	x	model 1	model 3	$I(1)^{n,d,t}$	$I(1)^{d}$, model 3	$I(1)^{d,t}$	$I(1)^{d}$, model 3
$REER^{ex}_{PPI_ind_ext}$	x	x	model 1	model 3	$I(1)^{n,d,t}$	$I(1)^{d}$, model 3	$I(1)^{d,t}$	$I(1)^{d}$, model 3
$REER^{ex}_{PPI_manuf}$	x	x	model 1	model 3	$I(1)^{n,d,t}$	$I(1)^{d}$, model 3	$I(1)^{d,t}$	$I(1)^{d}$, model 3
$REER^{ex}_{PPI_manuf_ext}$	x	x	model 1	model 3	$I(1)^{n,d,t}$	$I(1)^{d}$, model 3	$I(1)^{d}$, $I(2)^{t}$	$I(1)^{d}$, model 3
$REER^{ex}_{ULC}$	-	?	model 1	model 3	$I(1)^{n,d,t}$	$I(1)^{d}$, model 3	$I(1)^{d,t}$	$I(1)^{d}$, model 3
$REER^{im}_{CPI}$	x [3]	x	model 5	model 3	$I(1)^{n,d,t}$	$I(1)^{t}$, model 5	$I(2)^{d,t}$	?
$REER^{im}_{PPI_ind}$	x	x	model 1	model 3	$I(1)^{n,d,t}$	$I(1)^{d}$, model 3	$I(1)^{d}$, $I(2)^{t}$	$I(1)^{d}$, model 3
$REER^{im}_{PPI_ind_ext}$	x	x	model 1	model 3	$I(1)^{n,d,t}$	$I(1)^{d}$, model 3	$I(1)^{d}$, $I(2)^{t}$	$I(1)^{d}$, model 3
$REER^{im}_{PPI_manuf}$	x	x	model 1	model 3	$I(1)^{n,d,t}$	$I(1)^{d}$, model 3	$I(1)^{d}$, $I(2)^{t}$	$I(1)^{d}$, model 3
$REER^{im}_{PPI_manuf_ext}$	x	x	model 1	model 3	$I(1)^{n,d,t}$	$I(1)^{d}$, model 3	$I(1)^{d}$, $I(2)^{t}$	$I(1)^{d}$, model 3
$REER^{im}_{ULC}$	-	?	model 1	model 3	$I(1)^{n,d,t}$	$I(1)^{d}$, model 3	$I(1)^{t}$	?
$handelsint_{AT}$	x	x	model 3	model 3	$I(1)^{n,d,t}$	$I(1)^{d}$, model 3	$I(1)^{d,t}$	$I(1)^{d}$, model 3

Source: Own results.

[1] Trending behaviour according to graph of the series.
[2] Unit root according to ACF of the series.
[3] Quadratic trend.

Table B.6: Unit Root Test Results Netherlands, Intra-EMU

Dependent variables	Series trending[1]	ACF: unit root[2]	Augmented Dickey Fuller Tests: Enders	Elders and Kennedy	Order of integration	Conclusion ADF	Order of integration	Final decision
EX_{EMU}	x	x	model 4	model 3	$I(2)^{n,t}$	?	$I(1)^{d}$, $I(2)^{t}$	$I(2)^{t}$
IM_{EMU}	x	x	model 4	model 3	$I(1)^{n,t}$, $I(2)^{d}$	$I(1)^{d}$, model 3	$I(1)^{d}$, $I(2)^{t}$	$I(1)^{d}$, model 3
Demand variables								
$final_consumption_{(NL)}$	x	?	model 3	model 3	$I(2)^{n,d,t}$	$I(2)^{d}$, model 3	$I(1)^{d,t}$	?
$final_consumption_{(EMU)}$	x	?	model 3	model 3	$I(2)^{n,d,t}$	$I(2)^{d}$, model 3	$I(1)^{d,t}$	?
$HH_consumption_{(NL)}$	x	?	model 3	model 3	$I(1)^{n}$, $I(2)^{d,t}$	$I(2)^{d}$, model 3	$I(1)^{d,t}$	?
$HH_consumption_{(EMU)}$	x	x	model 3	model 3	$I(2)^{n,d,t}$	$I(2)^{d}$, model 3	$I(1)^{t}$, $I(2)^{d}$	$I(2)^{d}$, model 3
$GDP_{(NL)}$	x	?	model 3	model 3	$I(1)^{n}$, $I(2)^{d,t}$	$I(2)^{d}$, model 3	$I(1)^{d,t}$	?
$GDP_{(EMU)}$	x	?	model 3	model 3	$I(1)^{d,t}$	$I(1)^{d}$, model 3	$I(1)^{d,t}$	$I(1)^{d}$, model 3
$GFCF_{(NL)}$	x	?	model 4	model 6	$I(0)^{d,t}$, $I(1)^{n}$	$I(1)^{n}$, model 4	$I(1)^{d,t}$	?
$GFCF_{(EMU)}$	x	?	model 3	model 3	$I(1)^{d,t}$	$I(1)^{d}$, model 3	$I(1)^{d,t}$	$I(1)^{d}$, model 3
$IP_ind_{(NL)}$	x	?	model 1	model 6	$I(1)^{n,d,t}$	$I(1)^{t}$, model 6	$I(1)^{d}$	?
$IP_ind_{(EMU)}$	x	?	model 3	model 3	$I(1)^{d,t}$	$I(1)^{d}$, model 3	$I(1)^{d}$	$I(1)^{d}$, model 3
$IP_manuf_{(NL)}$	x	?	model 3	model 6	$I(1)^{n,d}$	$I(1)^{d}$, model 3	$I(1)^{d}$	$I(1)^{d}$, model 3
$IP_manuf_{(EMU)}$	x	?	model 3	model 3	$I(1)^{n,d,t}$	$I(1)^{d}$, model 3	$I(1)^{d,t}$	$I(1)^{d}$, model 3

Continued next page...

Source: Own results.

[1] Trending behaviour according to graph of the series.

[2] Unit root according to ACF of the series.

[3] Quadratic trend.

Table B.7: Unit Root Test Results Netherlands, Intra-EMU

Dependent variables	Series trending[1]	ACF: unit root[2]	Augmented Dickey Fuller Tests: Enders	Elders and Kennedy	Order of integration	Conclusion ADF	Order of integration	Final decision
Continued from previous page...								
Price variables								
$REER^{ex}_{CPI}$	x [3]	x	model 1	model 3	$I(1)^{n,t}$, $I(2)^{d}$	$I(2)^{d}$, model 3	$I(1)^{d,t}$	$I(1)^{t}$
$REER^{ex}_{PPI_ind}$	x	x	model 1	model 3	$I(1)^{n,t}$, $I(2)^{d}$	$I(2)^{d}$, model 3	$I(1)^{d,t}$	$I(1)^{t}$
$REER^{ex}_{PPI_ind_ext}$	x	x	model 1	model 3	$I(1)^{n,t}$, $I(2)^{d}$	$I(2)^{d}$, model 3	$I(1)^{d,t}$	$I(1)^{t}$
$REER^{ex}_{PPI_manuf}$	x	x	model 1	model 3	$I(1)^{n,d,t}$	$I(1)^{d}$, model 3	$I(1)^{d,t}$	$I(1)^{d}$, model 3
$REER^{ex}_{PPI_manuf_ext}$	x	x	model 1	model 3	$I(1)^{n,d,t}$	$I(1)^{d}$, model 3	$I(1)^{d,t}$	$I(1)^{d}$, model 3
$REER^{ex}_{ULC}$	-	?	model 4	model 1	$I(1)^{n,d,t}$	$I(1)^{n}$, model 1	$I(0)^{d,t}$	?
$REER^{im}_{CPI}$	x [3]	x	model 1	model 3	$I(1)^{n,d,t}$	$I(1)^{d}$, model 3	$I(1)^{d,t}$	$I(1)^{d}$, model 3
$REER^{im}_{PPI_ind}$	x	x	model 1	model 3	$I(1)^{n,d,t}$	$I(1)^{d}$, model 3	$I(1)^{d,t}$	$I(1)^{d}$, model 3
$REER^{im}_{PPI_ind_ext}$	x	x	model 1	model 3	$I(1)^{n,d,t}$	$I(1)^{d}$, model 3	$I(1)^{d,t}$	$I(1)^{d}$, model 3
$REER^{im}_{PPI_manuf}$	x	x	model 1	model 3	$I(1)^{n,d,t}$	$I(1)^{d}$, model 3	$I(1)^{d,t}$	$I(1)^{d}$, model 3
$REER^{im}_{PPI_manuf_ext}$	x	x	model 1	model 3	$I(1)^{n,d,t}$	$I(1)^{d}$, model 3	$I(1)^{d,t}$	$I(1)^{d}$, model 3
$REER^{im}_{ULC}$	-	?	model 1	model 3	$I(1)^{n,d,t}$	$I(1)^{d}$, model 3	$I(1)^{d}$	$I(1)^{d}$, model 3
$handelsint_{NL}$	x	x	model 3	model 3	$I(1)^{n,d,t}$	$I(1)^{d}$, model 3	$I(1)^{d,t}$	$I(1)^{d}$, model 3

Source: Own results.

[1] Trending behaviour according to graph of the series.
[2] Unit root according to ACF of the series.
[3] Quadratic trend.

Table B.8: Unit Root Test Results Austria and Netherlands, Extra-EMU

Dependent variables	Series trending[1]	ACF: unit root[2]	Augmented Dickey Fuller Tests					
			Enders	Elders and Kennedy	Order of integration	Conclusion ADF	Order of integration	Final decision
$EX_{extra-EMU_AT}$	x	x	model 5	model 3	$I(1)^{n,d,t}$	$I(1)^{d,t}$, model 5	$I(1)^{d,t}$	$I(1)^{d,t}$, model 5
$EX_{extra-EMU_NL}$	x	x	model 1	model 1	$I(1)^{n,d,t}$	$I(1)^{n}$, model 1	$I(1)^{d}$, $I(2)^{t}$	$I(1)^{d}$
$IM_{extra-EMU_AT}$	x	x	model 5	model 1	$I(1)^{n,d,t}$	$I(1)^{d,t}$, model 5	$I(1)^{d}$	$I(1)^{d,t}$, model 5
$IM_{extra-EMU_NL}$	x	x	model 5	model 3	$I(1)^{n,d,t}$	$I(1)^{d,t}$, model 5	$I(1)^{d}$	$I(1)^{d,t}$, model 5
Demand variables								
$consumpt_{(AT)}$	x	x	model 3	model 1	$I(1)^{d}$, $I(2)^{n,t}$	$I(1)^{d}$, model 3	$I(1)^{d,t}$	$I(1)^{d}$, model 3
$consumpt_{(NL)}$	x	x	model 3	model 1	$I(1)^{d,t}$, $I(2)^{n}$	$I(1)^{d}$, model 3	$I(1)^{d,t}$	$I(1)^{d}$, model 3
$consumpt_{extra-EMU}$	x	x	model 1	model 1	$I(1)^{n,d,t}$	$I(1)^{d}$, model 1	$I(0)$	?
$GDP_{(AT)}$	x	x	model 5	model 1	$I(1)^{d}$, $I(2)^{n,t}$	?	$I(1)^{d,t}$	$I(1)^{d}$
$GDP_{(NL)}$	x	x	model 3	model 1	$I(1)^{n,t}$, $I(2)^{d}$	$I(2)^{d}$, model 3	$I(1)^{d,t}$	$I(1)^{d}$, model 3
$GDP_{extra-EMU}$	x	x	model 3	model 1	$I(1)^{n,d,t}$	$I(1)^{d}$, model 1	$I(0)$	?
$GFCF_{(AT)}$	x	x	model 1	model 1	$I(1)^{n,d,t}$	$I(1)^{n}$, model 1	$I(1)^{d,t}$	$I(1)^{n}$, model 1
$GFCF_{(NL)}$	x	x	model 4	model 1	$I(1)^{n,d,t}$	$I(1)^{n}$, model 1	$I(1)^{d,t}$	$I(1)^{n}$, model 1
$GFCF_{extra-EMU}$	x	x	model 1	model 1	$I(1)^{n,d,t}$	$I(1)^{n}$, model 1	$I(1)^{t}$	$I(1)^{t}$
$IP_{(AT)}$	x	x	model 5	model 1	$I(1)^{n,d,t}$	$I(1)^{d,t}$, model 5	$I(1)^{d,t}$	$I(1)^{d,t}$, model 5
$IP_{(NL)}$	x	x	model 5	model 1	$I(1)^{n,d,t}$	$I(1)^{d,t}$, model 5	$I(1)^{d,t}$	$I(1)^{d,t}$, model 5
$IP_{(extra-EMU)}$	x	x	model 1	model 1	$I(1)^{n,d,t}$	$I(1)^{n}$, model 1	$I(1)^{d,t}$	$I(1)^{d,t}$

Continued next page...

Source: Own results.

[1] Trending behaviour according to graph of the series.

[2] Unit root according to ACF of the series.

Table B.9: Unit Root Test Results Austria and Netherlands, Extra-EMU

Dependent variables	Series trending[1]	ACF: unit root[2]	Augmented Dickey Fuller Tests: Enders	Elders and Kennedy	Order of integration	Conclusion ADF	Order of integration	Final decision
Continued from previous page...								
Price variables								
$REER^{ex}_{CPI_AT}$	x	x	model 5	model 3	$I(1)^{n,d,t}$	$I(1)^{d,t}$, model 5	$I(1)^{d,t}$	$I(1)^{d,t}$, model 5
$REER^{ex}_{CPI_NL}$	x	x	model 5	model 1	$I(1)^{n,d,t}$	$I(1)^{d,t}$, model 5	$I(1)^{d,t}$	$I(1)^{d,t}$, model 5
$REER^{ex}_{PPI_AT}$	x	x	model 4	model 1	$I(1)^{n,t}$	$I(1)^{n}$, model 1	$I(1)^{d}$, $I(2)^{t}$	?
$REER^{ex}_{PPI_NL}$	x	x	model 4	model 1	$I(1)^{n,t}$	$I(1)^{n}$, model 1	$I(1)^{d,t}$	$I(1)^{n}$, model 1
$REER^{ex}_{ULC_AT}$	-	x	model 5	model 1	$I(1)^{n,t}$	$I(1)^{n}$, model 1	$I(1)^{t}$	$I(1)^{n}$, model 1
$REER^{ex}_{ULC_NL}$	-	x	model 1	model 1	$I(2)^{n,d,t}$	$I(2)^{n}$, model 1	$I(1)^{d}$, $I(2)^{t}$	$I(2)^{t}$
$REER^{im}_{CPI_AT}$	x	x	model 3	model 1	$I(1)^{n,d,t}$	$I(1)^{d}$, model 3	$I(1)^{d,t}$	$I(1)^{d}$, model 3
$REER^{im}_{CPI_NL}$	x	x	model 5	model 1	$I(1)^{n,d,t}$	$I(1)^{d,t}$, model 5	$I(1)^{d,t}$	$I(1)^{d,t}$, model 5
$REER^{im}_{PPI_AT}$	x	x	model 4	model 1	$I(2)^{n,t}$	$I(2)^{n}$, model 1	$I(1)^{d,t}$	?
$REER^{im}_{PPI_NL}$	x	x	model 4	model 1	$I(2)^{n,t}$	$I(2)^{n}$, model 1	$I(1)^{d,t}$	?
$REER^{im}_{ULC_AT}$	-	x	model 5	model 1	$I(1)^{n,d,t}$	$I(1)^{n}$, model 1	$I(1)^{t}$, $I(2)^{d}$	$I(1)^{n}$, model 1
$REER^{im}_{ULC_NL}$	-	x	model 5	model 1	$I(2)^{n,d,t}$	$I(2)^{d}$, model 1	$I(1)^{d}$, $I(2)^{t}$	$I(2)^{d,t}$
$handelsint_extra_EMU_{AT}$	x	x	model 5	model 1	$I(1)^{n,d,t}$	$I(1)^{d,t}$, model 5	$I(1)^{d}$	$I(1)^{d,t}$, model 5
$handelsint_extra_EMU_{NL}$	x	x	model 5	model 1	$I(1)^{n,d,t}$	$I(1)^{d,t}$, model 5	$I(1)^{d,t}$	$I(1)^{d,t}$, model 5

Source: Own results.

[1] Trending behaviour according to graph of the series.

[2] Unit root according to ACF of the series.

B.3 Model Selection Procedure

In the following subsection, the detailed results of the single steps received from conducting the model testing procedure as described in section 4.5.1 will be presented.

B.3.1 Selection of the Lag-Length of the VAR-Models

This paragraph contains the detailed results of the first step of the model selection procedure, as described in section 4.5.1.. Namely the search for the ideal number of lags of the VAR-models used to estimate Austrian and Dutch intra- and extra-EMU imports and exports.

Table B.10: Intra-EMU: Lag-Length in VAR-Model, Austria

Model	**# of lags according to**			**Test for Normality of Residuals at...**	**Test for Autocorrelation in Residuals: no autocorrelation at...**
	AIC	**SC**	**HQC**		
Exports					
1a_i	2	1	2	2 , 3, 4 and 8 lags	2 , 3, 4 and 8 lags
with proxy	8	1	1	7 and 8 lags	7 and 8 lags
1a_ii	2	1	2	1, 2 and 8 lags	2 and 8 lags
with proxy	7	1	1	6 and 7 lags	7 lags
2a	7	1	1	$\geq$ 10 *lags*	
with proxy	8	1	1	8 lags	8 lags
3ai	3	1	2	$\geq$ 15 *lags*	2 and 3 lags
with proxy	8	1	1	$\geq$ 10 *lags*	-
3aii	3	1	2	-	-
with proxy	8	1	1	-	2 lags
4ai	4	1	1	$\geq$ 13 *lags*	1 and 4 lags
with proxy	8	1	1	$\geq$ 11 *lags*	1 lags
4aii				$\geq$ 15 *lags*	1 and 3 lags
with proxy	2	1	1	$\geq$ 10 *lags*	1 and 2 lags
5a	1	1	1	-	1 lag
with proxy	8	1	1	-	1 lag
6a	1	1	1	$\geq$ 13 *lags*	1 lag
with proxy	8	1	1	$\geq$ 12 *lags*	1 and 8 lags
7a	3	2	2	2 and 6 lags	2 and 6 lags
with proxy	8	1	2	$\geq$ 12 *lags*	2 and 8 lags
8a	6	1	1	$\geq$ 12 *lags*	1 and 6 lags
with proxy	8	1	7	$\geq$ 9 *lags*	1, 7 and 8 lags
9a	6	1	1	1 and 6 lags	1 and 6 lags
with proxy	7	1	7	7 and 8 lags	1, 7 and 8 lags

Continued next page...

Table B.11: Intra-EMU: Lag-Length in VAR-Model, Austria

Model	**# of lags according to**			**Test for Normality of Residuals at…**	**Test for Auto-correlation in Residuals: no autocorrelation at…**
	AIC	**SC**	**HQC**		
Continued from previous page...					
Imports					
1bi	3	1	1	$\geq$ 14 *lags*	3 lags
with proxy	8	1	1	$\geq$ 12 *lags*	8 lags
1bii	3	1	2	$\geq$ 15 *lags*	3 lags
with proxy	8	1	1	8 lags	8 lags
2b	1	1	1	7 lags	1 and 7 lags
with proxy	8	1	1	8 lags	1 and 8 lags
3bi	8	1	1	$\geq$ 15 *lags*	8 lags
with proxy	8	1	1	$\geq$ 9 *lags*	1 and 8 lags
3bii	8	1	1	$\geq$ 12 *lags*	1 and 8 lags
with proxy	8	1	1	$\geq$ 15 *lags*	1 and 8 lags
4bi	3	1	1	$\geq$ 12 *lags*	1 and 3 lags
with proxy	5	1	1	8 lags	1, 5 and 8 lags
4bii	3	1	1	-	1 and 3 lags
with proxy	5	1	1	-	1 and 5 lags
5b	8	1	1	$\geq$ 12 *lags*	1 lag
with proxy	8	1	1	8 lags	1 and 8 lags
6b	1	1	1	$\geq$ 13 *lags*	1 lag
with proxy	8	1	1	$\geq$ 12 *lags*	1 and 8 lags
7b	2	2	2	$\geq$ 9 *lags*	2 lags
with proxy	8	1	2	8 lags	2 and 8 lags
8b	5	1	2	2 and 5 lags	1, 2 and 5 lags
with proxy	8	1	1	8 lags	1 and 8 lags
9b	2	1	2	$\geq$ 9 *lags*	2 lags
with proxy	8	1	1	8 lags	8 lags

Table B.12: Intra-EMU: Lag-Length in VAR-Model, Netherlands

Model	**# of lags according to**			**Test for Normality of Residuals at...**	**Test for Auto-correlation in Residuals: no autocorrelation at...**
	AIC	**SC**	**HQC**		
Exports					
1a_i	2	2	2	2 lags	2 lags
with proxy	8	2	8	8 lags	2 and 8 lags
1a_ii	8	2	2	2 and 8 lags	2 and 8 lags
with proxy	8	2	8	8 lags	2 and 8 lags
2a	2	2	2	2 lags	2 lags
with proxy	8	1	3	8 lags	3 and 8 lags
3ai	5	1	1	$\geq$ 15 *lags*	5 lags
with proxy	8	1	8	8 lags	7 and 8 lags
3aii	5	1	1	$\geq$ 10 *lags*	5 lags
with proxy	8	1	8	$\geq$ 9 *lags*	8 lags
4ai	2	1	1	$\geq$ 15 *lags*	2 lags
with proxy	8	1	1	$\geq$ 12 *lags*	8 lags
4aii	2	1	1	g$\geq$ 9 *lags*	2 lags
with proxy	8	1	3	8 lags	3 and 8 lags
5a	8	1	1	$\geq$ 10 *lags*	-
with proxy	8	1	8	8 lags	7 and 8 lags
6a	7	1	1	$\geq$ 10 *lags*	7 lags
with proxy	8	1	7	7 lags	1 ang 7 lags
7a	5	2	4	5 lags	2, 4, and 5 lags
with proxy	8	1	8	8 lags	8 lags
8a	4	2	2	2 and 4 lags	2 and 4 lags
with proxy	8	1	5	5 and 8 lags	5 and 8 lags
9a	5	2	2	5 lags	2 and 5 lags
with proxy	7	1	6	6 and 7 lags	6 and 7 lags

Continued next page...

Table B.13: Intra-EMU: Lag-Length in VAR-Model, Netherlands

Model	**# of lags according to**			**Test for Normality of Residuals at…**	**Test for Auto-correlation in Residuals: no autocorrelation at…**
	AIC	**SC**	**HQC**		
Continued from previous page...					
Imports					
1bi	5	1	1	5 lags	5 lags
with proxy	8	1	1	8 lags	8 lags
1bii	5	5	5	5 lags	5 lags
with proxy	8	1	8	8 lags	8 lags
2b	7	1	1	7 lags	1 and 7 lags
with proxy	8	1	8	7 and 8 lags	7 and 8 lags
3bi	1	1	1	$\geq$ 15 *lags*	1 lag
with proxy	8	1	1	$\geq$ 12 *lags*	1 lag
3bii	1	1	1	$\geq$ 15 *lags*	1 lag
with proxy	8	1	1	$\geq$ 12 *lags*	1 lag
4bi	1	1	1	$\geq$ 11 *lags*	1 lag
with proxy	8	1	1	8 lags	1 and 8 lags
4bii	2	1	1	-	1 and 2 lags
with proxy	8	1	1	8 lags	1 and 8 lags
5b	8	1	1	$\geq$ 13 *lags*	1 and 8 lags
with proxy	8	1	8	$\geq$ 9 *lags*	1 and 8 lags
6b	1	1	1	$\geq$ 11 *lags*	1 lag
with proxy	8	1	1	$\geq$ 9 *lags*	1 lag
7b	7	1	1	8 lags	1 and 8 lags
with proxy	8	1	7	7 and 8 lags	1, 7 and 8 lags
8b	8	1	5	8 lags	1, 5 and 8 lags
with proxy	8	1	8	8 lags	1 and 8 lags
9b	8	1	8	8 lags	1 and 8 lags
with proxy	8	1	8	8 lags	1 and 8 lags

Table B.14: Extra-EMU: Lag-Length in VAR-model, Austria

Model	**# of lags according to**			**Test for Normality of**	**Test for Auto-correlation in Residuals:**
	AIC	**SC**	**HQC**	**Residuals at…**	**no autocorrelation at…**
Exports					
1_c	1	1	1	≥ 15 *lags*	1 lag
with proxy	8	1	1	≥ 9 *lags*	8 lags
2_c	1	1	1	≥ 14 *lags*	
with proxy	2	1	1	≥ 9 *lags*	2 lags
3_c	2	2	2	≥ 9 *lags*	2 lags
with proxy	8	1	2	8 lags	2 and 8 lags
4_c	1	1	1	8 lags	1 and 8 lags
with proxy	8	1	1	8 lags	8 lags
5_c	7	1	1	≥ 9 *lags*	1 and 7 lags
with proxy	8	1	1	8 lags	8 lags
6_c	2	1	2	≥ 9 *lags*	2 lags
with proxy	2	1	1	≥ 10 *lags*	2 lags
7_c	1	1	1	≥ 13 *lags*	1 lag
with proxy	1	1	1	≥ 10 *lags*	-
8_c	1	1	1	≥ 13 *lags*	1 lag
with proxy	8	1	1	≥ 11 *lags*	8 lags
Imports					
1_d	2	1	1	≥ 15 *lags*	2 lags
with proxy	8	1	1	≥ 12 *lags*	8 lags
2_d	1	1	1	-	1 lag
with proxy	1	1	1	≥ 12 *lags*	1 lag
3_d	1	1	1	≥ 9 *lags*	1 lag
with proxy	8	1	1	lag 8	1 and 8 lags
4_d	1	1	1	-	1 lag
with proxy	8	1	1	lag 8	1 and 8 lags
5_d	1	1	1	-	1 lag
with proxy	1	1	1	≥ 12 *lags*	1 lag
6_d	1	1	1	≥ 11 *lags*	1 lag
with proxy	1	1	1	≥ 12 *lags*	1 lag
7_d	8	1	1	≥ 11 *lags*	1 and 8 lags
with proxy	1	1	1	≥ 10 *lags*	1 lag
8_d	2	1	2	≥ 15 *lags*	2 lags
with proxy	8	1	1	≥ 11 *lags*	8 lags

Table B.15: Extra-EMU: Lag-Length in VAR-Model, Netherlands

Model	**# of lags according to**			**Test for Normality of**	**Test for Auto-correlation in Residuals:**
	AIC	**SC**	**HQC**	**Residuals at…**	**no autocorrelation at…**
Exports					
1_c	1	1	1	geq 12 lags	lag 1
with proxy	8	1	1	$\geq$ 12 *lags*	1 and 8 lags
2_c	2	1	1	$\geq$ 12 *lags*	1 and 2 lags
with proxy	8	1	1	8 lags	1 and 8 lags
3_c	8	1	5	$\geq$ 9 *lags*	5 and 8 lags
with proxy	8	1	5	8 lags	5 and 8 lags
4_c	8	1	1	$\geq$ 9 *lags*	1 and 8 lags
with proxy	8	1	1	8 lags	1 and 8 lags
5_c	5	1	1	$\geq$ 11 *lags*	1 and 5 lags
with proxy	7	1	1	$\geq$ 9 *lags*	1 and 7 lags
6_c	2	1	2	$\geq$ 11 *lags*	2 lags
with proxy	1	1	1	$\geq$ 10 *lags*	-
7_c	1	1	1	$\geq$ 13 *lags*	1 lag
with proxy	7	1	1	$\geq$ 11 *lags*	1 and 7 lags
8_c	1	1	1	$\geq$ 13 *lags*	1 lag
with proxy	8	1	1	$\geq$ 9 *lags*	1 lag
Imports					
1_d	5	1	5	$\geq$ 10 *lags*	1 and 5 lags
with proxy	8	1	1	$\geq$ 10 *lags*	1 and 8 lags
2_d	5	1	1	$\geq$ 9 *lags*	1 and 5 lags
with proxy	8	1	1	8 lags	1 and 8 lags
3_d	7	1	1	$\geq$ 12 *lags*	1 and 7 lags
with proxy	8	1	1	8 lags	1 and 8 lags
4_d	8	1	5	$\geq$ 9 *lags*	1 and 5 lags
with proxy	8	1	8	8 lags	1 and 8 lags
5_d	8	1	1	$\geq$ 9 *lags*	1 and 8 lags
with proxy	8	1	1	8 lags	1 and 8 lags
6_d	1	1	1	$\geq$ 12 *lags*	1 lag
with proxy	1	1	1	$\geq$ 10 *lags*	1 lag
7_d	5	1	5	$\geq$ 10 *lags*	5 lags
with proxy	8	1	1	8 lags	8 lags
8_d	5	1	1	$\geq$ 10 *lags*	1 and 5 lags
with proxy	1	1	1	7 and 8 lags	1, 7 and 8 lags

B.3.2 Results of the Cointegration Tests

In this section, the detailed results of the cointegration tests of the Austrian and Dutch import and export demand models, which corresponds to the second step of the model selection procedure will be presented.

Table B.16: Intra-EMU: Cointegration Test Results, Austria

Austria Intra-EMU	**# of cointegrating vectors rank(Π) and [#of lag length] model 3**	**model 4**
Exports		
1a_i	1[1], 1[6]	1[1], 1[6], 2[7]
with proxy	1[1], 1[5], 4[6], 3[7]	
1a_ii	1[1], 1[2], 1[3],1[6], 1[7]	1[1], 1[6], 1[7]
with proxy	1[5], 4[6]	
2a	1[6]	1[6], 2[7]
with proxy	1[2], 1[3], 1[4], 2[5], 2[6], 2[7]	
3ai	1[3], 3[4], 3[5], 3[6]	1[6]
with proxy	1[1], 4[2], 4[3], 4[4], 4[5], 4[6]	
3aii	1[3], 3[4], 3[5], 3[6]	1[6]
with proxy	1[1], 4[2], 4[3], 4[4], 4[5], 4[6]	
4ai	3[2], 1[3], 3[4], 3[5], 3[6]	1[3], 1[4],1[5], 1[6], 1[7]
with proxy	4[2], 4[3], 4[4], 4[5], 4[6]	
4aii	1[3], 3[4], 3[5], 3[6]	1[4], 1[6],1[7]
with proxy	1[1], 4[2], 4[3], 4[4], 4[5], 4[6]	
5a	1[3], 3[4], 3[5], 3[6]	n.
with proxy	1[2], 4[3], 4[4], 4[5], 4[6]	
6a	n.	n.
with proxy	3[4], 3[5], 3[6]	
7a	1[2], 1[4], 3[5], 3[6]	1[4], 2[5]
with proxy	1[2], 1[3], 4[4], 4[5], 4[6],	
8a	3[4], 3[5], 3[6]	1[5], 2[6], 1[7]
with proxy	2[2], 1[3], 4[4], 4[5], 4[6]	
9a	n.	n.
with proxy	2[4], 4[5], 2[6], 3[7]	

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Table B.17: Intra-EMU: Cointegration Test Results, Austria

Austria Intra-EMU	**# of cointegrating vectors rank(Π) and [#of lag length] model 3**	**model 4**
Continued from previous page...		
Imports		
1b_i	1[6]	1[1], 1[6]
with proxy	1[5], 2[7]	
1bii	1[6]	1[1], 1[6]
with proxy	1[5], 2[6], 2[7]	
2b	1[6]	1[6]
with proxy	1[6], 3[7]	
3bi	1[7]	1[7]
with proxy	1[2], 1[3], 2[6]	
3bii	1[7]	1[7]
with proxy	1[2], 1[3], 2[6]	
4bi	n.	
with proxy	4[2], 2[3], 3[4], 1[5], 2[6]	
4bii		1[5], 1[7]
with proxy	4[2], 2[3], 1[4], 2[6]	
5b		1[7]
with proxy	1[3], 3[6]	
6b	1[1], 3[4], 3[5], 3[6]	1[1], 1[4], 1[5],1[7]
with proxy	1[1], 1[3], 4[4], 4[5], 4[6]	
7b	n.	
with proxy	2[5], 1[6], 2[7]	
8b	n.	n.
with proxy	1[3], 2[6], 3[7]	
9b	n.	n.
with proxy	1[3], 1[4], 2[5], 4[6]	

Table B.18: Intra-EMU: Cointegration Test Results, Netherlands

Netherlands Intra-EMU	**# of cointegrating vectors rank(Π) and [#of lag length] model 3**	**model 4**
Exports		
1a_i	1[1], 1[2], 1[3], 1[4], 3[5], 3[6]	1[1], 1[3],1[7]
with proxy	1[1], 2[2], 2[3], 4[4], 2[5], 4[6],	
1a_ii	1[1], 1[2], 1[3], 3[4], 3[5], 3[6],	1[1], 1[3], 1[5], 1[6], 3[7]
with proxy	2[1], 2[2], 2[3], 4[4], 4[5], 4[6], 1[7]	
2a	1[1], 1[2], 1[4], 1[5], 1[6], 1[7]	1[1], 1[6]
with proxy	2[1], 2[2], 1[3], 2[4], 2[5], 4[6]	
3ai	3[4], 3[5], 3[6], 1[7]	1[4], 1[5], 1[6], 1[7]
with proxy	4[2], 4[4], 4[5], 4[6], 2[7]	
3aii	3[4], 3[5], 3[6], 1[7]	1[4], 1[5], 1[6], 1[7]
with proxy	4[2], 4[4], 4[5], 4[6], 2[7]	
4ai	3[4], 3[6], 1[7]	2[6], 1[7]
with proxy	4[2], 1[3], 4[4], 4[5], 4[6]	
4aii	3[4], 3[5], 3[6]	1[5], 2[6], 1[7]
with proxy	1[1], 4[2], 4[3], 4[4], 1[5], 4[6], 2[7]	
5a	3[4], 3[5], 1[6]	1[6], 1[7]
with proxy	2[2], 1[3], 4[4], 4[5], 4[6]	
6a	1[4], 1[6], 1[7]	1[4], 1[6], 1[7]
with proxy	2[4], 2[5], 2[6], 2[7]	
7a	n.	1[1], 1[2], 1[3], 1[4]
with proxy	1[2], 1[4], 2[5], 2[6], 2[7]	
8a	1[1]	1[1], 1[2], 1[4]
with proxy	1[1], 1[2], 1[3], 1[5], 2[6], 2[7]	
9a	n.	1[1], 1[4]
with proxy	1[4], 1[5], 2[6], 2[7]	

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Austria	**# of cointegrating vectors rank(Π) and [#of lag length]**	
Intra-EMU	**model 3**	**model 4**
Continued from previous page...		
Imports		
1bi	2[1], 2[2], 3[3], 1[4], 1[5], 1[6]	1[1], 1[2], 2[3], 1[4], 1[5], 1[6]
with proxy	1[1], 2[2], 2[3], 1[4], 2[5], 3[6], 3[7]	
1bii	1[2], 1[3], 1[4], 1[5], 1[6], 1[7]	1[1], 1[2], 2[3], 1[4], 3[5], 3[6]
with proxy	1[1], 1[2], 1[3], 1[4], 2[5], 3[6]	
2b	1[1], 1[2], 1[3], 1[6], 1[7]	1[1], 2[2], 2[3], 1[4], 1[5]
with proxy	1[1], 1[2], 2[3],2[4], 4[5], 4[6]	
3bi	3[4], 3[5], 3[6]	2[4], 3[5], 3[6]
with proxy	4[2], 1[3], 4[4], 4[5], 2[6], 2[7]	
3bii	3[4], 3[5], 3[6]	2[4], 3[5], 3[6]
with proxy	4[2], 1[3], 4[4], 4[5], 2[6], 2[7]	
4bi	3[4], 3[5], 3[6]	2[6]
with proxy	4[2], 1[39, 4[4], 4[5], 4[6]	
4bii	3[4], 3[5], 3[6], 2[7]	1[5], 2[6], 2[7]
with proxy	1[1], 4[2], 4[3], 4[4], 1[5], 4[6], 2[7]	
5b	1[2], 1[6]	1[2], 1[3], 1[7]
with proxy	2[2], 1[3], 2[4], 2[5], 3[6]	
6b	3[4], 1[6]	2[4], 1[6], 1[7]
with proxy	1[2], 1[3], 4[4], 4[5], 2[6]	
7b	3[1], 3[2], 3[3], 1[4], 3[5], 3[6]	1[1], 2[2], 2[3], 1[4], 1[5], 1[6], 2[7]
with proxy	2[1], 2[2], 2[3], 2[4], 2[5], 1[6], 2[7]	
8b	1[1], 2[2], 1[3], 1[7]	1[2], 1[7]
with proxy	1[1], 2[2], 2[3], 2[4], 2[5], 1[6], 2[7]	
9b	3[2], 3[4], 3[5], 3[6]	1[2], 1[4], 1[5], 2[6], 2[7]
with proxy	2[2], 2[3], 4[4], 2[5], 2[6], 2[7]	

Table B.19: Extra-EMU: Cointegration Test Results, Austria

Austria	**# of cointegrating vectors rank(Π) and [#of lag length]**	
Extra-EMU	**model 3**	**model 4**
Exports		
1_c	2[5], 1[6], 1[8]	
with proxy	1[5], 2[6], 2[7], 2[8]	1[5], 3[6], 3[7], 3[8]
2_c	2[5], 1[6], 1[8]	
with proxy	1[2], 1[5], 2[6], 2[8]	
3_c	2[1], 2[2], 2[3], 2[4], 1[5], 2[6], 2[7], 2[8]	2[1], 2[2], 2[3], 1[6], 1[7], 1[8]
with proxy	3[1], 3[2], 3[3], 2[4], 2[5], 2[6], 3[7], 3[8]	
4_c	1[2], 1[3], 1[5], 1[6],2[7], 2[8]	1[3], 1[5], 1[6],2[7], 2[8]
with proxy	1[2], 2[3], 1[4], 2[5]	
5_c	1[2], 2[3], 1[4], 1[5], 1[6], 2[7], 2[8]	1[3], 1[4], 1[6], 2[7], 2[8]
with proxy	1[2], 2[3], 1[4], 1[5], 2[6], 2[7], 2[8]	
6_c	1[3], 1[7], 1[8]	1[4], 1[7], 1[8]
with proxy	1[2], 1[3], 1[5], 1[6],2[7]	
7_c	n.	n
with proxy	1[5], 1[6], 2[7], 2[8]	
8_c	1[3], 1[5], 1[6]	1[3], 1[6], 1[7]
with proxy	1[6], 2[7], 2[8]	
Imports		
1_d	1[5], 1[6], 1[7], 1[8]	1[5], 1[6], 1[7], 1[8]
with proxy	1[5], 2[6], 2[7], 2[8]	
2_d		1[8]
with proxy	2[6], 2[7],	
3_d	1[1], 1[2], 1[3], 2[4], 2[5], 2[6],2[7], 1[8]	1[2], 1[3], 2[4], 1[5], 1[6],2[7], 2[8]
with proxy	1[2], 1[3], 1[4], 2[5]	
4_d	1[2], 1[3], 2[4], 2[5], 2[6], 2[7], 1[8]	1[3], 2[4], 1[5], 1[6], 2[7], 1[8]
with proxy	1[3], 1[4], 2[5], 3[6], 3[7], 2[8]	
5_d	2[1], 1[2], 1[3], 1[4], 2[5], 2[6], 2[7], 1[8]	1[1], 1[3], 1[4], 2[5], 2[6], 1[8]
with proxy	1[4], 1[5], 3[6], 2[7], 2[8]	
6_d	1[4], 1[5], 1[6], 1[7], 1[8]	1[4], 1[5], 1[6], 2[7], 2[8]
with proxy	1[4], 1[5], 1[6], 1[7], 2[8]	
7_d	1[4], 1[5], 1[6], 1[7], 1[8]	1[4], 1[5], 2[6], 2[7], 2[8]
with proxy	1[5], 1[6], 1[7], 2[8]	
8_d	1[1], 2[4], 1[5], 1[6], 1[7], 1[8]	2[4], 2[5], 2[6], 2[7], 1[8]
with proxy	1[4], 1[5], 1[6], 1[7], 2[8]	

Table B.20: Extra-EMU: Cointegration Test Results, Netherlands

Netherlands Extra-EMU	**# of cointegrating vectors rank(Π) and [#of lag length] model 3**	**model 4**
Exports		
1_c	1[8]	1[2], 1[3], 2[5], 1[7], 1[8]
with proxy	1[3], 1[5], 2[7], 2[8]	
2_c	1[6], 1[7], 1[8]	1[2], 1[3], 2[5], 1[6], 1[7], 1[8]
with proxy	1[1], 1[2], 1[3], 1[4], 1[5], 1[6], 2[7], 2[8]	
3_c	2[1], 2[2], 2[3], 1[4], 2[5], 2[6], 2[7], 2[8]	2[1], 2[2], 2[3], 1[5], 2[6], 2[7], 1[8]
with proxy	3[1], 3[2], 3[3], 3[4], 2[5], 3[6], 3[7], 3[8]	
4_c	1[1], 1[2], 2[3], 1[5], 2[6], 2[7], 2[8]	1[1], 1[2], 3[3], 2[5], 3[6], 3[7], 3[8]
with proxy	1[2], 3[3], 1[4], 2[5], 2[6], 3[7], 3[8]	
5_c	1[2], 2[3], 1[5], 2[6], 2[7], 2[8]	2[2], 3[3], 1[4], 2[5], 3[6], 3[7], 3[8]
with proxy	2[2], 3[3], 1[4], 1[5], 2[6], 3[7]	
6_c	1[2], 1[3]	1[2], 1[4], 1[7]
with proxy	1[2], 1[3], 1[4], 1[5], 1[7]	
7_c	1[2], 1[3]	1[2], 1[8]
with proxy	1[2], 1[3], 1[6], 1[7]	
8_c	1[3], 1[5], 1[6]	1[2], 1[3], 1[5]
with proxy	1[2], 1[3], 1[5], 1[6], 2[7]	
Imports		
1_d	1[2], 2[3], 1[6], 1[7]	1[2], 2[3], 1[5], 1[6], 2[7], 1[8]
with proxy	2[3], 1[5], 2[6], 2[7], 2[8]	
2_d	1[2], 2[3], 1[8]	1[2], 2[3], 1[6], 1[7], 1[8]
with proxy	1[3], 1[6], 2[7], 3[8]	
3_d	1[1], 1[2], 1[3], 1[4], 1[5],1[6], 1[7], 1[8]	1[2], 2[3], 1[4], 1[5], 1[6], 1[7], 1[8]
with proxy	1[2], 2[3], 1[4], 2[5], 3[6], 3[7], 3[8]	
4_d	2[1], 2[2], 2[3], 1[6], 1[7], 1[8]	1[1], 2[2], 2[3], 1[6], 1[7], 1[8]
with proxy	2[2], 2[3], 1[5], 2[7],2[8]	
5_d	1[2], 1[3], 1[7], 1[8]	1[2], 1[3], 1[7], 1[8]
with proxy	1[2], 1[3], 1[4], 1[5], 2[6], 3[7], 3[8]	
6_d	1[6], 1[7], 2[8]	2[6], 1[7], 2[8]
with proxy	1[6]	
7_d	1[1], 1[2], 1[3], 1[4], 1[5],1[6], 1[7], 1[8]	1[2], 2[3], 2[4], 1[5], 1[6], 1[7], 1[8]
with proxy	1[3], 1[4], 1[5],1[6], 2[7], 3[8]	
8_d	1[4]	1[4], 1[5], 1[7], 1[8]
with proxy	1[4], 1[7], 2[8]	

B.3.3 Summary of the Model Selection Procedure Results

This section summarizes the results of the model selection procedure and gives an overviwe of the models which pass the single steps of this procedure.

Table B.21: Austria, Intra-EMU Trade: Model Selection Procedure, 1. and 2. Step of the Johansen Procedure

Johansen Procedure:	**1. Step: # of lags according to:**				**2. Step: # of cointegrating vectors, i.e. rank(Π), and [#of lags]:**	
Model	**AIC**	**SC**	**HQC**	**Normality & autocorr. test of resid.[1]**	**Intercept, no trend in CE+;[2]**	**Intercept and trend in CE+;[3]**
Exports						
1a_i	2	1	2	2 , 3, 4 and **8** lags	1[1], 1[6]	1[1], 1[6], **2[7]**
1a_i, with proxy	8	1	1	**7 and 8 lags**	1[1], 1[5], **4[6], 3[7]**	-
1a_ii	2	1	2	**2 and 8 lags**	**1[1]** , 1[2], 1[3],1[6], **1[7]**	**1[1]** , 1[6], **1[7]**
1a_ii, with proxy*	7	1	1	**7 and 8 lags**	1[5], **4[6], 3[7]**	-
2a, with proxy	8	1	1	**8 lags**	1[2], 1[3], 1[4], 2[5], 2[6], **2[7]**	-
7a*	3	2	2	2 and 6 lags	1[2], 1[4], 3[5], 3[6]	1[4], 2[5]
9a	6	1	1	1 and 6 lags	n.n.	n.n.
9a, with proxy*	7	1	7	**7 and 8 lags**	2[4], 4[5], **2[6], 3[7]**	-
Imports						
1b_ii, with proxy	8	1	1	**8 lags**	1[5], **2[7]**	-
2b	1	1	1	**7 lags**	**1[6]**	**1[6]**
2b, with proxy*	8	1	1	**8 lags**	1[6], **3[7]**	-
4b_i, with proxy	5	1	1	8 lags	4[2], 2[3], 3[4], 1[5], 2[6]	-
5b, with proxy	8	1	1	8 lags	1[3], 3[6]	-
7b, with proxy*	8	1	2	**8 lags**	2[5], 1[6], **2[7]**	-
8b	5	1	2	2 and 5 lags	n.n.	n.n.
8b, with proxy	8	1	1	**8 lags**	1[3], 2[6], **3[7]**	-
9b, with proxy	8	1	1	8 lags	1[3], 1[4], 2[5], 4[6]	-

+ CE stands for cointegrating equation.
[1] Lag-length as suggested by Residual Normality and Autocorrelation Tests.
[2] # of lags in levels.
[3] # of lags in first differences: $p - 1$.

Table B.22: Austria, Intra-EMU Trade: Model Selection Procedure, 3. Step of the Johansen Procedure

Johansen procedure	**3. Step:**							
	Model specification:			**Selected according to:**		**a)**	**b)**	**c)**
Model	**# lags[1]**	**const.[2]**	**trend[3]**	**Johansen-proced.[4]**	**coint-to-VEC[5]**	**β' and α_x sign.**	**$\alpha_p = \alpha_y = \alpha_{proxy} = 0$**	**β' have right sign[6]**
Exports								
1a_ii, with proxy**	7	x	-	x	-	x	x	x
7a**	5	-	x	x	-	x	x	x
9a, with proxy	7	x	-	x	-	x	-	-
Imports								
2b, with proxy	7	x	-	x	-	x	-	-
7b, with proxy	7	x	-	x	-	x	-	-
8b, with proxy	7	x	-	x	-	x	-	-

[1] # of lags in first differences: $p - 1$.
[2] Intercept, no trend in cointegrating equation.
[3] Intercept and trend in cointegrating equation.
[4] Model selected by applying Johansen procedure (step 1. to 3.).
[5] Model selected by applying alternative procedure, comprising only steps 2. to 3. of Johansen procedure.
[6] The coefficients of the cointegrating vectors β' have the right positive (+) or negative (-) sign.

Table B.23: Netherlands, Intra-EMU Trade: Model Selection Procedure, 1. and 2. Step of the Johansen Procedure

Johansen Procedure:	**1. Step: # of lags according to:**				**2. Step: # of cointegrating vectors, i.e. rank(Π), and [#of lags]:**	
Model	**AIC**	**SC**	**HQC**	**Normality & autocorr. test of resid.[1]**	**Intercept, no trend in CE$^+$;[2]**	**Intercept and trend in CE$^+$;[3]**
Exports						
1a_i	2	2	2	**2 lags**	1[1], 1[2], 1[3], 1[4], 3[5], 3[6]	1[1], 1[3],1[7]
1a_i, with proxy	8	2	8	8 lags	1[1], 2[2], 2[3], 4[4], 2[5], 4[6]	
1a_ii	8	2	2	**2 and 8 lags**	1[1], 1[2], 1[3], 3[4], 3[5], 3[6]	1[1], 1[3], 1[5], 1[6], 3[7]
1a_ii, with proxy	8	2	8	**8 lags**	2[1], 2[2], 2[3], 4[4], 4[5], 4[6], 1[7]	
2a	2	2	2	**2 lags**	1[1], 1[2], 1[4], 1[5], 1[6], 1[7]	1[1], 1[6]
2a, with proxy	8	1	3	**8 lags**	2[1], 2[2], 1[3], 2[4], 2[5], 4[6], 4[7]	
3a_i, with proxy	8	1	8	**8 lags**	4[2], 4[4], 4[5], 4[6], 2[7]	
4a_ii, with proxy	8	1	3	**8 lags**	1[1], 4[2], 4[3], 4[4], 1[5], 4[6], 2[7]	
5a, with proxy	8	1	8	8 lags	2[2], 1[3], 4[4], 4[5], 4[6]	
6a, with proxy	8	1	7	**7 lags**	2[4], 2[5], 2[6], 2[7]	
7a	5	2	4	**5 lags**	n.	1[1], 1[2], 1[3], 1[4]
7a, with proxy	8	1	8	**8 lags**	1[2], 1[4], 2[5], 2[6], 2[7]	
8a	4	2	2	2 and 4 lags	**1[1]**	1[1], 1[2], 1[4]
8a, with proxy	8	1	5	5 and 8 lags	1[1], 1[2], 1[3], 1[5], 2[6], 2[7]	
9a	5	2	2	**5 lags**	n.	1[1], 1[4]
9a, with proxy	7	1	6	**6 and 7 lags**	1[4], 1[5], 2[6], 2[7]	

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[+] CE stands for cointegrating equation.
[1] Lag-length as suggested by Residual Normality and Autocorrelation Tests.
[2] # of lags in levels.
[3] # of lags in first differences: $p-1$.

Johansen Procedure:	**1. Step: # of lags according to:**				**2. Step: # of cointegrating vectors, i.e. rank(Π), and [#of lags]:**	
Model	**AIC**	**SC**	**HQC**	**Normality & autocorr. test of resid.[1]**	**Intercept, no trend in CE+;[2]**	**Intercept and trend in CE+;[3]**
Continued from previous page...						
Imports						
1bi	5	1	1	**5 lags**	2[1], 2[2], 3[3], 1[4], 1[5], 1[6]	1[1], 1[2], 2[3], 1[4], 1[5], 1[6]
1b_i, with proxy	8	1	1	**8 lags**	1[1], 2[2], 2[3], 1[4], 2[5], 3[6], 3[7]	
1bii	6	6	6	**6 lags**	1[2], 1[3], 1[4], 1[5], 1[6], 1[7]	1[1], 1[2], 2[3], 1[4], 1 [5], 3[6]
1b_ii, with proxy	8	1	8	8 lags	1[1], 1[2], 1[3], 1[4], 2[5], 3[6]	
2b	7	1	1	**7 lags**	1[1], 1[2], 1[3], 1[6], 1[7]	1[1], 2[2], 2[3], 1[4], 1[5]
2b, with proxy	8	1	8	7 and 8 lags	1[1], 1[2], 2[3],2[4], 4[5], 4[6]	
4b_i, with proxy	8	1	1	8 lags	4[2], 1[39, 4[4], 4[5], 4[6]	
4b_ii, with proxy	8	1	1	**8 lags**	1[1], 4[2], 4[3], 4[4], 1[5], 4[6], 2[7]	
7b	7	1	1	**8 lags**	3[1], 3[2], 3[3], 1[4], 3[5], 3[6]	1[1], 2[2], 2[3], 1[4], 1[5], 1[6], 2[7]
7b, with proxy	8	1	7	**7 and 8 lags**	2[1], 2[2], 2[3], 2[4], 2[5], 1[6], 2[7]	
8b	8	1	5	**8 lags**	1[1], 2[2], 1[3], 1[7]	1[2], 1[7]
8b, with proxy	8	1	8	**8 lags**	1[1], 2[2], 2[3], 2[4], 2[5], 1[6], 2[7]	
9b	8	1	8	**8 lags**	3[2], 3[4], 3[5], 3[6]	1[2], 1[4], 1[5], 2[6], 2[7]
9b, with proxy	8	1	8	**8 lags**	2[2], 2[3], 4[4], 2[5], 2[6], 2[7]	

[+] CE stands for cointegrating equation.

[1] Lag-length as suggested by Residual Normality and Autocorrelation Tests.

[2] # of lags in levels.

[3] # of lags in first differences: $p - 1$.

Table B.24: Netherlands, Intra-EMU Trade: Model Selection Procedure,3.Step of the Johansen Procedure

Johansen procedure	**3. Step:**							
	Model specification:			**Selected according to:**		**a)**	**b)**	**c)**
Model	**# lags[1]**	**const.[2]**	**trend[3]**	**Johansen-proced.[4]**	**coint-to-VEC[5]**	**β' and α_x sign.**	**$\alpha_p = \alpha_y = \alpha_{proxy} = 0$**	**β' have right sign[6]**
Exports								
1a_i	4,5	x	-	-	x	x	-	-
1a_ii	7	-	x	x	-	x	x	-
1a_ii	4,5	x	-	-	x	x	-	-
2a	1	-	x	x	-	x	-	-
7a, with proxy	7	x	-	x	-	x	-	-
7a, with proxy	2,4	x	-	-	x	x	x	-
8a, with proxy	7	x	-	x	-	x	-	-
8a, with proxy	5	x	-	-	x	x	-	-
9a, with proxy	5	x	-	x	-	x	x	-
Imports								
1_bi, 3 lags,c	3	x	-	-	x	x	-	-
1b_ii	5	x	-	x	x	x	x	x
1b_ii, 4 and 7lags, c,t	4, 7	x	-	-	x	x	x	x
2b	3,7	x	-	-	x	x	x	x
7b, 6 lags, c	6	x	-	-	x	x	-	-

[1] # of lags in first differences: $p - 1$.
[2] Intercept, no trend in cointegrating equation.
[3] Intercept and trend in cointegrating equation.
[4] Model selected by applying Johansen procedure (step 1. to 3.).
[5] Model selected by applying alternative procedure, comprising only steps 2. to 3. of Johansen procedure.
[6] The coefficients of the cointegrating vectors β' have the right positive (+) or negative (-) sign.

Table B.25: Austria, Netherlands, Extra-EMU Trade: Model Selection Procedure, 1. and 2. Step of the Johansen Procedure

Johansen Procedure:	**1. Step: # of lags according to:**				**2. Step: # of cointegrating vectors, i.e. rank(Π), and [#of lags]:**	
Model	**AIC**	**SC**	**HQC**	**Normality & autocorr. test of resid.[1]**	**Intercept, no trend in CE$^+$;[2]**	**Intercept and trend in CE$^+$;[3]**
Austria						
Exports						
3c, with proxy	9	1	8	**8 and 9 lags**	3[1], 3[2], 3[3], 2[4], 2[5], 2[6], 3[7], 3[8]	
4c	1	1	1	**8 lags**	1[2], 1[3], 1[5], 1[6],2[7], 2[8]	1[3], 1[5], 1[6],2[7], 2[8]
4c, with proxy	8	1	1	8 lags	1[2], 2[3], 1[4], 2[5]	
5c, with proxy	8	1	9	**8 and 9 lags**	1[2], 2[3], 1[4], 1[5], 2[6], 2[7], 2[8]	
Imports						
3d, with proxy	8	1	1	lag 8	1[2], 1[3], 1[4], 2[5]	
4d, with proxy	8	1	1	**lag 8**	1[3], 1[4], 2[5], 3[6], 3[7], 2[8]	

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[+] CE stands for cointegrating equation.
[1] Lag-length as suggested by Residual Normality and Autocorrelation Tests.
[2] # of lags in levels.
[3] # of lags in first differences: $p - 1$.

Table B.26: Austria, Netherlands, Extra-EMU Trade: Model Selection Procedure, 1. and 2. Step of the Johansen Procedure

Continued from previous page...						
Johansen Procedure:	**1. Step: # of lags according to:**				**2. Step: # of cointegrating vectors, i.e. rank(Π), and [#of lags]:**	
Model	**AIC**	**SC**	**HQC**	**Normality & autocorr. test of resid.[1]**	**Intercept, no trend in CE⁺;[2]**	**Intercept and trend in CE⁺;[3]**
Netherlands						
Exports						
2c, with proxy	8	1	9	**8 and 9 lags**	1[1], 1[2], 1[3], 1[4], 1[5], 1[6], 2[7], 2[8]	
3c, with proxy	8	1	5	**8 lags**	3[1], 3[2], 3[3], 3[4], 2[5], 3[6], 3[7], 3[8]	
4c, with proxy	8	1	1	**8 lags**	1[2], 3[3], 1[4], 2[5], 2[6], 3[7], 3[8]	
Imports						
2d, with proxy	8	1	1	**8 lags**	1[3], 1[6], 2[7], 3[8]	
3d, with proxy	8	9	1	**8 and 9 lags**	1[2], 2[3], 1[4], 2[5], 3[6], 3[7], 3[8]	
4d, with proxy	9	1	8	**8 and 9 lags**	2[2], 2[3], 1[5], 2[7],2[8]	
5d, with proxy	8	1	1	**8 lags**	1[2], 1[3], 1[4], 1[5], 2[6], 3[7], 3[8]	
7d, with proxy	8	1	1	**8 lags**	1[3], 1[4], 1[5],1[6], 2[7], 3[8]	
8d, with proxy	1	1	1	**7 and 8 lags**	1[4], 1[7], 2[8]	

⁺ CE stands for cointegrating equation.
[1] Lag-length as suggested by Residual Normality and Autocorrelation Tests.
[2] # of lags in levels.
[3] # of lags in first differences: $p - 1$.

Table B.27: Austria, Netherlands, Extra-EMU Trade: Model Selection Procedure, 3.Step of the Johansen Procedure

Johansen procedure	**3. Step:**							
	Model specification:			**Selected according to:**		**a)**	**b)**	**c)**
Model	**# lags[1]**	**const.[2]**	**trend[3]**	**Johansen-proced.[4]**	**coint-to-VEC[5]**	β' **and** α_x **sign.**	$\alpha_p = \alpha_y = \alpha_{proxy} = 0$	β' **have right sign[6]**
Austria								
Exports								
3c, with proxy	8	x	-	x	-	x	-	-
5c, with proxy	8	x	-	x	-	x	-	-
Imports								
4d, with proxy	7	x	-	x	-	x	-	-

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[1] # of lags in first differences: $p - 1$.
[2] Intercept, no trend in cointegrating equation.
[3] Intercept and trend in cointegrating equation.
[4] Model selected by applying Johansen procedure (step 1. to 3.).
[5] Model selected by applying alternative procedure, comprising only steps 2. to 3. of Johansen procedure.
[6] The coefficients of the cointegrating vectors β' have the right positive (+) or negative (-) sign.

Table B.28: Austria, Netherlands, Extra-EMU Trade: Model Selection Procedure, 3.Step of the Johansen Procedure

Johansen procedure	**3. Step:**							
	Model specification:			**Selected according to:**		**a)**	**b)**	**c)**
Model	**# lags[1]**	**const.[2]**	**trend[3]**	**Johansen-proced.[4]**	**coint-to-VEC[5]**	β' **and** α_x **sign.**	$\alpha_p = \alpha_y = \alpha_{proxy} = 0$	β' **have right sign[6]**
Continued from previous page...								
Netherlands								
Exports								
2c, with proxy	8	x	-	x	-	x	-	-
Imports								
3d, with proxy	8	x	-	x	-	x	-	-
4d, with proxy	8	x	-	-	x	x	-	-
7d, with proxy	7	x	-	x	-	x	x	x

[1] # of lags in first differences: $p - 1$.
[2] Intercept, no trend in cointegrating equation.
[3] Intercept and trend in cointegrating equation.
[4] Model selected by applying Johansen procedure (step 1. to 3.).
[5] Model selected by applying alternative procedure, comprising only steps 2. to 3. of Johansen procedure.
[6] The coefficients of the cointegrating vectors β' have the right positive (+) or negative (-) sign.

Abstract

As part of a large-scale project of the Macroeconomic Policy Institute (IMK), aiming to examine the causes of the trade imbalances and divergences among the countries of the European Monetary Union (EMU), the focus of this thesis is the analysis of the determinants driving Austrian and Dutch intra- and extra-EMU import and export demand. In particular, I look at the two main factors of import and export demand, namely prices and income. Therefore, different *consumer-* and *producer-based* models are used to estimate Austrian and Dutch intra- and extra-EMU import and export demand. Employing different price and income variables, I try to find which of the model specifications adequately explains the determinants of Austrian and Dutch import or export demand.

Despite the large number of employed import and export demand models, I find that only a few fulfill all imposed requirements of the model selection procedure. However, compared to other studies, the estimated price and income elasticities are, too high in scale and thus do not allow drawing any serious conclusions for Austrian and Dutch imports and exports. This rather modest result is very likely caused by estimation problems of the import and export demand models, resulting from data unavailabilities- in particular in case of intra-EMU trade.

Zusammenfassung

Im Rahmen eines groß angelegten Projektes des Instituts für Makroökonomische Konjunkturforschung (IMK) mit dem Ziel, die Ursachen der Handelsungleichgewichte und Divergenzen zwischen den Ländern der Europäischen Währungsunion (EWU) zu untersuchen, liegt der Schwerpunkt dieser Arbeit in der Analyse der Determinanten der österreichischen und niederländischen intra-und extra-EWU Import- und Exportnachfrage. Dabei werde ich insbesondere die beiden wichtigsten Faktoren der Import- und Exportnachfrage, Preise und Einkommen, untersuchen. Für diese Analyse werden verschiedene *Konsumenten-* oder *Produzenten-basierte* Modelle dazu verwendet, die österreichische und niederländische intra-und extra-EWU Import- und Exportnachfrage zu schätzen. Unter Verwendung unterschiedlicher Preis- und Einkommensvariablen, versuche ich herauszufinden, welche der Modellspezifikationen die Determinanten der österreichischen und niederländischen Import- oder Exportnachfrage angemessen erklärt.
Trotz der großen Anzahl der verwendeten Import- und Exportnachfrage-Modelle, genügen nur wenige allen gestellten Anforderungen des Modell-Auswahlverfahren. Im Vergleich zu anderen Studien sind die geschätzten Preis- und Einkommenselastizitäten, jedoch zu hoch und somit knnen keine ernsthaften Rückschlüsse auf die österreichischen oder niederländischen Importe und Exporte gezogen werden. Dieses eher bescheidene Ergebnis wird sehr wahrscheinlich durch Probleme bei der Schätzung der Import- und Exportnachfrage Modelle verursacht, die sich aus nicht vorhandenen Daten ergeben- insbesondere im Falle des intra-EWU-Handels.

Lebenslauf

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