Calculating the Fundamental Equilibrium Exchange Rate of the Macedonian Denar

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2007

CALCULATING THE FUNDAMENTAL EQUILIBRIUM EXCHANGE RATE OF THE MACEDONIAN DENAR

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This dissertation is submitted in partial fulfilment of the requirements of Staffordshire University for the award of MSc Economics for Business Analysis

February 2007

EXECUTIVE SUMMARY

The real exchange rate is a macroeconomic variable of a crucial importance, since it determines relative price of goods and services home and abroad, and influences economic agents' decisions. The real exchange rate needs to be on the right level, as it can result in wrong signals and economic distortions if it is not. In order to be able to say whether a currency is misaligned or not, one needs some measure of the just exchange rate – the equilibrium exchange rate.

Many different concepts of equilibrium exchange rates exist. The one which is defined as the real effective exchange rate that is consistent with the economy being in internal and external equilibrium in the medium term is the subject of this thesis, and is known under the name of Fundamental Equilibrium Exchange Rate concept. The first part of this study, thus, explains the concept of Fundamental Equilibrium Exchange Rate and surveys the literature on the uses to which it has been put and on the ways in which it has been calculated. The second part of the dissertation illustrates how the Fundamental Equilibrium Exchange Rate concept can be operationalised towards the end of assessing the right parity of the Macedonian denar.

What we find is that the denar is neither overvalued nor overvalued in the period 1998-2005. That would imply that price competitiveness is not adversely affected, and that the exchange rate does not generate distortions in the economy. We also find that the fundamental equilibrium exchange rate tends to appreciate due to the increase in the net current transfers flows. In contrast, the real effective exchange rate tends to depreciate in the last three periods, and we are of the opinion that if these trends are maintained, in near future the denar might become undervalued.

ACKNOWLEDGEMENTS

This dissertation would never come to existence if the Foreign and Commonwealth Office, the Open Society Institute and the Staffordshire University did not grant me the opportunity to study at this programme. Since they did, I would like to express my gratitude to Prof. Geoff Pugh for his invaluably useful comments and critical suggestions, to Prof. Jean Mangan, for her comments and willingness to help, and to Igor Velickovski and Sultanija Bojceva-Terzijan for their help with the data.

I dedicate this dissertation to my Biljana. She knows why.

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CHAPTER 1

Introduction

The real exchange rate is well recognised in the economic literature as one of the key macroeconomic variables. Being defined as the relative price of a common basket of goods domestically and internationally measured in the same numeraire (i.e. price-adjusted nominal exchange rate), it determines price competitiveness and affects the consumption and production decisions of the economic agents, and hence trade, economic activity, unemployment and inflation.

The variability of the exchange rate, as well as the consequences of it, has not been overlooked in the economic literature either. Two dimensions of variability can be identified: exchange rate *volatility* is the change of the rate from one point of time to another; exchange rate *misalignment* is the departure of the exchange rate from its equilibrium value (Williamson 1983). While the costs associated with volatility have attracted significant attention[1], leading often to variability being identified with volatility, the costs associated with misalignments have often been overlooked. However, as Williamson (1983, p. 45) states, while exchange rate volatility is a troublesome nuisance, exchange rate misalignment is a major source of concern, generating 'austerity, adjustments costs, recession, deindustrialization, inflation and protectionism'. In addition, as Stein and Paladino (1999) argue, misalignments may lead to speculative attacks.

The identification of misalignments, thus, requires identification of the equilibrium level of the exchange rate. Several methods for this purpose exist[2], with one of the most popular and most widely used being the Fundamental Equilibrium Exchange Rate concept. This dissertation will engage with both the theoretical foundations of this concept and its application to the Macedonian denar. There has been a substantial academic debate lately with respect to the exchange rate of the Macedonian denar, with a prevailing opinion that

[1] See Rose (2000), Pugh et al. (1999) and Pugh and Tyrrall (2002), for example

[2] For a survey on these methods, see Driver and Westaway (2003)

the denar is overvalued, and that this affects adversely the performances of the Macedonian economy. However, while the debate in the academic circles is sound and ongoing, it has been characterised with a lack of researches on the issue. This dissertation will therefore illustrate how the Fundamental Equilibrium Exchange Rate concept can be applied to assess whether the Macedonian denar is overvalued or undervalued.

The dissertation is organised as follows: in Chapter 2 the theoretical issues regarding the Fundamental Equilibrium Exchange Rate are discussed. After the costs of misalignment are presented and the most popular method for estimating the equilibrium exchange rate, the Purchasing Power Parity method is assessed, the definition of the Fundamental Equilibrium Exchange Rate and its distinctive characteristic – its medium-term nature – are discussed. The final section of Chapter 2 surveys the different approaches in the literature to calculating the Fundamental Equilibrium Exchange Rate. In Chapter 3 one of these approaches, the partial equilibrium approach, is operationalised for calculating the Fundamental Equilibrium Exchange Rate of the denar. As the Fundamental Equilibrium Exchange Rate estimates are believed to be extremely sensitive on the underlying assumptions, great attention is paid to this issue. Additionally, an analysis of the sensitivity of the calculations with respect to different assumptions is carried out, and a range of alternative estimates is presented. The findings turn out to be robust to the assumptions, and the reasons explaining the findings are then discussed. Chapter 3 concludes with a discussion on the possible weaknesses of the research, arguing that most of them are of an objective nature and arise from data limitations. In Chapter 4 the conclusions we find are presented, and recommendations for future revisions of the study, or other similar researches on the topic, are given.

CHAPTER 2

Literature Review on FEER

'The concept of the equilibrium exchange rate is an elusive one.'
Williamson (1994, p. 179)

In this chapter the theoretical foundations of the Fundamental Equilibrium Exchange Rate (FEER) concept are explained. As an introduction to the discussion, the costs of exchange rate misalignment are pointed out. Then the most popular concept for assessing whether a currency is misaligned or not, the Purchasing Power Parity is explained and critically evaluated. The discussion on the FEER begins with a survey on the development of the concept and its use. Then the definition of the FEER is explained in more depth, and the distinctive characteristic of the concept, its medium-term nature, is analyzed. Issues related to the calculation of the fundamental equilibrium exchange rate are considered in the final section, when the most important studies on FEER calculation are briefly explained.

2.1. Exchange rate misalignment

Real exchange rate as a macroeconomic variable determines the relative price of domestic products relative to foreign, and therefore directly influences exports and imports and thus aggregate demand, output, unemployment and inflation. Real appreciation decreases price competitiveness, lowers the demand for domestic products, decreases exports and increases imports, inhibiting economic activity, raising unemployment and lowering inflation; the opposite happens with real depreciation.

'The impact of exchange rate misalignment … on economic development has been, and continues to be, deleterious' (Yotopoulos and Sawada 2005, p. 10). Therefore, it is surprising that the costs associated with a misaligned exchange rate, i.e. the departure of the exchange rate from its equilibrium level, have received so little attention in the economic literature (Williamson, 1983).

The costs of exchange rate misalignment are mainly seen as higher unemployment when the currency is overvalued and higher inflation when it is undervalued. However, as Williamson (1983) argues, exchange rate misalignments incur other costs, as well. First, to maintain full employment in presence of overvaluation, the decline in the demand for tradable goods will have to be offset by an increased demand for non-tradable goods; this increases consumption over the sustainable level and results in trade deficits. Sooner or later, devaluation will have to occur to make up for the accumulated trade deficits, when the consumption will have to be cut down, below the sustainable level. These variations in consumption are costly, as people are made worse off, given that according to the 'permanent income hypothesis' they tend to even up their consumption. Second, there are costs associated with the reallocation of the resources between tradable and non-tradable industries, e.g. costs for retraining the workers and for adjustment of the capital equipment. Third, some companies might be able to work if the real exchange rate is at the equilibrium level, but might go bankrupt if the currency is overvalued; the loss of these productive capacities is costly. Fourth, there is a ratchet effect on inflation in a sequence of overvaluations and undervaluations, as depreciation is associated with an increase in prices and wages, while appreciation is less likely to be associated with a decrease, due to labour unions' bargaining power. Fifth, overvaluation might generate protectionist pressures by the industries adversely affected by it.

The idea of exchange rate misalignment is directly connected with the concept of equilibrium exchange rate. Actually, in order to be able to asses whether the currency is aligned or not, one must have something to compare the actual exchange rate against; in other words, one needs some equilibrium exchange rate. Different concepts of equilibrium exchange rate can be found in the literature; Frenkel and Goldstein (1986) identify three – the purchasing power parity approach, the underlying balance approach (or the fundamental equilibrium exchange rate) and the structural model approach. The structural model approach is based on a model of exchange rate determination that explains the changes in the exchange rate through fundamentals – money supply and money demand home and abroad (the monetary model) or assets stocks in domestic and foreign currencies (the portfolio balance model). The other two concepts will be elaborated into details in the following sections.

2.2. Purchasing Power Parity

The idea that the real exchange rate will converge on some equilibrium level is not novel – the first concept of equilibrium real exchange rate is the Purchasing Power Parity (PPP). The idea that the nominal exchange rate will offset changes in relative inflation rates has first been operationalised by Cassel (1922), but originates from the 16th century School of Salamanca scholars (Officer 1982). Later, it has been translated in the notion that the equilibrium real exchange rate is the one given by the PPP. As space precludes more thorough elaboration of the PPP concept, a discussion about different PPP theories and different ways of testing the PPP can be found in Officer (2006), while overview of the PPP tests can be found in Officer (2006), Breuer (1994) and Froot and Rogoff (1995).

As Williamson (1994) states, the PPP equilibrium exchange rate can be calculated in two ways. The first one, working on the relative PPP criterion, calculates the current equilibrium exchange rate as the exchange rate in some initial period, when the economy was judged to be in equilibrium, adjusted for the cumulative inflation differential. In the second one, based on the absolute PPP criterion, the equilibrium exchange rate is calculated as the exchange rate which equalises purchasing power in the countries. In either case, the PPP equilibrium real exchange rate is a constant.

The PPP approach to calculating the equilibrium exchange rate can be criticised both on the grounds of its inherent weaknesses and its inappropriateness as a guide for the equilibrium exchange rate. As Officer (2006) points out, two groups of arguments against the PPP theory exist - arguments that the PPP theory is inaccurate, and arguments that the PPP theory is biased. Factors limiting arbitrage, on which the idea of the PPP is based, such as transaction costs, transport costs, trade barriers, product differentiation and imperfect competition, fall into the first group, as well as non-price factors affecting demand and supply of the traded goods, as income, for example, and financial flows not associated with trade which affect the exchange rate. The second group consists of factors that cause divergence from factor-price equalization, such as international differences in technology, factor endowments and tastes, which further leads to a bias in the PPP theory.

Regarding the appropriateness of the PPP as an equilibrium exchange rate concept, two further points should be mentioned. PPP calculation of the equilibrium exchange rate assumes that the exchange rate in the base period has been in equilibrium, which, however, might not be the case. Also, the equilibrium real exchange rate given by the PPP, as mentioned above, is a constant, while, for a variety of reasons, the equilibrium exchange rate might change. Therefore, the PPP exchange rate is generally inconsistent with macroeconomic balance. As an illustration, if a country whose PPP exchange rate were consistent with macroeconomic balance experiences a one time permanent increase in the price of its imports (e.g. oil price shock), that would ask for a real depreciation in the equilibrium real exchange rate consistent with the macro balance, in order to maintain a current account balance. The PPP exchange rate would, however, remain constant, assuming similar production technologies home and abroad, as inflation would remain unchanged. The reason why the PPP rate is inconsistent with the macroeconomic balance is that it does not depend on a range on factors on which FEER depends – the underlying capital flows, the trade elasticities, the assumptions regarding the internal balance and the terms of trade.

In effect, as Williamson (1994) argues, the PPP theory is useful for comparison of living standards, but not for calculating the equilibrium exchange rate. Estimates of the PPP rate can be misleading, and reliance on them as a policy guide can have disastrous effects. Two historical episodes illustrate this. The first one, as argued by Faruqee et al. (1999), is the return of Great Britain to the Gold Standard in April 1925 at a pre-war parity, assuming that this would restore the pre-war PPP of the sterling against the US dollar; the overvalued rate has resulted in a prolonged depression. The second, more recent one is the rate at which the sterling joined the ERM in 1990. As argued by Williamson (1994), joining the ERM at a rate of DM 2.95=£1, substantially higher than the FEER (Wren-Lewis et al. 1990 suggest an optimal entry rate for the sterling of DM 2.60=£1, with a range from DM 2.5 to DM 2.7, or, of DM 2.4=£1 if the sterling were to enter as a currency that would not be devalued), partly due to the high PPP estimates (Goldman Sachs estimate for the PPP rate was DM 3.41=£1 for the second half of 1989), resulted in 'Black Wednesday', i.e. withdrawal of the sterling from the ERM in September 1992.

2.3. How is FEER defined?

The underlying balance approach is the second most popular concept of equilibrium exchange rate, developed by the IMF staff in the 1970s (see Artus, 1978). It attempts in great deal to overcome the conceptual deficiencies of the PPP approach, defining the equilibrium real exchange rate as the rate that makes the 'underlying' current account equal to 'normal' net capital flows, where the underlying current account is the actual current account adjusted for temporary factors, and the normal net capital flows are estimated on the grounds of an analysis of past trends (Frenkel and Goldstein, 1986). The underlying balance approach has later on become known under the name of Fundamental Equilibrium Exchange Rate.

It is Williamson (1983) who coined the term 'Fundamental Equilibrium Exchange Rate', as an analogy to the concept of 'fundamental disequilibrium', that has provided the criterion for a parity change in the Bretton Woods system. As fundamental disequilibrium relates to exchange rate inconsistent with medium-run macroeconomic balance, the FEER is the exchange rate that is consistent with it.

The FEER is defined as the real effective exchange rate that is consistent with achievement of medium-term macroeconomic equilibrium, both internal and external. It is real, i.e. inflation-adjusted, because the nominal exchange rate consistent with macroeconomic balance will tend to change as inflation domestically differs from inflation abroad; it is defined as an effective, i.e. multilateral trade-weighted, and not as a bilateral exchange rate because changes in the latter would not incur changes in the balance of payments as long as the former remained unchanged (Williamson, 1991).

Williamson (1983, 1994) developed the FEER concept as an accompaniment to his proposals for international coordination of economic policy[3]. However, it has a much wider application. It, in principle, establishes a benchmark against which the market exchange rate can be compared, so, it is primarily an analytical device for assessing exchange rates

[3] The target zone proposal and 'the blueprint for policy coordination' proposal. See Bergsten and Williamson (1983), Frenkel and Goldstein (1986), Williamson (1983), Williamson and Miller (1987) for a discussion on these proposals.

misalignments. FEER estimates can also serve as a potential early warning signal of external crisis (see Smidkova 1998). They can be also used as medium-term exchange rates forecasts (see Wren-Lewis and Driver, 1998). Finally, FEER estimates are used as an instrument for deciding on the central parity at which to join an exchange rate system or monetary union, most recently, joining the ERM II by the new EU accession countries (see Coudert and Couharde 2002, Egert and Lahreche-Revil 2003, Genorio and Kozamernik 2004, Rubaszek 2005).

2.4. Understanding the FEER

The FEER concept embodies a normative element in itself, 'inasmuch as both internal and external balance are to some extent normative constructs' (Williamson 1991, 46). The internal balance condition is interpreted as a state when the economy is running at the natural rate, i.e. highest level of activity consistent with controlled inflation; it therefore involves a normative element due to the different views regarding the unemployment-inflation trade-off.

The traditional interpretation of the external balance condition as a zero balance of payments account is not sufficient, as it does not provide a unitary solution for the current and capital account, since different capital flows are consistent with different current account targets and thus different exchange rates. Interpretation of the external balance as a current account balance is not appropriate, either, as for no reasons should a country's investments equal its savings. Instead, Williamson (1983) proposes interpreting the external equilibrium condition as that current account balance that corresponds to the underlying capital flows. Therefore, the normative in the external balance condition lies in the identification of the underlying capital flows (Williamson, 1991).

As Wren-Lewis and Driver (1998) argue, it is the medium-term nature that distinguishes the FEER from similar equilibrium exchange rate concepts and that is crucial to understanding it. The equilibrium to which the FEER is related is not defined in the manner the equilibrium is traditionally defined – as a state when no tendency to change exists. The long-run equilibrium is defined in that way – as a state when the assets stocks have settled down on their long-run equilibrium levels and exhibit no tendency to change, i.e. as a stock equilibrium. Instead, the medium-term equilibrium is defined as flow equilibrium, as a state when the assets stocks can be changing over time, but only as a result of flows that are related to the long-run equilibrium level of stocks. Those capital flows are named structural, or underlying, and, consequently, in the medium term only structural, and no speculative capital flows exist[4] (Williamson, 1983, Wren-Lewis, 1992).

Therefore, the external balance condition is interpreted as a current account corresponding to capital flows that are consistent with the convergence to the long-run equilibrium, i.e. the underlying capital flows. The process of estimating the FEER thus involves identification of these flows. According to Williamson (1994) these flows can not be identified with the actual flows over some time, because many of the actual flows are transitory or reversible. Neither are these flows likely to be found by investigating the balance of payments accounts, by identifying the subset of flows invested in long-term assets as structural, as speculative flows can be placed in long-term assets as well. A better approach would be to look at the national accounts, at the savings-investment relationship:

$$(X-M) = (S-I) - (G-T),$$

i.e. net investment in rest of the world equal net savings of the private sector minus the public sector deficit (Williamson, 1991, p. 46).

To obtain the underlying capital flows one would have to identify the public sector deficit, given the net savings of the private sector. One option is to estimate the optimal public sector's deficit, optimal in a sense that it leads to a maximisation of intertemporal welfare. Another option is to identify the likely fiscal position, not the optimal. The first approach can be criticised on the grounds that budgetary outcomes are rarely optimal, due to the political process they are subject to, and that it is not of much relevance to calculate the exchange rate associated to a fiscal policy outcome that is unlikely to be realised. Drawback

[4] As Wren-Lewis (1992) points out, to be able to ignore the speculative flows, an assumption that the real interest rates will either be constant or changing at a steady rate must be made. This in fact puts a constraint on monetary policy in the medium term. For a discussion on this, see Wren-Lewis (1992).

of the second approach is that the capital flows estimated in that manner might not be sustainable in the medium term[5].

In practise, however, these considerations need to be approximated by some theories on current account determination. The most common ones are the intertemporal model, the debt stages theory, and an application of the life-cycle hypothesis. Only the predictions of these theories for underdeveloped and developed countries are presented here; for a thorough discussion on these theories see Williamson (1994) and Williamson and Mahar (1998).

The *intertemporal model of savings and investment,* developed by Abel and Blanchard (1982), predicts that an underdeveloped country will have higher investment needs than the domestic savings, and will run a current account deficit in the beginning increasing its debt. After some time the country will reach a steady state in which the current account will be balanced, and the trade surplus off-set by the debt interest payments. Therefore, underdeveloped and developing countries can be expected to import capital, while developed countries to export it. The *debt stages theory,* similarly, implies that capital-rich countries are likely to occur as capital exporters, while developing countries as capital importers. The *demographic structure* of the society should also be taken into account when determining the current account target, as according to the *life-cycle hypothesis,* individuals tend to save more during their earning years and to consume more during the retirement years. Consequently, societies with more population in the pre-retirement phase will tend to exhibit higher savings rate, while societies with much population in the retirement phase will have lower savings rates. Additionally, societies with high population growth can be expected to have increased need for capital.

2.5. Further discussion

As Williamson (1983) notes, the FEER can change over time, and therefore should be observed as a trajectory, not as a constant rate. Being defined as the rate that makes the

[5] For a more thorough discussion on this see Williamson (1994, p.182-192)

underlying capital flows equal with the current account, the FEER can change either due to changes in the underlying capital flows or because of changes in the demand and supply of traded goods. The changes that the FEER can take can be both discontinuous and gradual. Discontinuous changes are one-time changes and affect the level of the FEER permanently. They may occur if a country's relation to the international capital market changes (if a country gains access to it, or if it loses its creditworthiness), as a result of a permanent change in the terms of trade (e.g. oil price shocks) and as a result of new resources discoveries. Gradual changes cause the FEER to appreciate or depreciate all the time. Because of the productivity bias, the currency of a country that is growing at a faster rate will tend to appreciate (see Balassa 1964). Also, a country in deficit will build up liabilities which have to be serviced through improved trade balance, which will call for a real depreciation. Finally, as Johnson (1954) and Houthakker and Magee (1969) argue, if the product of the income elasticity of import demand and the domestic growth rate exceeds the product of the income elasticity of export demand and the foreign growth rate, the current account will tend to deteriorate, which would have to be offset by a continuing depreciation. This is the so-called Houthakker-Magee effect.

As mentioned before, a distinctive feature of the FEER is its medium-term nature. However appealing, due to the fact that a short-run exchange rate concept is difficult to build, while a long-term concept is not of a much relevance, this involves two further issues – can the FEER analysis then abstract from short-run considerations about the path towards the medium-term equilibrium, and can it abstract from where the exchange rate is going in the long-term (Wren-Lewis, 1992).

Concerning the first question, the answer is negative, for as Wren-Lewis (1992) and Bayoumi et al. (1994) argue, hysteresis effects[6] are likely to occur due to debt interest flows. The FEER is the exchange rate that makes the current account equal to the underlying capital flows. If the transition towards equilibrium incurs current account balances different from the underlying capital flows, this will result in different level of debt than previously, and

[6] 'Hysteresis is the notion that an equilibrium may not be independent of the dynamic adjustment paths towards it' (Wren-Lewis and Driver, 1998, 14 (note))

consequently in different equilibrium asset stocks and underlying capital flows, which would result in FEER differing from the one in the beginning. In other words, current accounts differing from the underlying capital flows change the level of debt and the debt interest flows, and the current account that would have been equal to the underlying capital flows previously would no longer be so, because of the different interest flows[7]. Therefore, the equilibrium level of the FEER appears not to be independent of the adjustment path towards it. However, hysteresis effects are more important when FEER is used as a forecast; when the focus is on assessing whether a country's currency has been overvalued or undervalued at a certain point of time they are less worrying (Wren-Lewis, 1992).

The answer to the second question is negative, too. From one side, the FEER depends on the long run, because the structural capital flows to which it is related are determined by the long-run asset stock. From the other side, the long-run level of assets may depend on the FEER, as well. For instance, depreciation in the FEER might lead to foreign direct investments, which changes the long-run level of assets, and hence the FEER.

2.6. How is FEER estimated?

The equilibrium real exchange rate associated with internal and external balance is illustrated in figure 1. The internal equilibrium condition, defined as non-inflationary full-employment output, is given by the vertical schedule at the full-employment income point (Y*)[8] in the real income (Y) and real exchange rate (R) space. The external balance condition, defined as a targeted level of the current account balance, is given by the downward sloping current account (CA) schedule. The schedule has a negative slope for reasons that imports rise with an increase in income, which, in order to maintain unchanged current account position, has to be off-set by exchange rate depreciation[9], stimulating exports. The point at which the two

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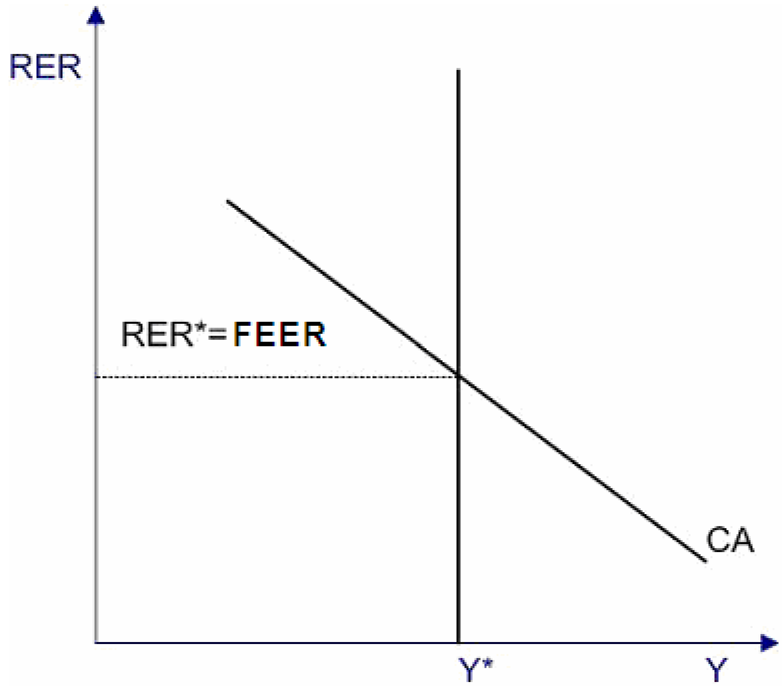
[7] For a more thorough discussion on hystereis effects on FEER, see Wren-Lewis (1992), Bayoumi et al. (1994), Wren-Lewis and Driver (1998)

[8] According to Bayoumi et al. (1994), the full-employment level of income and the full-employment level of output will be approximately the same.

[9] Exchange rates are defined as units of foreign per a unit of domestic currency, decrease meaning depreciation.

curves intersect, i.e. when both the internal and external balance conditions are met, gives the FEER (R*).

Figure 1: FEER, the exchange rate consistent with internal and external balance



Source: Bayoumi et al. (1994, 24)

The traditional approach to estimating the FEER inspires from the process of calculating the PPP equilibrium exchange rate – it involves identifying a base period in which the exchange rate is assumed to have been in equilibrium and then extrapolating that exchange rate. This approach, however, has two deficiencies – the arbitrary choice of the base period, and the assumption that the FEER has remained constant. Instead, it would be more appropriate to calculate the FEER as the exchange rate that would be consistent with the economy being in equilibrium (Williamson, 1983).

Two approaches to estimating the FEER can be found in the literature. The first one, the general equilibrium, or the model based approach, is based on a macro-econometric model, already existing or specially estimated, on which the internal and external balance conditions are imposed, and which is then solved for the real exchange rate, the FEER. Three studies that use this approach are mentioned.

Williamson (1983) calculates the FEER for the US dollar, the Japanese yen, the German mark, the Pound sterling and the French franc for 1976-1977 and extrapolates them to 1983, using the IMF's Multilateral Exchange Rate Model. The external equilibrium condition is imposed as the current account target for the five countries set on the ground of the actual current account balances, the long-term net capital outflows and the savings and investments; the internal balance condition is imposed as the cyclically normal demand. He then calculates the FEERs for the five currencies for 1976-1977, and extrapolates them to 1983 by considering the factors that might have affected the FEER in the interim.

Bayoumi et al. (1994) illustrate how the FEER[10] can be estimated on the example of the G-7 currencies in the early 1970s, i.e. the break-up of the Bretton-Woods system, using the IMF's Multimod model. Due to the illustrative nature of their study, they impose the external balance as a current account of 1% of GDP, and the internal balance as IMF's estimates of the output gap.

Coudert and Couharde (2002) use the NIESR's NIGEM[11] model to estimate the FEER for the Czech Republic, Poland, Hungary, Slovenia and Estonia for 2000 and 2001. The internal balance is imposed as the trend output obtained using the Hodrick-Prescott filter, and the external balance as values of the current account taken from Doisy and Herve (2001) for the first four countries, and from Williamson and Mahar (1998) for Estonia.

One clear advantage of this approach is that it is consistent, as all the feedbacks are taken into account. Additionally, as Wren-Lewis and Driver (1998) state, there is no need to worry about the meaning of the medium term, as models produce projections for any period in the future. Also, hysteresis effects are taken into account. The main disadvantage of this approach is connected with the difficulty of building a macro-econometric model. Furthermore, the quality of the FEER estimates obtained using the model based approach

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[10] Actually, Bayoumi et al. (1994) estimate the Desired Equilibrium Exchange Rate (DEER), but it is conceptually identical to the FEER

[11] NIESR=National Institute for Economic and Social Research, NIGEM=National Institute's Global Economic Model

depends critically on the quality of the model used. Finally, these estimates may lack transparency, i.e. it might be difficult to isolate factors behind different FEERs (Wren-Lewis and Driver 1998).

However, as Wren-Lewis (1992) notes, the process of estimating the FEER is in principle a comparative static, partial equilibrium calculation. In the second approach, based on a partial equilibrium, unlike in the model-based approach, the FEER is calculated by modelling only the external sector, i.e. the current account, not the whole economy. The internal and external balance conditions are established in the same manner as in the model based approach, when exogenous estimates of the trend output and the current account balance are fed into the model.

Wren-Lewis and Driver (1998) estimate the FEERs for the G-7 countries for 1995 and 2000 using the partial equilibrium approach. They model the current account as a sum of the balance of goods and services, the interest, profit and dividend flows, and the net transfers. The trade is split between goods and services, exports and imports, volumes and prices. Trade volumes are modelled as a demand curve, as a function of demand and competitiveness. They use two estimation methods for obtaining the trade elasticities – the Johansen technique and the Error Correction Model. Goods prices are modelled as a function of commodity prices, domestic prices and world export prices, while consumer prices, domestic for exports and OECD for imports, are taken as the price of the services. The interest, profit and dividend flows are modelled as a function of domestic assets, external liabilities, real exchange rate and the interest rate for the credits and the debits, while net transfers are modelled as a function of an intercept term and a deterministic trend. The current account targets for the external balance criterion are taken from Williamson and Mahar (1998), and the trend output estimates are taken from Giorno et al. (1995).

Costa (1998) estimates the FEER for the Portuguese economy for the 1980-1995 period. Following Dolado and Vinals (1991) she uses one equation model of the fundamental account, where the fundamental account is the sum of the current account and the net structural capital flows. For the net structural capital flows she takes the net direct investments (the difference between foreign direct investments in Portugal and Portuguese direct investments abroad). The fundamental account is then modelled as a function of the domestic demand, the foreign demand, the degree of openness of the economy and the real effective exchange rate. As in the medium term the current account equals the structural capital flows, the external balance condition is imposed as a zero fundamental account, while the internal balance by using the trend value of the explanatory variables, obtained by the HP filter.

Genorio and Kozamernik (2004) estimate the FEER for the Slovenian economy for the 1992-2003 period modelling the current account as the difference between export and import values, the latter being modelled as a product of volumes and prices. Export and import prices are taken at their trend values, obtained by a non-linear trend and the HP filter. Trade volumes are modelled as a function of demand, competitiveness and the terms of trade; they use 6 alternative specifications of the trade model; the model is estimated by the OLS method. The external equilibrium is set as the current account target; they use 4 alternative current account targets. The internal equilibrium is imposed by the trend values of the explanatory variables, obtained by the exponential trend, except in the case of the terms of trade, where the trend values are obtained by the HP filter and the non-linear trend.

A slightly modified approach to estimating the FEER can be found in Faruqee et al. (1999); the difference is in the treatment of the external balance condition. They model the savings-investment relationship, and obtain the structural current account position via a quantitative assessment, instead of imposing it in a judgemental manner. They model the underlying current account in a similar manner to the previously mentioned studies, and calculate the FEER as the exchange rate that equalises these two.

An application of this approach on the case of Macedonia can be found in Gutierrez (2006). She estimates the underlying current account using the non-oil trade volumes equations from Isard et al. (2001), and the structural current account using the equation for developing countries, excluding Africa, from Chinn and Hito (2005). The use of these equations is the point at which this study can be criticised most, as such panel estimations do not account for the specificities of the individual countries, and therefore, the equations used may not be representative of the state in the Macedonian economy.

The comparative static approach has certainly got its advantages. Its merits include simplicity and clarity. It does not require a model of the whole economy. Additionally, factors standing behind different levels of FEER are not difficult to identify, and sensitivity analysis to different assumptions can be easily conducted. However, the simplicity has a price.

As Wren-Lewis (1992) and Wren-Lewis and Driver (1998) point out, the demand curve modelling of the trade, traditional to the FEER calculations, has several shortcomings. The first line of criticism stresses the neglect of non-price competitiveness factors. Second, the activity variable used in the calculation is the natural rate output, which is by definition independent of demand considerations, while imports and exports depend entirely on demand. While this might be valid for intermediate goods, for final goods some measure of final demand is more appropriate. Finally, the most serious criticism is that the traditional demand curve way of modelling trade does not take into account supply-side factors.

Another problem is the exogenous treatment of the trend output and the capital flows, ignoring any feedbacks that FEER might have on them (see Wren-Lewis and Driver, 1998). Additionally, the structural capital flows and the trend output, being both exogenous inputs in the calculation, may not be mutually consistent, which would not be a problem had they been independent (Wren-Lewis and Driver, 1998). Finally, the dependence of the level of FEER on the adjustment path towards it, i.e. the hysteresis of the FEER, is not accounted for in the partial equilibrium approach to calculating FEER.

However, the costs of the simplification do not seem to be disastrous. Wren-Lewis and Driver (1996) conclude that the effects of feedbacks from the real exchange rate to output are relatively small. Wren-Lewis et al. (1991) obtain similar estimates for the UK's FEER using both model based and partial equilibrium approach. Bayoumi et al. (1994) obtain that in many cases the FEER estimates for the G7 countries using the two approaches do not differ by more than 10 percent for any country. These findings seem to provide enough justification for the use of the partial equilibrium approach when estimating FEER.

CHAPTER 3

Estimating the FEER of the denar

In this chapter the partial equilibrium approach to estimating FEER explained in the previous chapter is applied in order to calculate the FEER of the Macedonian denar. The chapter is structured in the following way - after the model is explained in the first section, the data are discussed in the second. The implementation of the model is explained in the next three sections: first the trade equations are estimated; then the trend values of the exogenous inputs are obtained; finally a range of FEER estimates is obtained. The chapter is concluded with a discussion on the drawbacks of the study.

3.1. Methodology

As was mentioned in the previous chapter, the process of estimating the FEER consists of imposing internal and external balance conditions on a model, and solving it for the real effective exchange rate.

The methodology adopted here derives from Wren-Lewis and Driver (1998) and Genorio and Kozamernik (2004). It differs from Wren-Lewis and Driver (1998) in that our study models the trade volumes but not the prices; it differs from Genorio and Kozamernik (2004) in that they identify the current account with the trade account, i.e. they exclude the debt interest flows and the net current transfers from the current account model, while this study does not.

The current account is modelled as a sum of the trade flows, the net transfers and the debt interest flows, following Wren-Lewis and Driver (1998). The demand approach to modelling trade, as suggested by Goldstein and Khan (1985) is employed, where trade depends on demand (domestic and foreign activity) and competitiveness (real effective exchange rate). The trade is modelled as a difference between export and import values; values are modelled as a product of volumes and prices.

The internal balance condition is imposed when values corresponding to the equilibrium are substituted for the exogenous inputs (domestic and foreign activity, debt interest flows and net transfers); the external balance condition is imposed as the targeted current account to which the sum of the trade flows, the net transfers and the debt interest flows is equalised.

The model is:

$$\overline{CA} = \overline{trade} + \overline{tran} + \overline{int} \qquad (1)$$

$$\overline{trade} = \overline{Px} * \overline{X} - \overline{Pm} * \overline{M} \qquad (2)$$

$$X = f(Yf, RER) \qquad (3)$$

$$M = f(Yd, RER) \qquad (4)$$

CA standing for the current account, 'trade' for the trade flows, 'tran' for the net transfers, 'int' for the debt interest flows, X and M for exports and imports volumes, respectively, Px and Pm for exports and imports prices, respectively, Yf and Yd for foreign and domestic activity, and the bar denoting the equilibrium values of the variables.

The two trade equations are first estimated, in the log-linear form:

$$\ln X = \alpha_1 + \alpha_2 * \ln Yf + \alpha_3 * \ln RER + \varepsilon_1 \qquad (5)$$

$$\ln M = \alpha_4 + \alpha_5 * \ln Yd + \alpha_6 * \ln RER + \varepsilon_2 \qquad (6)$$

$\alpha 2$ and $\alpha 3$ standing for export volumes elasticities to foreign activity and the real exchange rate respectively, $\alpha 5$ and $\alpha 6$ for import volumes elasticities to domestic activity and the real exchange rate, $\alpha 1$ and $\alpha 4$ representing the intercept terms in the equations, $\varepsilon 1$ and $\varepsilon 2$ representing the error terms, and ln denoting the natural logarithm.

Assuming:

$$\ln \overline{X} = \alpha_1 + \alpha_2 * \ln \overline{Yf} + \alpha_3 * \ln \overline{RER} \qquad (7)$$

$$\ln \overline{M} = \alpha_4 + \alpha_5 * \ln \overline{Yd} + \alpha_6 * \ln \overline{RER} \qquad (8)$$

i.e. that the equilibrium export and import volumes are obtained when equilibrium values for the activity variables and the exchange rate are substituted in the estimated trade equations, equation (1) can be rewritten as:

$$\overline{CA} = \overline{Px} * e^{[\alpha_1 + \alpha_2 \ln(\overline{Y_f}) + \alpha_3 \ln(\overline{RER})]} - \overline{Pm} * e^{[\alpha_4 + \alpha_5 \ln(\overline{Y_d}) + \alpha_6 \ln(\overline{RER})]} + \overline{tran} + \overline{int} \tag{9}$$

The FEER is then found as the solution for $\overline{RER}$ in equation (9). As there is one unknown and one equation, there is a unique solution; however, this exponential equation cannot be solved by the standard analytical methods, but must be solved iteratively. One of the methods is by using the Newton-Raphson algorithm (Monahan, 2001)[12].

Therefore, three stages can be identified in the process of calculating the FEER. First, the trade equations, i.e. equations (5) and (6) are estimated. Then the equilibrium values of the exogenous inputs ($\overline{Px}, \overline{Pm}, \overline{Yf}, \overline{Yd}, \overline{tran}, \overline{int}$) are obtained. Finally, the FEER is calculated, i.e. equation (9) is solved for $\overline{RER}$.

3.2. Data

The data used in the analysis is presented in Appendix 1. The sample spans from 1998q1 to 2005q3, giving 31 observations. It is driven by the availability of data on Macedonian export and import prices, which are not available for the periods before or after.

Data on Macedonian export and import volumes are obtained when export and import values are divided by export and import prices, respectively. Trade values data are from IMF's International Financial Statistics (IFS), in dollars, nominal; trade prices data are from National Bank of the Republic of Macedonia (NBRM), index numbers. Data on the real

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[12] The Newton-Raphson algorithm is an iterative algorithm for approximating a root of a function. It starts with a number close to the solution, x_0, and uses the following algorithm for calculating the iterations:

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)} \tag{10}$$

Where f stands for the function and f' for its first derivative.

The solution is found when x_n and x_{n+1} get close enough to each other (Monahan, 2001).

In our case, the function is equation (9), the conversion was set at 6 decimal places, and for x_o the value of the REER was taken.

effective exchange rate (REER) are from IMF's IFS, index numbers; rise in the REER represents real appreciation, i.e. fall in price competitiveness.

The domestic activity variable is Macedonian GDP by 1997 prices, treated as real GDP, from the National Statistical Office of the Republic of Macedonia (NSORM). The foreign activity variable, following Genorio and Kozamernik (2004), is constructed as a weighted average of the imports of the major 13 trading partners, using the weights obtained when Macedonian exports to those 13 countries for the whole period are normalised to 1. Countries who participate with more than 1,5% in the Macedonian exports for the period were included as major trading partners. These 13 countries account for 87% of the Macedonian exports (see Table 1). Data on Macedonian exports by countries are from the NBRM, nominal, in dollars. Imports data for all the countries are from the IFS, except data for Serbia and Montenegro, which are from the National Bank of Serbia. They are all nominal, in dollars, and are converted into real using import prices, wherever possible, otherwise using US's PPI (Serbia and Montenegro, Croatia, Slovenia and Bulgaria[13]). Import

[13] The decision to use the US PPI as a deflator when nominal trade was converted into real was a necessity, but is, arguably, the best approximation, as can be seen from the analysis below.

The data we have (A) is the nominal trade (trade values) converted into dollars using the nominal exchange rate in the current period; the data we need is the trade volumes, i.e. real trade, R. Let us denote with N the nominal trade, with P_d and P_f domestic and foreign price levels, respectively, with ER the nominal exchange rate, and let the indices c and b after P_d,P_f and ER stand for the base and the current period, respectively. Then:

$$A=N*ER_c \qquad (11)$$

$$N = \frac{A}{ER_c} \qquad (12)$$

Assuming the real trade is given when the nominal is corrected for the change in the domestic price levels, i.e.

$$R = N * \frac{P_{db}}{P_{dc}} \qquad (13)$$

and substituting (12) into (13), we have:

$$R = A * \frac{P_{db}}{P_{dc} * ER_c} \qquad (14)$$

We further assume that the relative Purchasing Power Parity holds, i.e. the changes in the bilateral nominal exchange rate are equal to the difference between changes in domestic and foreign price levels, i.e.

пrices and US's PPI data are from IFS, index numbers. Data on net transfers and debt interest flows are from the NBRM, nominal, in dollars, and are deflated using the US PPI.

$$\frac{ER_c}{ER_b} = \frac{\frac{P_{fc}}{P_{fb}}}{\frac{P_{dc}}{P_{db}}} = \frac{P_{fc} * P_{db}}{P_{fb} * P_{dc}} \qquad (15)$$

Rearranging (15) we get:

$$\frac{ER_c * P_{dc}}{P_{db}} = \frac{ER_b * P_{fc}}{P_{fb}} \qquad (16)$$

Substituting (16) into (14) we obtain:

$$R = A * \frac{P_{fb}}{P_{fc}} * \frac{1}{ER_b} \qquad (17)$$

ER_b and P_{fb} are constants, and, consequently, cancel out when the numbers are converted into index numbers. Therefore, to obtain R we just need to divide A, i.e. the data we have, with the foreign price index. As all the values are in US dollars, we use US price index. We choose the PPI instead of the CPI as studies (see Breuer, 1994) have shown that the PPP holds more for the PPI, which consists of tradable goods.

One should not forget that this is a fairly good approximation only so long as the two assumptions made hold – that the real trade (trade volumes) is obtained when nominal trade (trade values) is corrected for the changes in domestic inflation, and that the change in the bilateral exchange rate is equal to the difference in the inflation domestically and abroad.

Table 1: Structure of Macedonian exports by countries and weights attached to each country in the construction of the foreign activity variable

Country	Macedonian exports to country, period 1998q1-2005q3, in percents	Weight
Germany	20.10	0.23
Serbia and Montenegro	21.54	0.25
Greece	10.49	0.12
Italy	7.45	0.09
USA	7.82	0.09
Netherlands	3.18	0.04
Croatia	4.47	0.05
Switzerland	1.76	0.02
Great Britain	2.27	0.03
Slovenia	2.03	0.02
Bulgaria	2.50	0.03
France	2.21	0.03
Turkey	1.58	0.02
Total	**87.40**	**1**[14]

3.3. Discussion about the characteristics of the Macedonian economy

Several issues emerge prior and with regards to the estimation of the trade equations. As a common first step in any empirical analysis of time series data, the series are examined for the order of integration. This determines the estimation technique to be used, as in time series analysis the variables often turn out to be non-stationary and OLS estimates might reflect spurious relationship in that case (unless the variables are cointegrated); in that case cointegration methods are more appropriate (Harris and Sollis, 2003). Also, there have been some important events in the period under observation, and the effects of these events must be taken into consideration when modelling trade, as failure to do so might lead to obtaining biased estimates. Therefore, as a corollary to the later analysis, and as an answer to the above posed questions, we proceed with a discussion on the characteristics of the Macedonian economy and on the behaviour of the data series in the observed period.

[14] Rounding error of 0.02. The weights used in the analysis are not rounded, though.

Macedonia in the observed period is characterised by continuously high trade deficits, stable at around 14% of GDP in the period 1998-2001, and higher in the 2002-2005 period, around and above 20% of GDP. Not much can be noticed about the current account, except that it is negative throughout all the period. The net transfers constitute a significant part of the current account, around 10% of GDP in the 1998-2002 period, and 15-20% of GDP in the 2003-2005 period (Table 2).

Table 2: Trade balance, net transfers and current account, as % of GDP

Year	Trade balance, % of GDP	Net transfers, % of GDP	Current account, % of GDP
1998	-14.9	8.7	-6.7
1999	-13.7	10.9	-0.7
2000	-16.4	13.0	-1.6
2001	-11.9	7.6	-5.3
2002	-19.6	11.1	-8.0
2003	-19.3	15.2	-3.1
2004	-23.4	14.7	-7.7
2005	-22.3	20.0	-1.6

Exports, imports and current account data from IFS. Net transfers data from the NBRM. GDP data from the NSORM.

Bearing in mind that intermediate products represent a majority of imports, i.e. about 60-65% (NBRM 1998-2005), a high elasticity of imports with respect to domestic activity can be expected a priori. Due to the high level of dependency of the economy on imports, one would expect only moderately high exchange rate elasticity of imports. On the exports side, fairly high exchange rate elasticity can be expected, as the majority of exports consist of products from the commodity end of the market, about 45-55% (NBRM 1998-2005). Taking into account the small size of Macedonia relative to the world, one would not expect high world activity elasticity of exports.

In the period under examination the Macedonian economy is characterised by extremely high unemployment rates and low inflation rates. Table 3 summarises these data. The higher inflation rate in 2000 was due to the VAT introduction and the rise in the oil price, while the higher inflation in 2001 was a consequence of the psychological effect of the crisis, which caused a depreciation in the nominal exchange rate.

Table 3: Unemployment and inflation rates

Year	Rate of unemployment (percents)	Rate of inflation (percents)*
1998	34.5	-0.1
1999	32.4	-0.7
2000	32.2	5.8
2001	30.5	5.5
2002	31.9	1.8
2003	36.7	1.2
2004	37.2	-0.4
2005	37.3	0.5

*Inflation measured by consumer prices

Source: NSORM (1998-2005)

The period observed is characterized by two external shocks. The first one is the conflict in FR Yugoslavia in the first half of 1999 and the accompanying refugees crisis in Macedonia; the second one is the conflict in Macedonia in the first, second and third quarter of 2001. The effects of both shocks on Macedonian *import* volumes can be seen from Figure 2 – dramatic fall in the first two quarters of 1999 and in the first three quarters of 2001. The 1999 shock caused a fall in the *export* volumes in the first half of 1999, while the immediate effects of the 2001 shock on the exports are disguised by the fall in export prices (Figure 4)[15]; however, the prolonged effects of the crisis are clear – a structural break in the first quarter of 2002, characterised by a fall in the intercept (Figure 3). The effects of the first crisis on *economic activity* are evident – fall in the first two quarters of 1999, while the effects of the second crisis are not that clear (Figure 5).

[15] Although the fall in the export prices instead of in the export volumes in 2001 is quiet surprising, augmenting, or at least investigating the reasons behind it is out of the scope of this research; therefore we proceed with the data we have.

Figure 2: Macedonian import volumes, 1998-2005

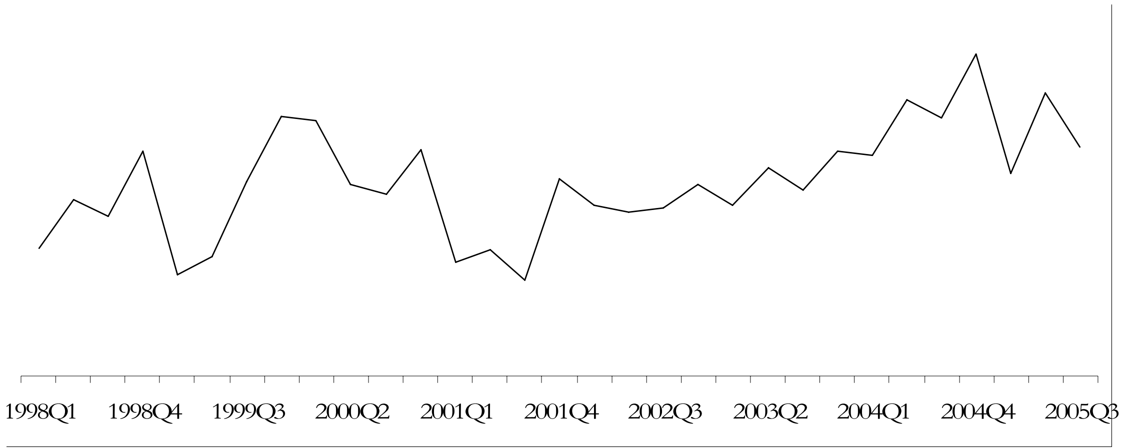


Figure 3: Macedonian export volumes, 1998-2005

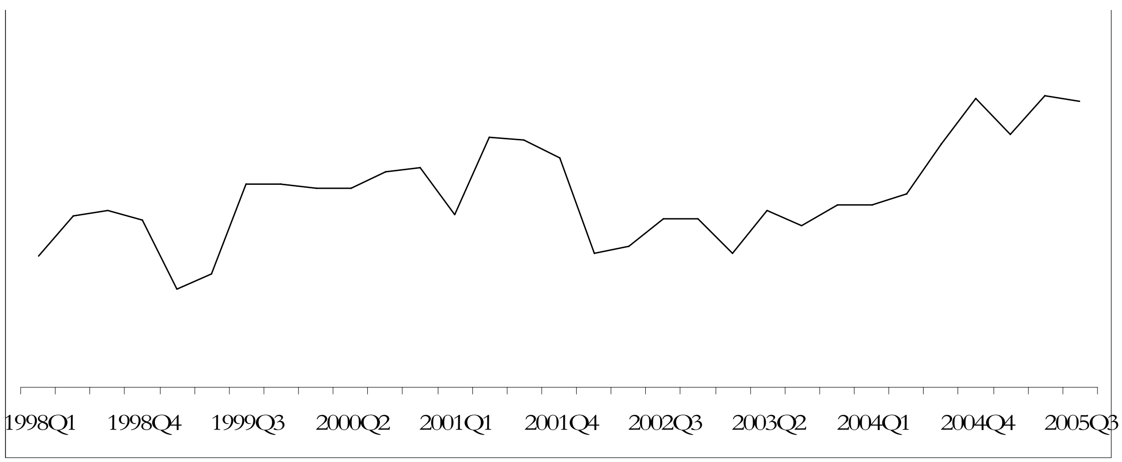


Figure 4: Macedonian export prices, 1998-2005

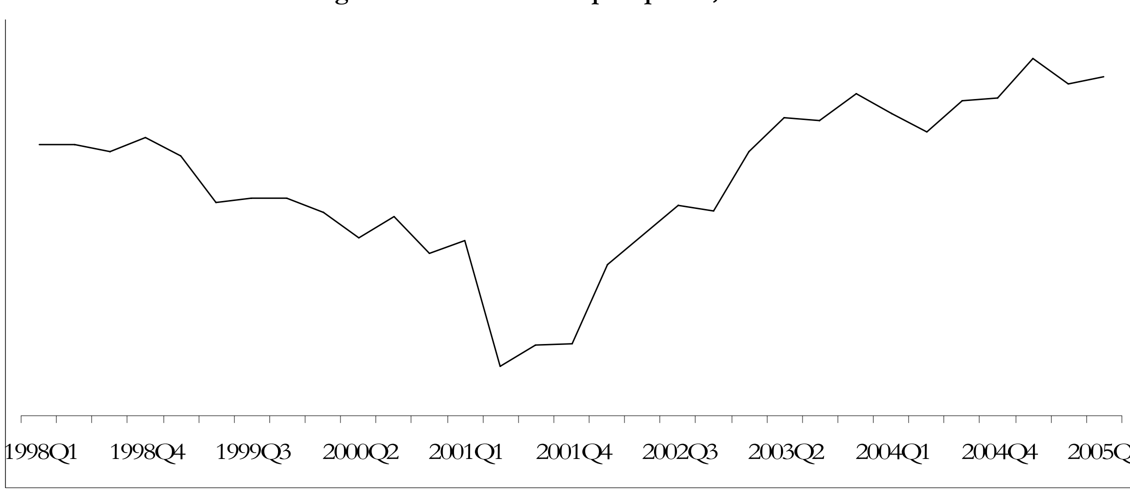
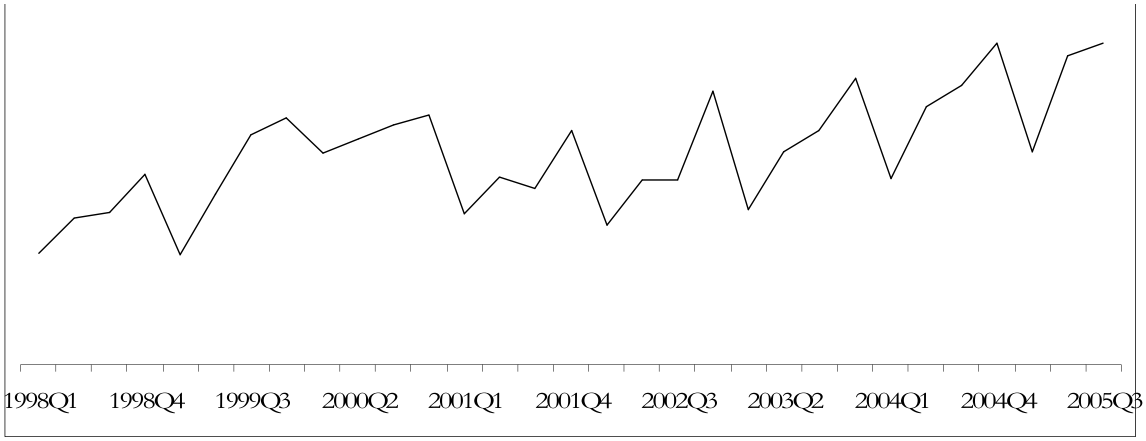
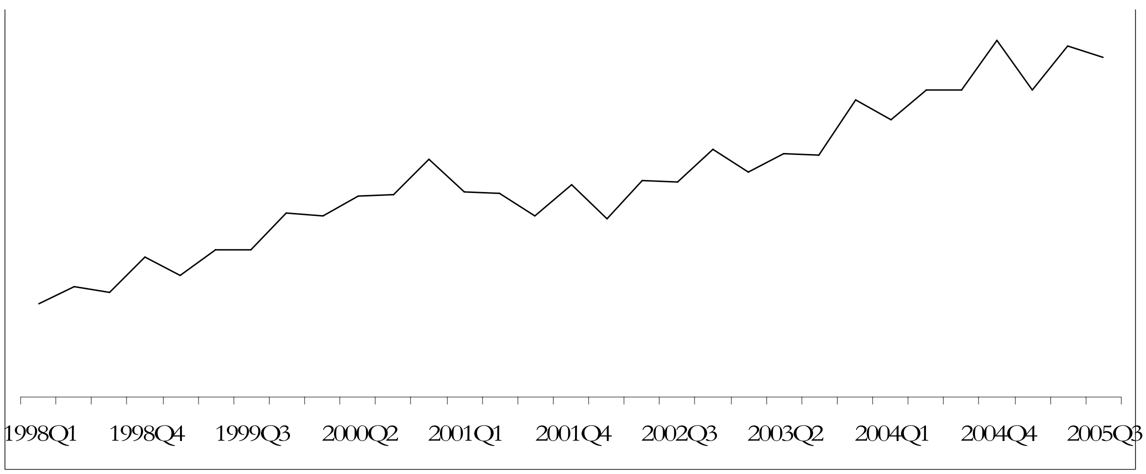


Figure 5: Macedonian GDP, 1998-2005



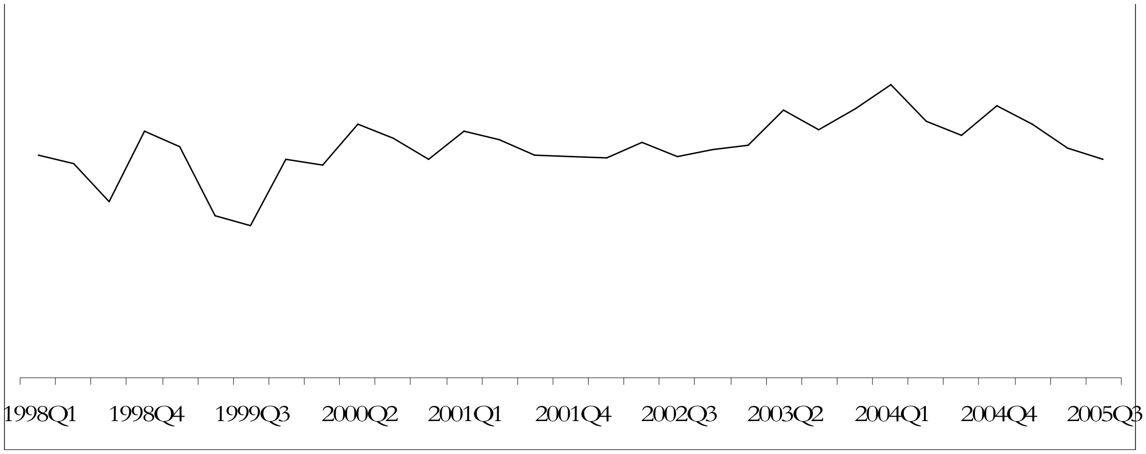
We also present the plots of the other series used in the analysis – the foreign demand variable (Figure 6) and the real effective exchange rate (Figure 7), as a support to the formal unit root tests presented in the next section[16].

Figure 6: Foreign demand, 1998-2005



[16] We believe that it is a good practice to examine each data series 'by eye', prior to conducting all the formal stationarity tests

Figure 7: Real Effective Exchange Rate of the denar



3.4. Tests of order of integration of the series

The order of integration of the series plays crucial role in the empirical analysis, since the decision on the estimation method is driven by it. A few common tests were applied in order to determine the order of integration of the series – the Augmented Dickey-Fuller (ADF) test, the ADF Generalised Least Squares (ADF-GLS) test, the ADF-Perron method and the Philips-Perron (PP) test. When the ADF test was done, the Dolado-Enders sequential testing procedure was followed (Enders, 1995), and the results presented are those on which the decision of rejection or otherwise of the null was based. The ADF-GLS test uses Generalised Least Squares detrending, and is characterised by a greater power and better performances in small samples than the other tests (Harris and Sollis, 2003). The ADF-Perron test allows for structural break in the series (Perron, 1989), and is used for the export volumes series, since the structural change is suspected there. The PP test is similar to the ADF test, with that difference that it uses non-parametrical statistical methods to account for a possible serial correlation, i.e. it uses Newey-West adjusted standard errors, which are robust on heteroskedasticity and serial correlation. The caveat with the PP test is that the Newey-West S.E.'s are a large sample technique. We, however, report this test. As the weaknesses of the tests are well acknowledged in the literature (low power and size, poor small sample performances), ambiguous results are expected. It is for this reason that we do not rely on any particular test but, rather, assemble an evidence base using all appropriate tests[17]. Table 4 presents these tests.

Table 4: Results of the test of the hypothesis that the series are non-stationary

Series	ADF test	ADF-GLS test	ADF-Perron	PP test	Decision
Export volumes	Not rejected on any level*	Not rejected on any level	Rejected on all levels	Not rejected on any level	Ambiguous. Either non-stationary or stationary with break
Import volumes	Not rejected on 1% Rejected on 5% and 10%*	Not rejected on any level		Not rejected on 1%. Rejected on 5%	Non-stationary
Foreign Demand	Not rejected on any level **	With 4 lags, rejected on 5% and 10%, not on 1%		Not rejected on any level without trend. Not-rejected on 1%, rejected on 5% with trend	Ambiguous. Either stationary around a deterministic trend, or non-stationary
Domestic GDP	Not rejected on any level***	Not rejected on any level		Not rejected on 1%. Rejected on 5%	Non-stationary
Real effective exchange rate	Rejected on all levels****	With more than 1 lag, not rejected on any level With 1 lag, rejected on 5% and 10%, not on 1%		Not rejected on 1% and 5%, rejected on 10%	Ambiguous, probably non-stationary

* intercept included, as the coefficient in front of the lag of the level was higher than 1;
** 4 lags included due to serial correlation; intercept included; trend included (significant at 5%);
*** 4 lags and an intercept included;
**** no constant, no trend, no lags included

Besides the ambiguity of the test results on some of the occasions, it was decided to proceed as the series were non-stationary and, thus, appropriate for cointegration analysis. Next, tests for unit root in the first differences of the series are conducted.

[17] Details of the test shown in Appendix 2

Table 5: Results of the tests for unit root in the first differences series

Series	DF test	ADF test	ADF-GLS test	PP test
Export volumes	Rejected on all levels		Rejected on all levels	Rejected on all levels
Import volumes	Rejected on all levels		Rejected on all levels	Rejected on all levels
Foreign Demand		Rejected on all levels**	Rejected on all levels	Rejected on all levels
Domestic GDP	Rejected on all levels*		Rejected on all levels	Rejected on all levels
Real effective exchange rate		Rejected on all levels***	Rejected on all levels	Rejected on all levels

* the hypothesis of no serial correlation was rejected, even when lagged values of the dependent variable were included

** two lags and an intercept included

*** one lag included, due to serial correlation

The results of the tests in Table 5 are rather unanimous. The first differenced series are stationary, therefore we proceeded as if the series are integrated of order 1 (I(1)).

3.5. Estimating the trade equations

Dealing with a sample with such a short time span (8 years), for reasons of robustness, two estimation methods were employed for obtaining the trade equations – the Auto Regressive Distributed Lag (ARDL) model and the Johansen technique. Another factor that influenced the decision to use two methods for obtaining the trade equations was the wish to have alternative trade elasticities, for sensitivity analysis purposes.

ARDL estimates

If the Johansen technique is a kind of a standard when estimating time series models, the decision to use the ARDL method was based on the well recognised advantages of this method - it can be applied irrespectively of whether the variables are I(0) or I(1) and it has better finite samples properties (Pesaran and Pesaran, 1997; Pesaran and Shin, 1997).

The ARDL method is based on estimating an Error Correction Model by the OLS method, which, for two independent variables and two lags is of the form:

$$\begin{aligned}\Delta Y_t = \alpha_0 + \alpha_1 \Delta Y_{t-1} + \alpha_2 \Delta Y_{t-2} + \alpha_3 \Delta X_{t-1} + \alpha_4 \Delta X_{t-2} + \alpha_5 \Delta Z_{t-1} + \alpha_6 \Delta Z_{t-2} \\ + \alpha_7 Y_{t-1} + \alpha_8 X_{t-1} + \alpha_9 Z_{t-1} + u_{t'}\end{aligned} \tag{18}$$

The first part of the ECM (the lagged changes) gives the short-run dynamics, while the second part (lagged levels) the long-run relationship.

Implementing the ARDL approach for obtaining the long-run relationship between the variables of interest, involves two stages: first, whether there exists a long-run relationship between the variables is tested; and second, if exists, a long-run relationship is estimated (Pesaran and Pesaran, 1997).

Before the existence of long-run relationship is tested, the maximum number of lags in the ARDL has to be chosen. The decision has to balance between including enough lags so as to ensure statistical validity and not including too many lags due to the small sample size. Two criteria are employed for the purpose: the diagnostic tests of the regressions, as a measure of the statistical validity; and the Schwartz Bayesian Criterion (SBC) and the Akaike Information Criterion (AIC), as a measure of the regression-fit, where the option with the highest value for the information criteria is chosen (Pesaran and Pesaran, 1997, 130). We started with four lags, as a common rule when working with quarterly data, and tested down. The results are given in Table 6[18].

[18] Full results of the regressions are presented in Appendix 3

Table 6: Criteria for choosing the number of lags in the ARDL

		4 lags	3 lags	2 lags	1 lag
E X P O R T S	**Diagnostic tests:***				
	No serial correlation	x	x	√√√	√√√
	Correct functional form	√√√	√√√	√√√	√√√
	Normality in the residuals	x	√√√	√√√	√√√
	Homoskedasticity	√√√	√√√	√√√	√√√
	Information criteria:				
	SBC	12.45	16.58	20.58	22.66
	AIC	23.14	25.65	27.90	28.13
I M P O R T S	**Diagnostic tests:**				
	No serial correlation	x	√	√√√	√√√
	Correct functional form	√√√	√√√	√√√	√√√
	Normality in the residuals	√√√	√√√	√√√	√√√
	Homoskedasticity	√√√	√√√	√√√	√√√
	Information criteria:				
	SBC	6.77	4.65	7.21	11.50
	AIC	17.47	13.72	14.54	16.96

* The serial correlation test is the Langrange Multiplier test. The functional form test is the Ramsey's RESET test. The normality test is the Jarque-Bera test. The heteroskedasticity test is the Koenker-Basset test. The null hypotheses are those given in the first column.
√√√ - the p value for rejecting the hypothesis is above 10%;
√ - the p value for rejecting the hypothesis is between 5% and 10%;
x - the p value for rejecting the hypothesis is bellow 5%.

In both export and import regressions the diagnostic tests were equally good when both one and two lags were included. However, due to the higher SBC and AIC, one lag was chosen in them both.

Whether there exists there a long-run relationship between the variables is determined by testing the significance of the coefficients in front of the lagged levels in (18), where the null of 'no long-run relationship' is rejected if the test statistic is higher than the critical values computed by Pesaran et al. (2001). In the export equation a dummy for the period after 2001 was included, to capture the structural break, and a dummy for the first three quarters in 2001 was included in import equation, to capture the effect of the exogenous shock.

Even though no answer was found in the literature on the issue of including dummy variables in this stage of the analysis, it was decided to include them since they appeared highly significant and the regression fit improved substantially. Furthermore, the diagnostic tests improved as well – both the normality test in the import regression and the heteroskedasticity test in the export regression (Table 7). Finally, the plots of the residuals seem more like the textbook example of stationarity, and their range of variation is narrower (Figure 8, 9, 10 and 11).[19]

Table 7: Regressions with and without dummy

		Without dummy	**With dummy**
Imports	P value of the normality hypothesis	0.094	0.612
	R-bar-squared	0.30	0.59
Exports	P value of the heteroskedasticity hypothesis	0.069	0.917
	R-bar-squared	0.36	0.56

[19] Including a dummy for the biggest outlier in Figure 9 – 2001q1 changed nothing in the results. Therefore, we decided not to include it, as this might indicate data mining.

Figure 8: Plot of the residuals from EXPORT regression WITHOUT the dummy

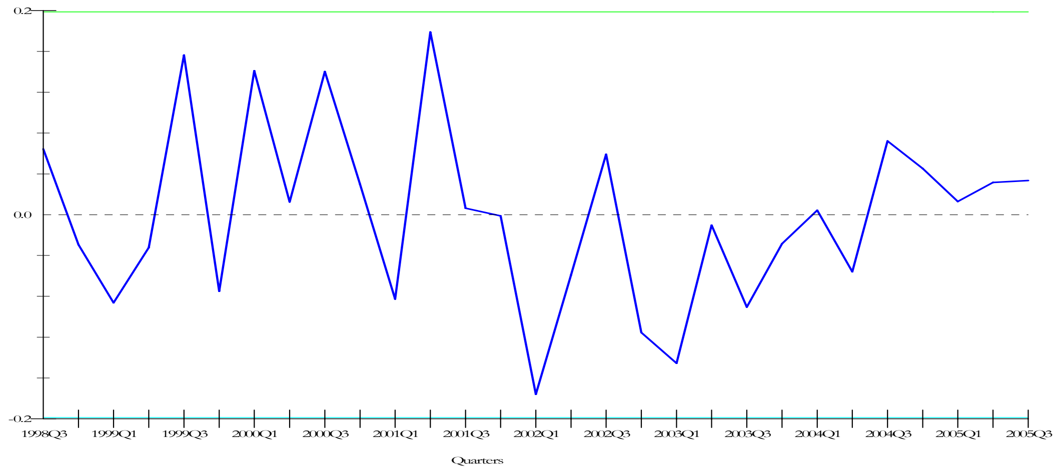


Figure 9: Plot of the residuals from EXPORT regression WITH the dummy

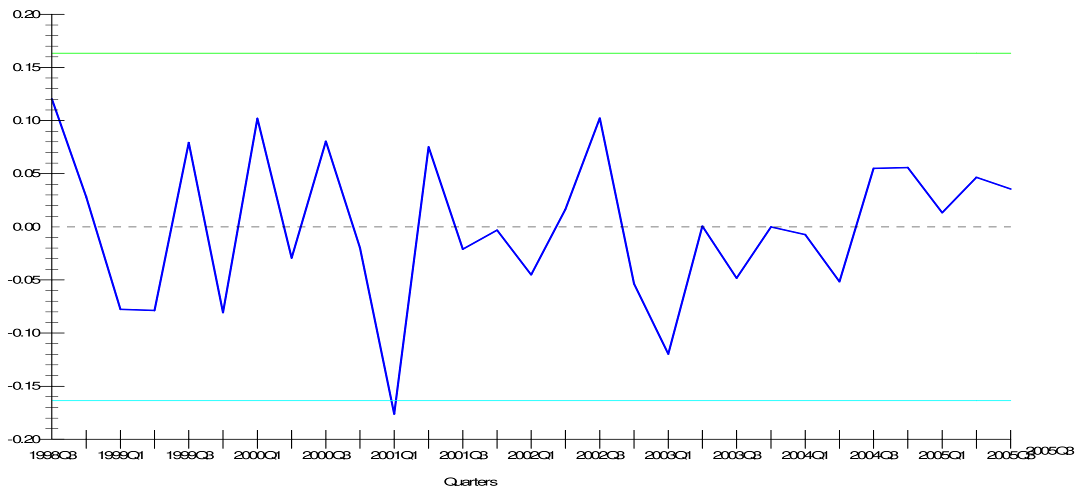


Figure 10: Plot of the residuals from IMPORT regression WITHOUT the dummy

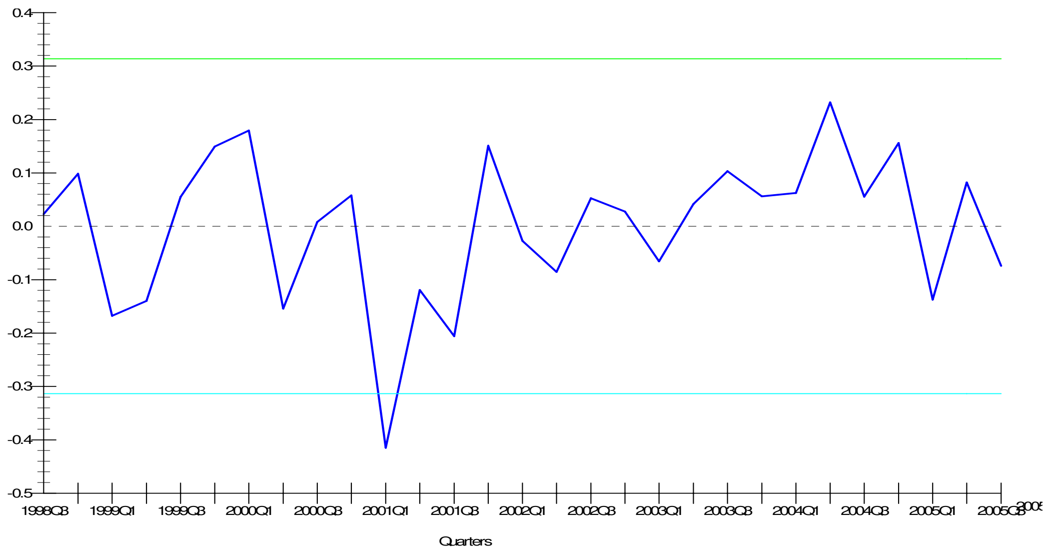
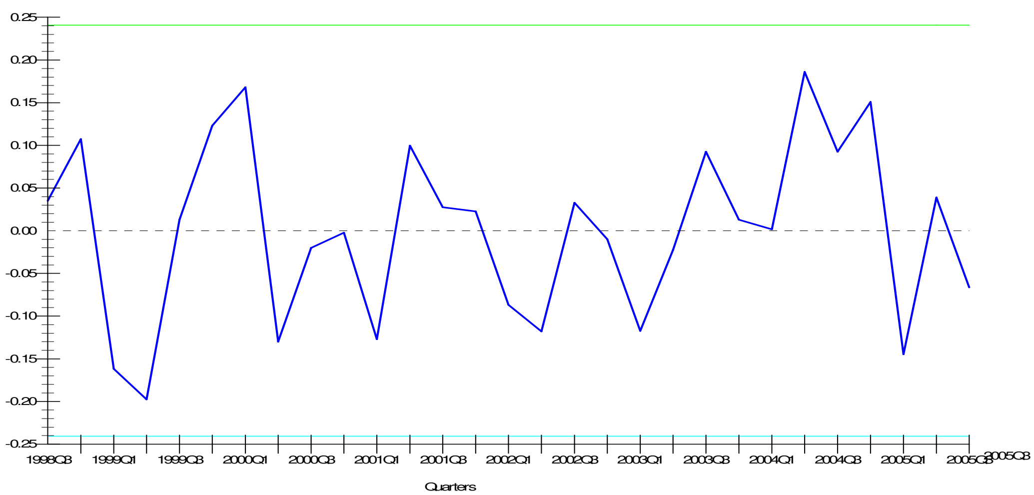


Figure 11: Plot of the residuals from IMPORT regression WITH the dummy



The results of the test of the existence of a long-run relationship are given in Table 8.

Table 8: Results of the test of a long-run relationship

	Test statistic	**2.5% Critical value**	**1% Critical value***	**Decision**
Export regression	4.56	4.38	5.00	Reject H_0: ‘No LR relationship’ at the 2.5% level; Do not reject it at the 1% level
Import regression	5.76	4.38	5.00	Reject H_0: ќNo LR relationshipќ

* The critical value is from Table CI(ii) from Pesaran et al. (2001), p.300 - Restricted intercept and no trend. The intercept is needed in the long-run relationship to account for the different units of measurement in the dependent variable (levels) and the independent variables (index numbers). No trend is needed. The value at the 1% level of significance, for k=2 (two regressors) and as all the variables were I(1) is the highest value, and rejecting the null under these conditions, thus, means rejecting it under any conditions.

Following Pesaran and Pesaran (1997), we next investigate whether only one cointegrating vector exists, and whether foreign demand and exchange rate are the long-run forcing variables for exports (the domestic GDP and the exchange rate for imports). This is done when the test for a long-run relationship is done on the ECM model in which the dependent variable is one of the previously independent variables (Table 9).

Table 9: Results of the test of long-run relationship with changed dependent variable

Dependent variable	Test statistic	Critical value*	Decision
Export regression			
Foreign demand	0.78	3.35	Cannot reject H_0: No long-run relationship
Real exchange rate	3.24	3.35	Cannot reject H_0: No long-run relationship
Import regression			
Domestic demand	1.73	3.35	Cannot reject H_0: No long-run relationship
Real exchange rate	3.25	3.35	Cannot reject H_0: No long-run relationship

*Critical values from Table CI(ii) from Pesaran et al. (2001), p.300, k=2, all variables I(1), 10% level of significance. The 10% level is chosen as the critical values are lowest at it, and an inability to reject the null at this levels means inability to reject it at any level.

As the test statistics are lower than the critical value on all occasions, it was decided to proceed as if only one cointegrating vector existed, and as if the real exchange rate and the foreign demand were the forcing variables in the export regression, i.e. the exchange rate and the domestic GDP in the import regression.

Finally, the long-run relationship between the variables is obtained, i.e. the ARDL model is estimated. There are $(1+n)^p$ different ARDL regressions, 8 in this case (n=maximum number of lags in the ARDL, 1 in this case, p=number of variables in the ARDL, 3 in this case). The selection of the order of the ARDL model is based on the standard information criteria – the SBC, the AIC and the HQC (Hannah-Quinn Criterion). Pesaran and Shin (1997) examine the small sample performances of the ARDL model, using both the AIC and the SBC as model selection criteria, and on the grounds of Monte Carlo experiments conclude that the ARDL-SBC performs slightly better in small samples. For this reason the SBC was chosen as a criterion for selecting the order of the ARDL.

In both export and import regressions the SBC suggested order of ARDL (0, 0, 0), i.e. no lags of any of the variables. The same was suggested by the HQC.

Three dummy variables were included in the export regression: for the structural change after 2001; and for the crisis in the first two quarters of 1999. They all appeared highly significant. Furthermore, the regression fit improved significantly – the R-bar-squared rose from 0.34, when no dummies were included, to 0.77 with the three dummies. Finally, the plot of the residuals seemed better for the regression with the dummy (Figure 12 and 13) – quiet a narrower range of variation.

Figure 12: Plot of the residuals from EXPORT regression WITHOUT dummies

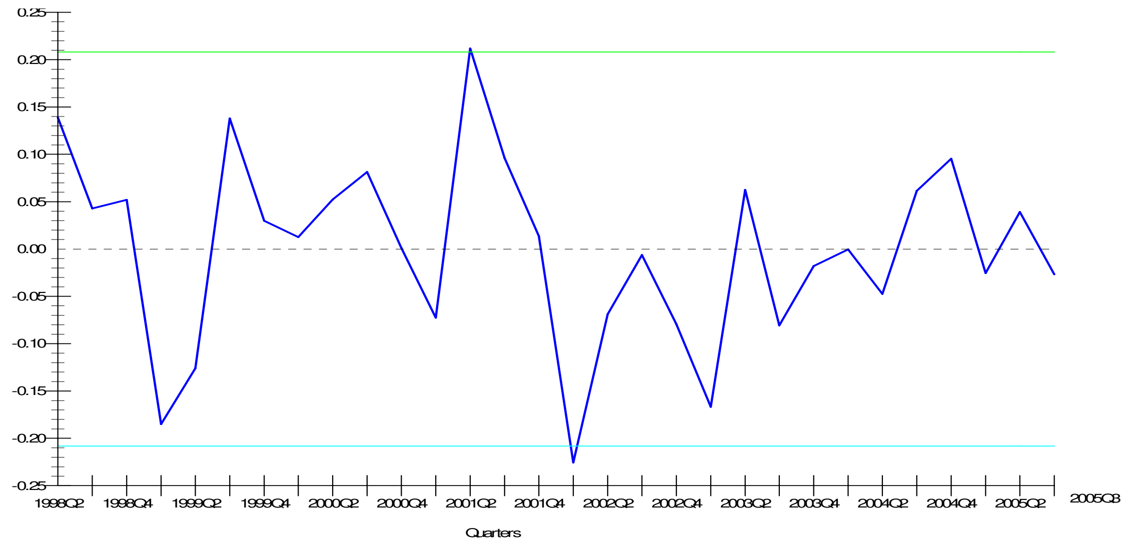
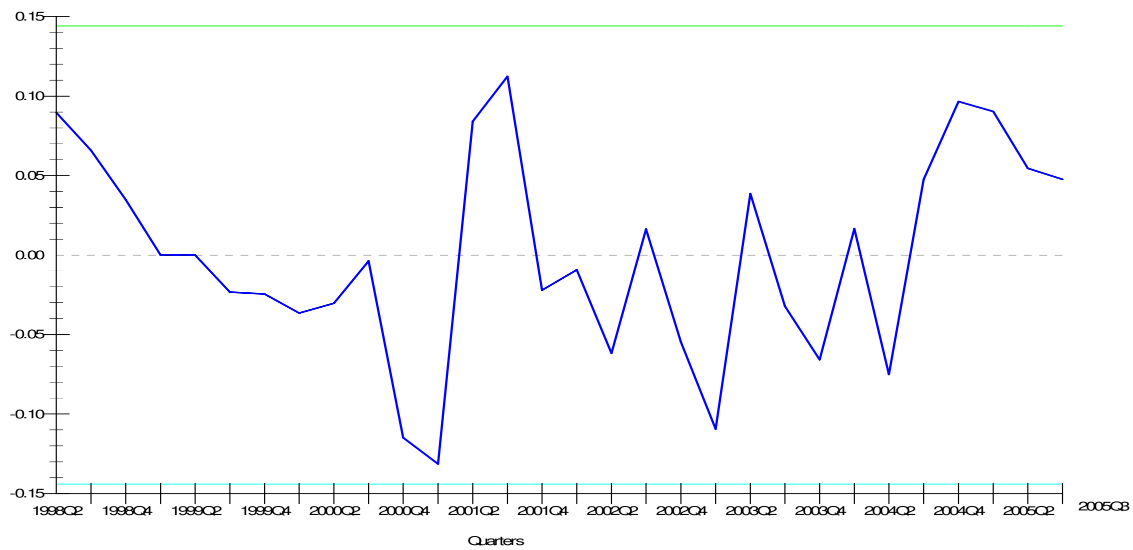


Figure 13: Plot of the residuals from EXPORT regression WITH dummies



In the import regression only a dummy for the third quarter of 2001 was included, to capture the effect of the 2001 crisis. The dummies for the first two quarters of 2001 turned out to be insignificant at 5%, as well as the dummies for the 1999 crisis. This is most probably due to a fall in both imports and domestic GDP series in those periods. Again, the residuals seem more stationary (Figure 14 and 15) and with a narrower range of variation.

Figure 14: Plot of the residuals from IMPORT regression WITHOUT the dummy

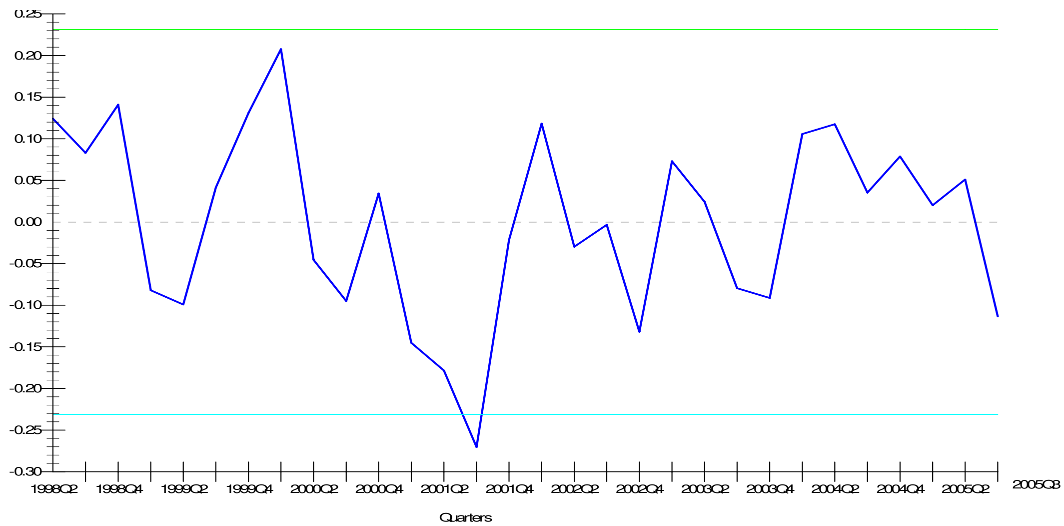
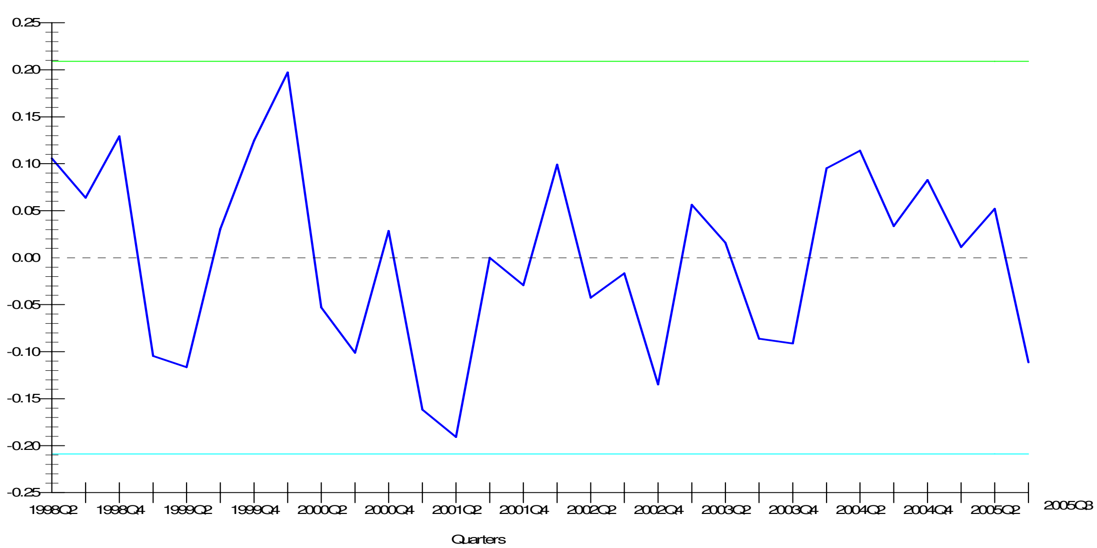


Figure 15: Plot of the residuals from IMPORT regression WITH the dummy



According to the diagnostic tests of the ARDL regressions, these are all well specified (see Appendix 3), and the long-run coefficients and their significances are given in Table 10 and 11.

Table 10: Long run coefficients and probability values for EXPORT regression

Dependent variable: Log of exports

Explanatory variable	Coefficient	p value
Constant term	5.67	0.000
Log of foreign demand	1.51	0.000
Log of REER	-2.24	0.020
Crash dummy	-0.24	0.000
Dummy 99q1	-0.19	0.024
Dummy 99q2	-0.31	0.001

Table 11: Long run coefficients and probability values for IMPORT regression

Dependent variable: Log of imports

Explanatory variable	Coefficient	p value
Constant term	6.01	0.000
Log of domestic GDP	2.10	0.000
Log of REER	1.20	0.234
Dummy 01q3	-0.29	0.013

The signs and the sizes of all the coefficients are in accordance with the expectations. The export volumes appear to be more price than income elastic, which is plausible, bearing in mind the above discussion. Both elasticities appear with the correct signs: rise in real exchange rate, i.e. decline in price competitiveness is associated with a decline in exports; and increase in foreign activity is associated with an increase in exports. Both coefficients are highly significant. The dummy variables turn out to be significant, too, and with the appropriate signs and sizes, capturing the effect of the external shock in 1999 and the structural break after 2001.

The income elasticity of the import volumes, on the other hand, proved to be higher than the price elasticity. This is again in accordance with the expectations, bearing in mind the import dependency of the Macedonian economy. The signs are also correct, indicating that imports rise when the price competitiveness falls (rise in real exchange rate) and that imports rise when domestic activity rises. The domestic GDP coefficient is highly significant, while the real exchange rate is not.

Johansen estimates

The second technique used for estimating the trade equations is the Johansen technique (Johansen 1988 and 1991). It is based on a Maximum Likelihood multivariate approach to estimation, and, therefore, is thought to be more efficient than the univariate methods. Furthermore, more than one cointegrating relationships can be estimated, and both I(1) and I(0) variables can be included (Harris and Sollis, 2003).

Estimating the trade elasticities by the Johansen technique involves several steps. Since the method starts by a Vector Auto Regression (VAR) model, later on transformed into a VECM (Vector Error Correction Model), first the order of the VAR has to be determined. The number of cointegrating vectors has to be established next, as well as the presence of deterministic components in the long-run and in the short-run model. Finally, the cointegrating vectors are obtained.

Two criteria are used for selecting the order of the VAR – diagnostic tests and information criteria. Table 12 gives the results of the diagnostic tests of the single regressions of the export VARs of order 1, 2, 3 and 4, with the dependent variable appearing in the row heading; Table 13 shows the same for imports. For reasons of consistency, the same dummies were included as in the ARDL: a dummy for the structural break after 2001 and dummies for the first two quarters of 1999 in the export regression; and a dummy for the third quarter of 2001 in the import equation (full results given in Appendix 4)[20].

[20] Although the dummy in the import regression appeared insignificant in most of the regressions, it was kept, as the results with and without it differed in no single way.

Table 12: Diagnostics for different orders of the VAR for EXPORTS*

		Exports	REER	Foreign activity
	H_0: No serial correlation	√√	√	x
VAR(1)	H_0: Linear functional form	√√√	√√√	√√√
	H_0: Normality in the residuals	√√√	√√√	√√√
	H_0: Homoskedasticity	√√√	√√√	√√√
	H_0: No serial correlation	√√√	√√√	√√√
VAR(2)	H_0: Linear functional form	√	√√√	√√√
	H_0: Normality in the residuals	√√√	√√√	√√√
	H_0: Homoskedasticity	√√√	√√√	√√√
	H_0: No serial correlation	√√√	√√√	√√√
VAR(3)	H_0: Linear functional form	√√	x	√√√
	H_0: Normality in the residuals	√√	√√√	√√√
	H_0: Homoskedasticity	√√√	√√√	√√√
	H_0: No serial correlation	√	x	√√√
VAR(4)	H_0: Linear functional form	√√√	√√	√
	H_0: Normality in the residuals	√√	√√√	√√√
	H_0: Homoskedasticity	√√√	√√√	√√√

* The serial correlation test is the Langrange Multiplier test. The functional form test is the Ramsey's RESET test. The normality test is the Jarque-Bera test. The heteroskedasticity test is the Koenker-Basset test. The null hypotheses are those given in the first column.

√√√ - the p value for rejecting the hypothesis is above 10%;
√√ - the p value for rejecting the hypothesis is between 5% and 10%;
√ - the p value for rejecting the hypothesis is between 1% and 5%;
x - the p value for rejecting the hypothesis is bellow 1%.

Table 13: Diagnostics for different orders of the VAR for IMPORTS*

		Imports	REER	Foreign activity
	H_0: No serial correlation	√√√	√√√	x
VAR(1)	H_0: Linear functional form	√√√	√√√	√√√
	H_0: Normality in the residuals	√√√	√√√	√√√
	H_0: Homoskedasticity	√√√	√√√	√
	H_0: No serial correlation	√√√	√√√	√√√
VAR(2)	H_0: Linear functional form	√√	√√√	√√√
	H_0: Normality in the residuals	√	√√√	√√√
	H_0: Homoskedasticity	√√√	√√√	√√√
	H_0: No serial correlation	√√√	√√	√√√
VAR(3)	H_0: Linear functional form	√√√	√√	√√√
	H_0: Normality in the residuals	√	√√√	√√√
	H_0: Homoskedasticity	√√√	√√√	√√√
	H_0: No serial correlation	√√	√√	√√
VAR(4)	H_0: Linear functional form	√√√	√√	√√√
	H_0: Normality in the residuals	√√√	√√√	√√√
	H_0: Homoskedasticity	√√√	√√√	√√√

* The serial correlation test is the Langrange Multiplier test. The functional form test is the Ramsey's RESET test. The normality test is the Jarque-Bera test. The heteroskedasticity test is the Koenker-Basset test. The null hypotheses are those given in the first column.

√√√ - the p value for rejecting the hypothesis is above 10%;
√√ - the p value for rejecting the hypothesis is between 5% and 10%;
√ - the p value for rejecting the hypothesis is between 1% and 5%;
x - the p value for rejecting the hypothesis is bellow 1%.

Regarding exports, the diagnostic tests seemed best for two lags in the VAR, as no rejection occurred there. No decision could be made only on the grounds of the diagnostic tests in the imports case, since the tests indicated that all the VARs, except the VAR(1) were well specified. Further the information criteria are examined (Table 14).

Table 14: The Schwarz Bayesian Criterion and the Akaike Information Criterion

	Order of VAR	SBC	AIC
EXPORTS	4	127.41	**158.51**
	3	127.64	152.91
	2	**132.45**	151.89
	1	132.35	145.96
IMPORTS	4	**120.50**	**147.71**
	3	108.17	129.55
	2	117.85	133.40
	1	119.42	129.14

The SBC suggests 2 lags for the export VAR, while the AIC suggests 4. As the diagnostic tests seemed best for 2 lags, it was decided to include 2 lags in the further analysis. In the imports, the highest values of both the SBC and AIC are for VAR(4), so it was decided to choose 4 lags.

The next step in the analysis is to establish the number of cointegrating vectors, i.e. to test for the rank of the cointegrating vector. Two test statistics are available for this; the first one is based on the Maximal Eigenvalue of the Stochastic Matrix (λ_{max}) and the second one on the Trace of the Stochastic Matrix (λ_{trace}). The λ_{max} tests the null hypothesis that the rank of the cointegrating vector (r) is equal to the hypothesised rank (s) against the alternative that the r=s+1, while the λ_{trace} tests the null r=s against the alternative r≥s+1. In the both cases the null is rejected if the test statistics is higher than the critical value. The λ_{trace} is believed to be more reliable in presence of non-normality in the residuals (Harris and Sollis, 2003).

The critical values for the tests depend on the deterministic components included in the model; therefore, before the tests for the number of cointegrating vectors are carried out, a decision about the presence of deterministic components has to be made. Five possibilities are there regarding the deterministic components: (1) no intercepts and trends in either the long-run or the long-run model; (2) restricted intercept (i.e. intercept in the long-run model) and no trends; (3) unrestricted intercept (i.e. intercept in the short-run model) and no trends; (4) unrestricted intercept and restricted trend; and (5) unrestricted intercept and unrestricted trend. Johansen (1992) proposes using the Pantula principle for deciding on the number of the cointegrating vectors and the deterministic components at the same time. We start with the most restricted model (1), and proceed towards the least restricted (5). The λ_{max} and λ_{trace} tests are done for every level of s. The first combination of the number of cointegrating vectors and the deterministic components in which the null is not rejected is chosen.

In this case only one model was appropriate, as an intercept term was needed in the long-run relationship to account for the different units of measurement between the variables (nominal values for the dependent variables and index numbers for the independent), and there is no evidence of trends. Therefore, model 2, restricted intercepts and no trends was chosen. The results of the tests for the rank of the cointegrating vector are given in Table 15.

Table 15: Tests for the number of cointegrating vectors

	Test	H_0	Test statistics	95% critical value	90% critical value
	λ_{max}	r=0	34.01	22.04	19.86
Exports		r≤1	12.74	15.87	13.81
	λ_{trace}	r=0	51.40	34.87	31.93
		r≤1	17.39	20.18	17.88
	λ_{max}	r=0	46.50	22.04	19.86
Imports		r≤1	11.39	15.87	13.81
	λ_{trace}	r=0	63.22	34.87	31.93
		r≤1	16.73	20.18	17.88

In the both import and export regressions the both λ_{max} and λ_{trace} tests suggest one cointegrating vector, since the hypothesis that r=0 can be rejected, while the hypothesis that r≤1 can not.

Once the number of cointegrating vectors is established, they have to be estimated. However, the cointegrating vector itself does not tell anything about the economic relationship, i.e. there are no dependent and independent variables. In order for the relationships to have an economic meaning, restrictions motivated by economic arguments have to be imposed on the vector (Harris and Sollis, 2003). The restrictions that were applied are that exports and imports are the dependent variables in the two vectors, respectively, i.e.

the coefficients of the vector were normalised on the coefficients of exports and imports. The cointegrating vectors after the restrictions have been imposed are given in Table 16.

Table 16: The cointegrating vectors (the dependent variable given in the first column)

		Intercept	Activity	Real exchange rate
Exports	Coefficient	5.66	1.59	-2.81
	Standard error	0.04	0.22	1.41
Imports	Coefficient	5.92	2.47	1.33
	Standard error	0.02	0.26	0.69

The coefficients again seem reasonable. The sizes and the signs are again in accordance with the expectations. Exports turn out to be more price- than income- elastic. Imports, on the other hand, turn out to be more elastic to income than to price. The income elasticities in the both regressions appear highly significant, as the standard errors are very small relatively to the coefficients. The price elasticities are not highly significant, but are not highly insignificant, either (t value near 2).

Table 17 compares the estimated trade elasticities for the both regressions under the both methods.

Table 17: Comparison between the coefficients obtained by the two methods

		Intercept	Activity	Real exchange rate
Exports	ARDL	5.67	1.51	-2.24
	Johansen	5.66	1.59	-2.81
Imports	ARDL	6.01	2.10	1.20
	Johansen	5.92	2.47	1.32

The trade elasticities appear quiet similar. Therefore, we next test whether the trade elasticities given by the Johansen technique differ statistically from those obtained by the ARDL method. This is done by imposing the ARDL coefficients on the vector obtained by the Johansen method. The results of the tests are given in Table 18 and 19.

Table 18: Test whether the Johansen EXPORT elasticities differ from the ARDL

		Intercept	Activity	Real exchange rate
Old	Coefficient	5.66	1.59	-2.81
results	Standard error	0.04	0.22	1.41
New	Coefficient	5.68	1.51	-2.24
results	Standard error	0.02	None	none

p value of the LR test of the restriction: 0,913

(H_0: restriction holds can not be rejected)

Table 19: Test whether the Johansen IMPORT elasticities differ from the ARDL

		Intercept	Activity	Real exchange rate
Old	Coefficient	5.92	2.47	1.33
results	Standard error	0.02	0.26	0.69
New	Coefficient	5.96	2.10	1.20
results	Standard error	0.01	None	none

p value of the LR test of the restriction: 0,070

(H_0: restriction holds can not be rejected)

The restrictions in the export regression can not be rejected at any of the conventional levels, while in the imports case the restrictions can not be rejected at the 5% level, but can at the 10%. We may conclude that the two estimation methods implemented gave statistically very similar trade elasticities.

3.6. Obtaining the equilibrium values

Having obtained the trade elasticities, the next step is to obtain the values of the exogenous inputs. Variables that appear as exogenous inputs in the model are domestic GDP, foreign demand, export and import prices and net transfers and interest flows.

Wren-Lewis and Driver (1998), who have only the domestic and the foreign output as the exogenous inputs, use values from Giorno et al. (1995), who derive the trend output using the production function method, the split time trend method and the Hodrick-Prescott (HP) filter. Genorio and Kozamernik (2004) use the HP filter and the log-linear (exponential) trend for obtaining the equilibrium values.

The values obtained applying a filter on a series represent the trend, or the low frequency, component of the series, i.e. the component that remains after the high frequency, or the cyclical component is removed. According to the theory of spectral analysis, any series can be decomposed into different frequency components; the tool for decomposing a series is known as a filter. The ideal filter leaves intact components within a specified band of frequencies, while eliminates all other. In reality, however, approximations of the ideal filters are used, as the ideal filter requires infinite data (Christiano and Fitzgerald, 2003). The requirements that the optimal filter should meet are to leave as much information unaffected as possible, not to introduce spurious phase shifts, and to produce stationary output (Iacobucci and Noullez, 2005).

The main critique of the use of statistical filters for this purpose is that what they give is the trend, which, in the case of the output, for example, does not necessarily have to be the level of output consistent with the NAIRU. The idea behind the use of filters is that the component that can not be altered by the business cycle represents the long-run equilibrium values (Genorio and Kozamernik, 2004).

For sensitivity analysis purposes it would be good to have more than one variant of the trend value of each series. The solution would therefore be to use different filters for extracting the trend. However, some of the filters applied (the Baxter-King and the Christiano-Fitzgerald filters), seemed to fail one of the requirements of the optimal filter – the output they produced was not stationary. Furthermore, these two filters did not eliminate some of the high frequencies. Therefore, the only filter that seemed appropriate for obtaining the trend values of the series was the Hodrick-Prescott filter. We reserve the possibility to apply the Kalman filter in a revised version of the study.

The Hodrick-Prescott (HP) filter calculates the trend by smoothing, i.e. if a series y_t is a sum of a trend component, t_t, and a cyclical component, c_t, the trend component is obtained as the t_t that minimises the function:

$$\sum_{t=1}^{T}(y_t - t_t)^2 + \lambda \sum_{t=2}^{T-1}[(t_{t+1} - t_t) - (t_t - t_{t-1})]^2 \qquad (19)$$

where the λ is the smoothing parameter. The higher is the λ, the smoother the filtered series becomes, and as λ approaches very high values, the HP trend approaches the deterministic trend. Hodrick and Prescott (1997) suggest smoothing parameter of 1600 for quarterly data, 100 for annual and 14400 for monthly. Some studies suggest calculating the optimal smoothing parameter (see French, 2001). In many studies, however, a smoothing parameter of 6400 is used as an addition or an alternative to the smoothing parameter of 1600 for quarterly data.

The HP filter has been widely criticised on a few grounds. First, it is appropriate only in case the series is integrated of order 2. Next, it is appropriate only if the cyclical component is a white noise process. Furthermore, the HP is known to suffer from the 'end of the sample' problem, i.e. it performs poorly as it approaches the end of the sample. Finally, the filter has been criticised for the ad-hoc manner of the use of the smoothing parameter of 1600 (French, 2001). However, despite all the criticisms, the HP filter remains the most widely used filtering tool, and in the case of FEER, very often the only one used.

The trend values for the domestic GDP, the foreign demand, the export and import prices and the interest flows are given on Figures 16-20.

Figure 16

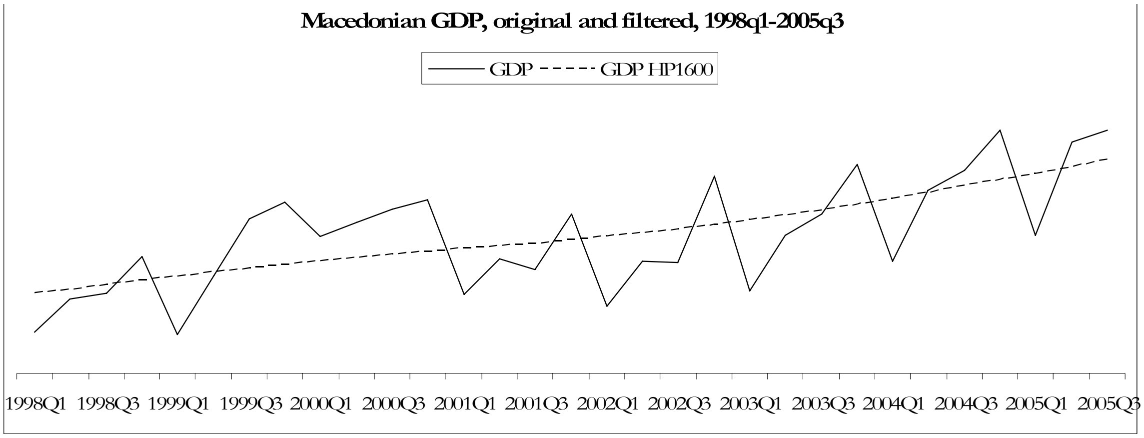


Figure 17

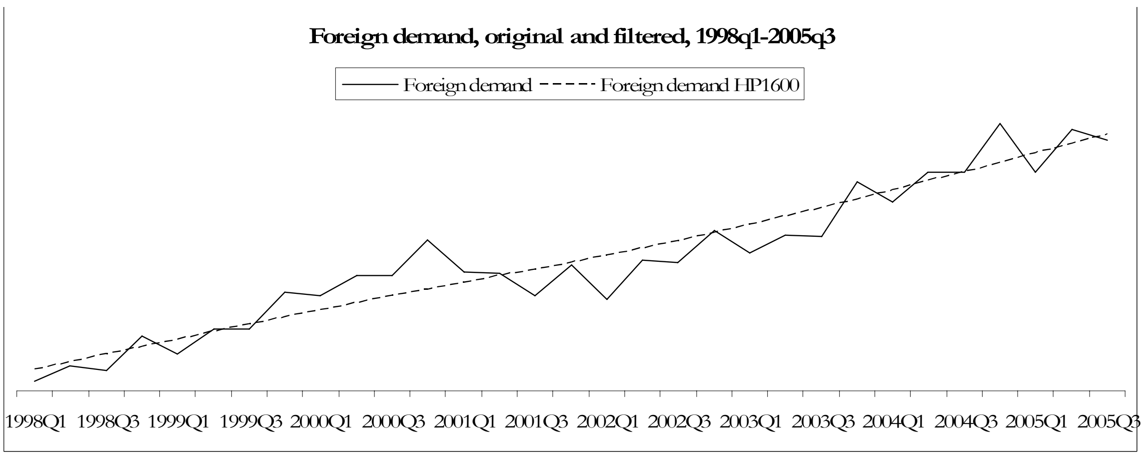


Figure 18

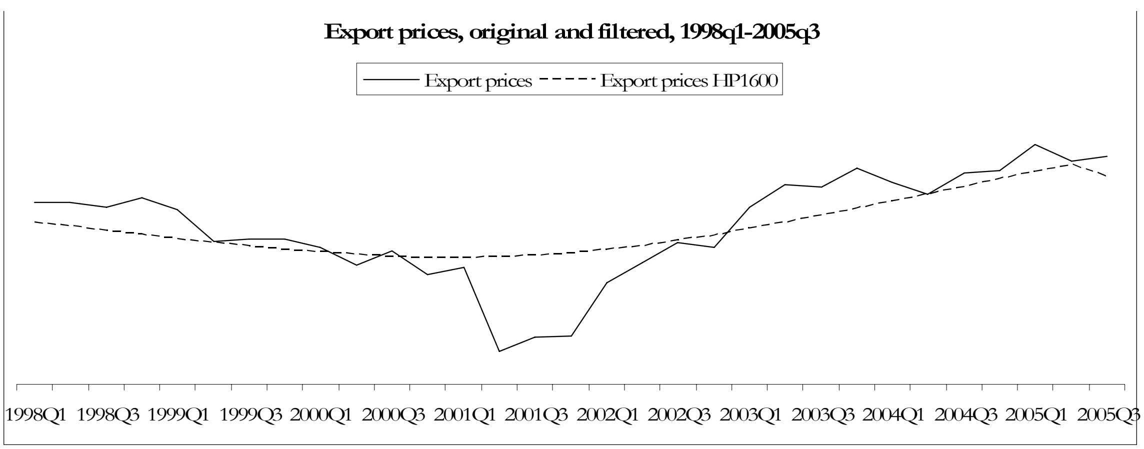


Figure 19

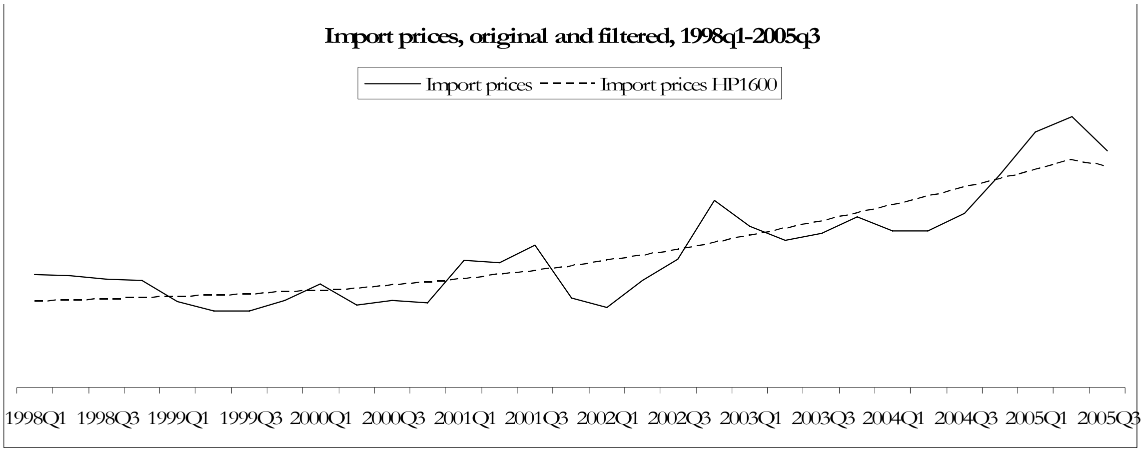
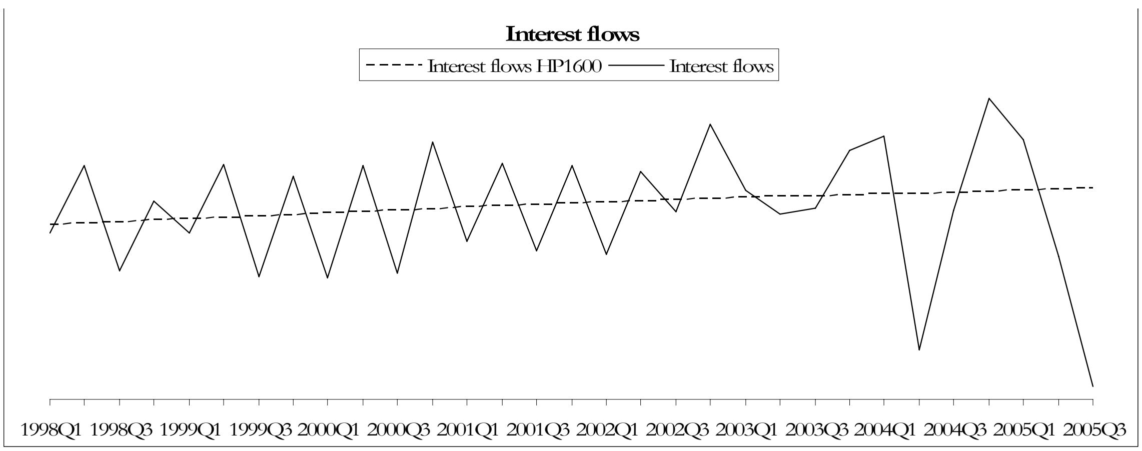


Figure 20

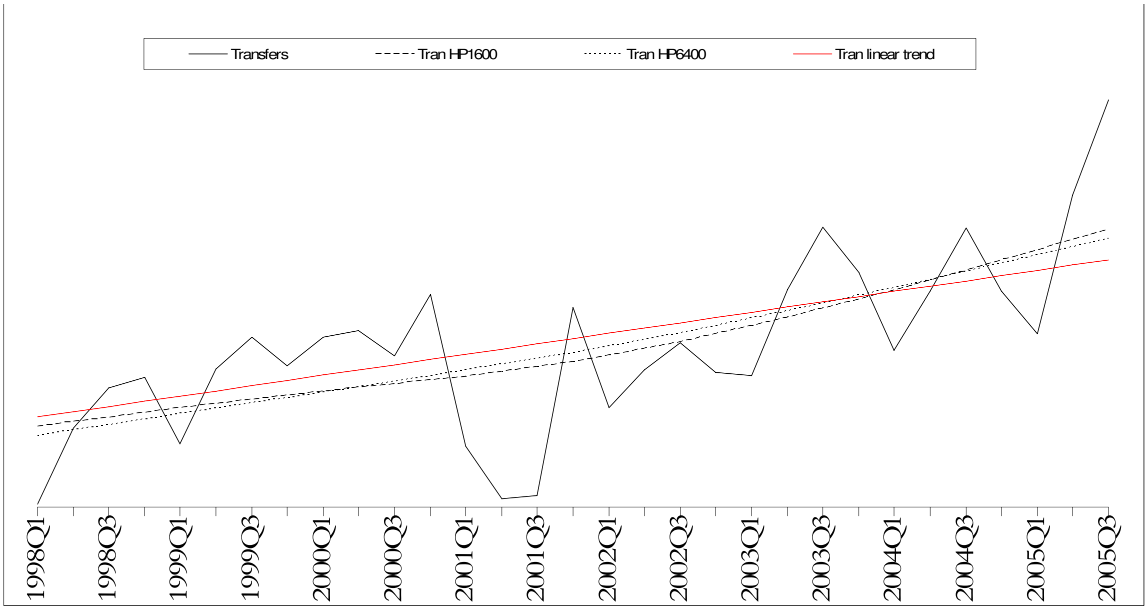


While some FEER calculations do not even include net transfers in the analysis, in our case they appeared to be of critical importance, so it was decided to include three alternatives for the trend values of transfers. In modelling them, we followed mainly Wren-Lewis and Driver (1998), who estimate the equilibrium net transfers as a deterministic trend, and Costa (1998), who calculates them using the HP filter. Therefore, in this study, the first two options for the net transfers are obtained using the HP filter, the first one using a smoothing parameter of 1600, the second one using a parameter of 6400[21], and the third alternative used is a simple deterministic trend, i.e. the predicted values from the regression of the series on a constant and a trend, including dummies for the three largest outliers. These are given on Figure 21.

[21] This was decided due to the fact that in some cases the difference between the both series exceeded 5%.

Figure 21

Net transfers, original and filtered



3.7. Selecting the current account target

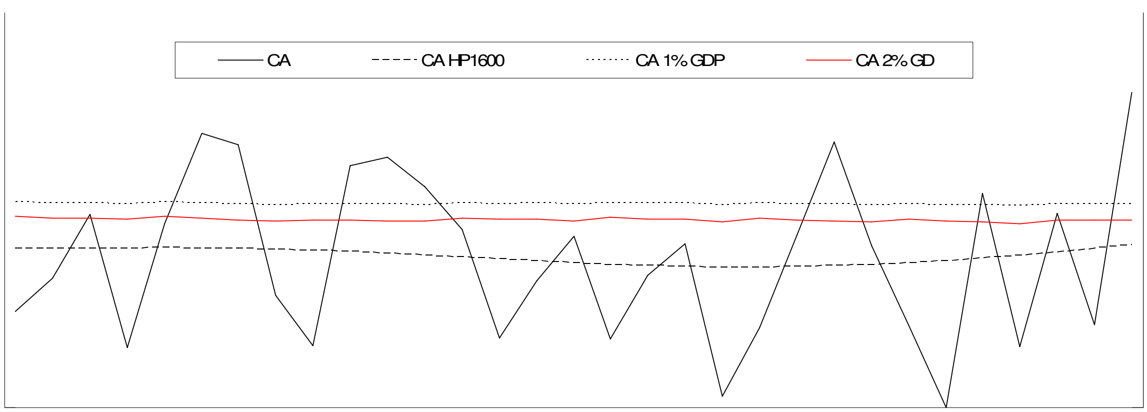
Having obtained the equilibrium values of the exogenous inputs, the only thing that remains to be done before the FEER is estimated is to select the current account consistent with the external equilibrium.

Most attention in the literature has been paid to the issue of external equilibrium, both in theoretical and empirical terms. The theoretical considerations have been discussed in the previous chapter; now we discuss the empirical issues. Williamson (1994) takes into account a variety of factors (investment and saving considerations, debt cycle, demographics etc.) when he sets the current account targets. Wren-Lewis and Driver (1998) use current account targets from Williamson and Mahar (1998), set pretty much in the same manner. Bayoumi et al. (1994) set the current account target in an ad hoc manner, at 1% of GDP, mainly due to the illustrative nature of their study. Genorio and Kozamernik (2004) use four alternatives for the current account target: balanced current account; the HP filter; gradually increasing current account in the first half of the transition period up to 3% of GDP and gradually decreasing towards zero afterwards; and decreasing towards zero in the first half of the transition and zero afterwards.

Two alternatives for the current account target are used in this study. In the first one, the current account target is set at 1% of GDP, in the second at 2% of GDP. It was also considered how higher current account targets, e.g. the one produced by the HP filter, would affect the FEER, and these results will be presented in the following section, for illustrative reasons. But, for several reasons, we decided not to include such a target in the final discussion. First, as will be shown in the next section, in the Macedonian case the critical factor of the FEER does not appear to be the current account target, but the net transfers, as the latter greatly exceeds the former. Furthermore, although the average deficit of the current account in the period under observation is about 4% of GDP, and although the HP filter produced similar values to those, a target of that magnitude would be associated with a trade deficit of 15%-20% of GDP, given the high net transfers, which could by no means be attributed to as a state consistent with the external equilibrium. Additionally, Williamson and Mahar (1998) propose a current account target of only 0.3% of GDP for the Central and Eastern European countries. Finally, Gutierrez (2006) estimates the structural current account deficit for Macedonia at 2% of GDP. Therefore, a current account target of 1% or 2% would seem more likely to be consistent with external equilibrium in the Macedonian case. Figure 22 shows the three alternative current account targets along with the actual current account.

Figure 22

Current account targets



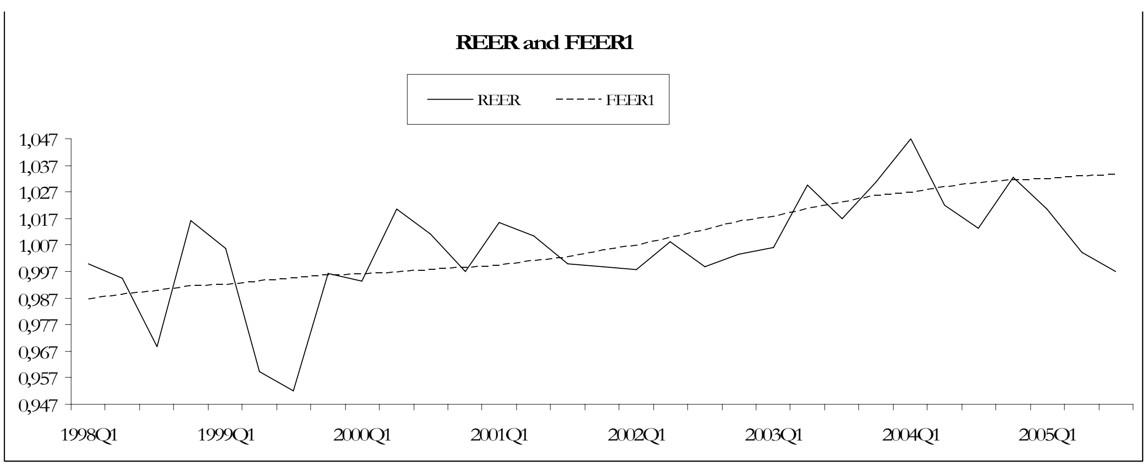
3.8. Sensitivity analysis, discussion and results

In this section the sensitivity of the FEER estimates to different assumptions will be examined; and alternative FEERs, based on different assumptions, will be presented.

As Driver and Wren-Lewis (1999) state, the assessment of the sensitivity of the FEER estimates should address two things: the assumptions made about the exogenous inputs; and assumptions made about the estimated trade elasticities. In this study, the sensitivity of the FEER to different targeted current accounts and to different assumptions about the net transfers, as exogenous inputs, will be examined, as well as how changes in the underlying elasticities affect the FEER.

Different combinations of the mentioned sources of sensitivity yield different FEERs. However, the aim here is not to calculate all the possible combinations, as we do not consider this of relevance. Only a few alternative FEERs will be calculated, sufficiently different and representative to support the conclusions. First the FEER given by the trade elasticities obtained by the Johansen technique, the current account target set at 1% of GDP, and net transfers obtained by the HP filter, smoothing factor 1600, is presented on Figure 23. It is named FEER1.

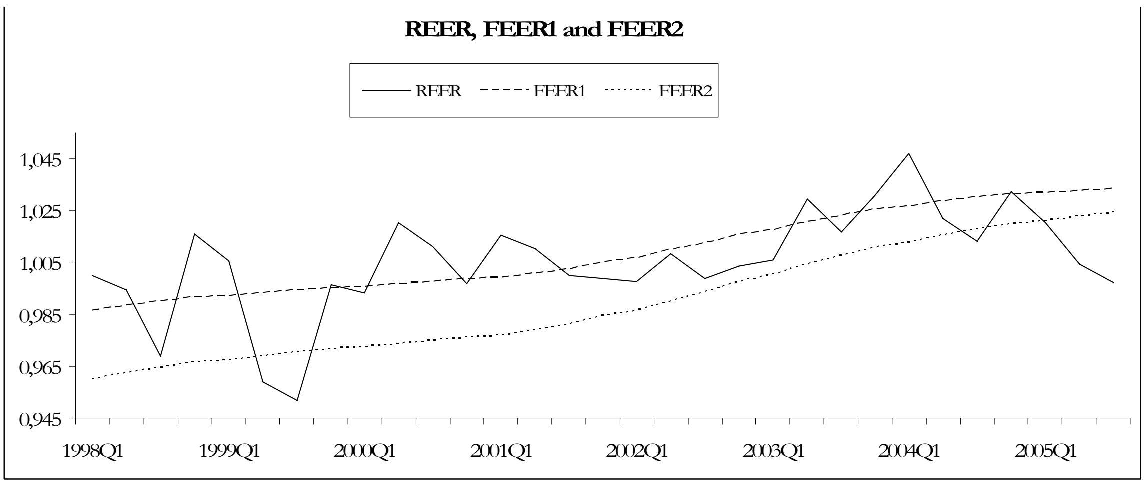
Figure 23



The real effective exchange rate is generally close to FEER1. The largest misalignments are in the third quarter of 1999, when the REER is undervalued by 4.5% and in the last period under observation, when the REER is undervalued by 3.6%. Also, there appears to be a clear tendency of the FEER1 to appreciate, especially after 2001q3.

How changes in the assumed trade elasticities affect the FEER is examined next, by replacing the Johansen coefficients with the ARDL coefficients. This is FEER2, given on Figure 24.

Figure 24

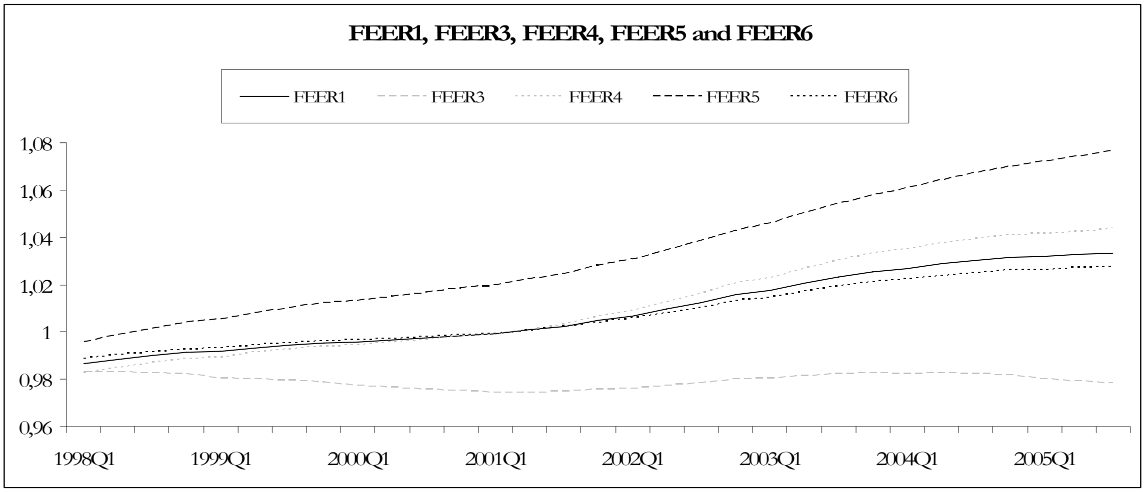


Even though the coefficients obtained by the two methods seemed quiet similar, the two FEERs seem to differ. FEER2 is below FEER1 all the time, and the difference decreases, from 2.7% (of FEER1) in the first period, to 0.9% in the last. This is most probably due to the higher intercept term in the ARDL imports equation. Furthermore, FEER2 is below the REER in most periods. The highest misalignment is in 1998q4, when the REER is overvalued by 4.9%. FEER2, seems even more than FEER1, exhibits a tendency to rise, and the REER is undervalued 2.7% in the last period.

The FEER estimates are believed to be very sensitive to the assumed trade elasticities. We next examine this, in order to see which of the four elasticities influences the estimates most. We are also interested to see whether the assumptions regarding the elasticities are critical for the analysis. Towards that end, the previously estimated trade elasticities are replaced with elasticities imposed in an ad-hoc manner (see Driver and Wren-Lewis, 1999). Thus, an income elasticity of exports of 1 instead of 1.59 is assumed in FEER3, price elasticity of exports of -1.75 instead of -2.81 in FEER4, income elasticity of imports of 1.75 instead of

2.47 in FEER5 and price elasticity of imports of 2 instead of 1.32 in FEER6 (Figure 25). Other assumptions remain as in FEER1.

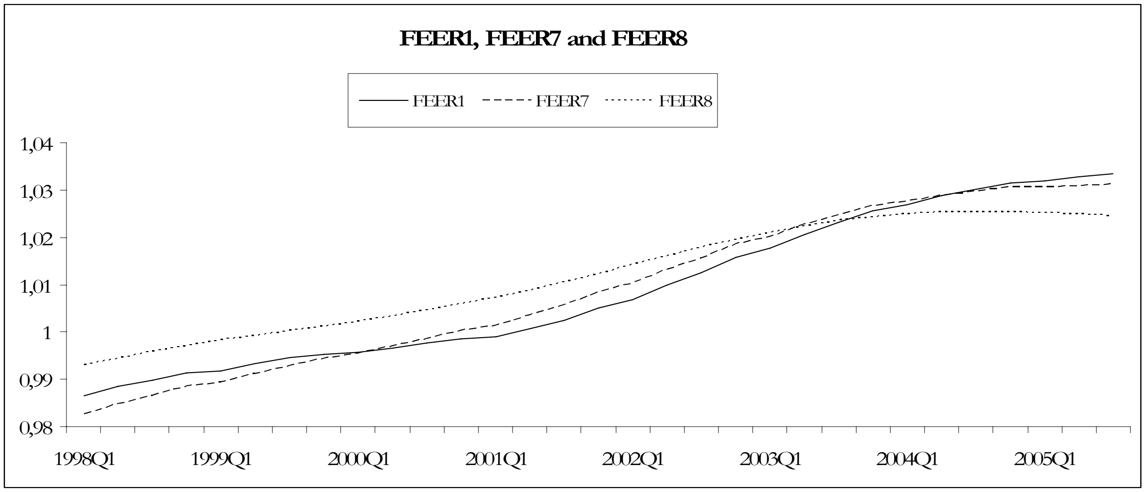
Figure 25



Lower income elasticity of exports lowers (depreciates) the FEER, and FEER3 is lower than FEER1 by 0.3% in the first period and 5.3% in the last. Additionally, FEER3, unlike all the other FEERs, does not tend to appreciate over time. This is most likely due to the Houthakker-Magee effect mentioned above, i.e. now the product between the foreign growth and the income elasticity of exports is smaller than the product between the domestic growth and the income elasticity of imports, so the FEER depreciates (depreciation meaning decline in the exchange rate). Next, lower income elasticity of imports increases the FEER, and FEER5 is above FEER1 by 0.9% in the first period and 4.2% in the last. As can be further seen from the figure, a change in the price elasticity of exports and imports does not affect the FEER dramatically. Lower price elasticity of exports lowers the FEER in the beginning, and increases it afterwards. Higher price elasticity of imports increases the FEER in the beginning, and decreases it afterwards. However, the magnitudes of the changes in FEER4 and FEER6 are very small, never exceeding 1%. Therefore, the FEER estimates are more sensitive to the assumptions made about the underlying income elasticities than to the assumptions regarding the price elasticities.

Next, the sensitivity of the FEER to the assumptions about the net transfers is examined. Instead of net transfers obtained by the HP1600, the values obtained by the HP6400 and by the linear trend are taken. Other assumptions remain as in FEER1. These FEERs will be referred to as FEER7 and FEER8, respectively, and are presented on Figure 26.

Figure 26



FEER7 is below FEER1 in the beginning and in the end, and above it in the middle section. That is because the transfers obtained with a factor of 6400 are smoother, i.e. flatter – lower in the tails and higher in the middle. FEER8 is above the both FEER1 and FEER7, roughly, in the first six years, are below them in the last two years. This is because the transfers given by the linear trend are higher in the beginning, but lower in the end. However, in no period does the difference between FEER1 and FEER7 or FEER1 and FEER8 exceed 1% of FEER1. Conclusively, the alternative net transfers assumed would not affect the calculated FEER importantly.

All the FEERs presented so far tend to rise, i.e. to appreciate (appreciation meaning fall in price competitiveness). One would guess that this is most probably because of the increased net transfers, as the currency of a country experiencing an increase in the net capital inflows would tend to appreciate. To see whether this is indeed the case, a simple test is carried out - the net transfers, instead of rising, are kept stable over time, ceteris paribus. If the FEER does not tend to rise anymore, than one may conclude that the appreciation in the FEER is due to the increased net transfers.

The dynamics of the net transfers as a percentage of GDP is shown on Figure 27. The rising trend is apparent, especially in the last few periods. There is a dramatic fall in the first three quarters of 2001, the time of the external shock. In all the periods remaining, however, the net transfers as a proportion of a GDP would seem to be mean reverting to around 12%, roughly (the average for the whole period is 12.6% of GDP). Therefore, they are set at 12% of GDP in all the periods, keeping other assumptions as in FEER1. FEER9 and FEER1 are given on Figure 28.

Figure 27

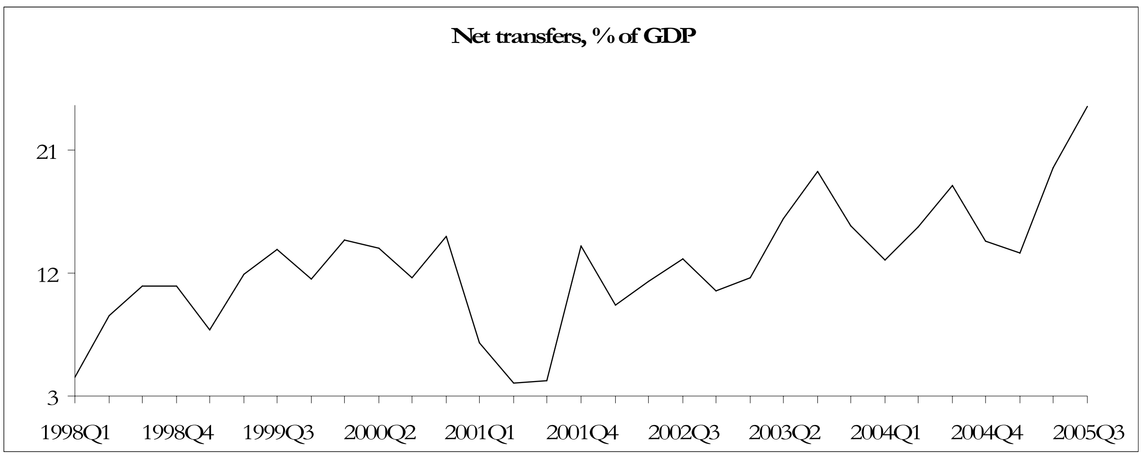
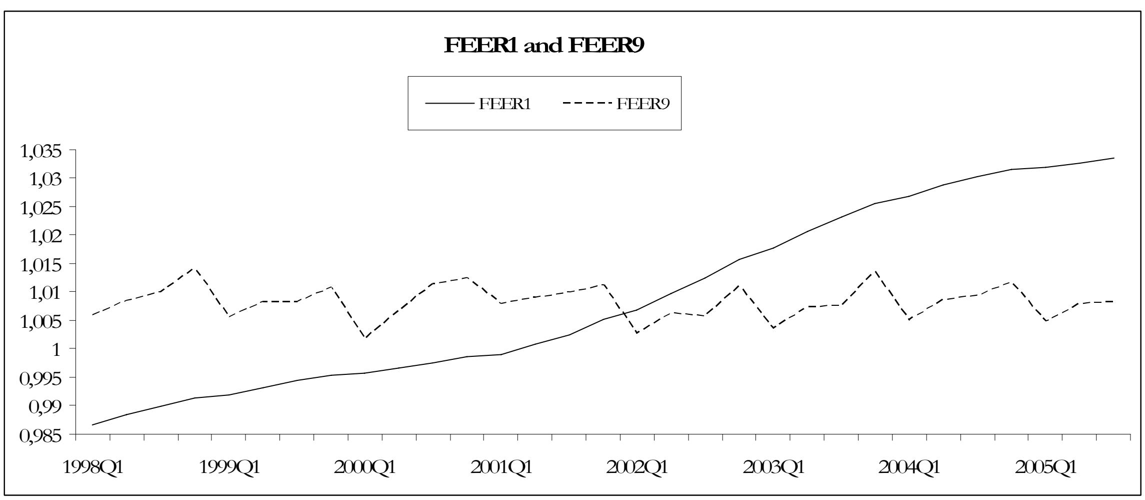


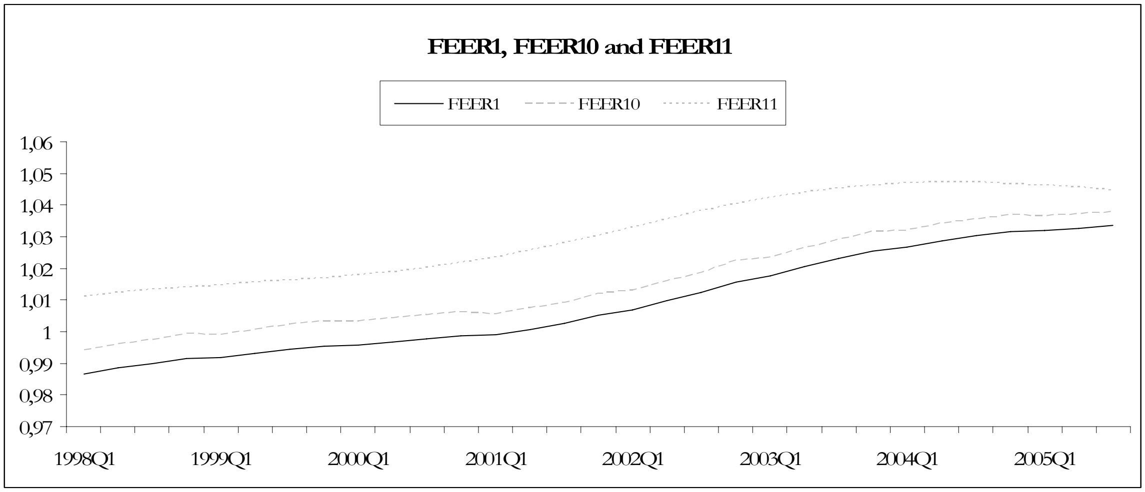
Figure 28



Not surprisingly, in contrast with all the previous FEERs, FEER9 would rather seem to decline over time, not to rise. It is above FEER1 in the beginning and below afterwards. Therefore, the conclusion that the tendency of the FEER to rise is due to the rise in the net transfers seems plausible.

Last, the sensitivity of the FEER to the assumption about the targeted current account is probed. Alternatively to the current account target of 1% of GDP, current accounts of 2% of GDP (FEER10) and extracted by the HP filter, factor 1600, (FEER11) are assumed (Figure 29).

Figure 29



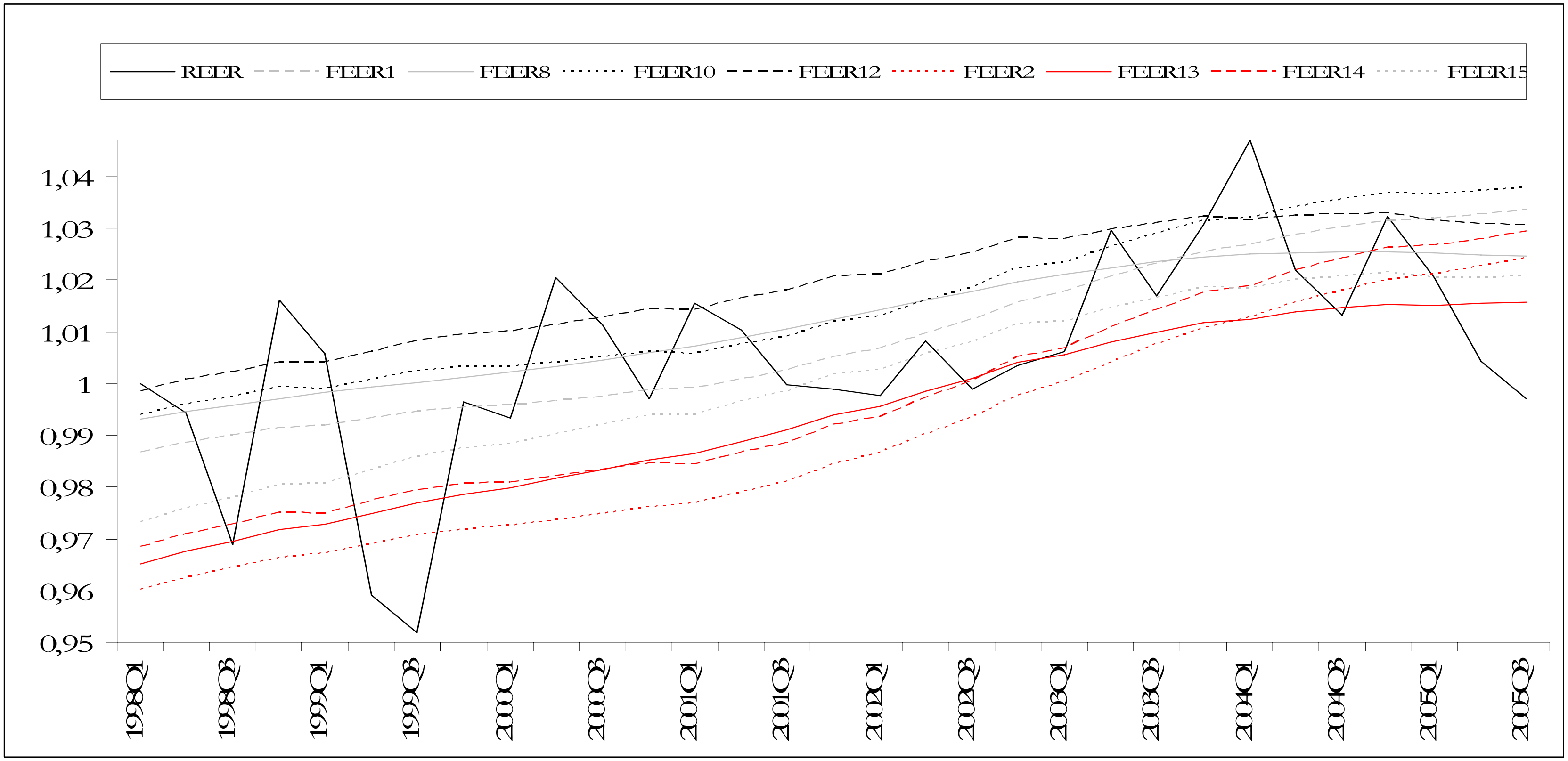
As expected, higher current account targets make the FEER rise. FEER10 is higher than FEER1; in no period by more than 0.8%, though. FEER11 is higher than FEER1 by a maximum of 2.6%.

Finally, having assessed the sensitivity of the FEERs to the assumptions, we choose 8 alternative FEER estimates in order to compare them to the REER. Table 20 explains how these FEERs are obtained, and Figure 30 presents them alongside with the REER.

Table 20: Different FEERs

	Elasticities	CA	Transfers
FEER1	Johansen	1%	HP1600
FEER8	Johansen	1%	Linear trend
FEER10	Johansen	2%	HP1600
FEER12	Johansen	2%	Linear trend
FEER2	ARDL	1%	HP1600
FEER13	ARDL	1%	Linear trend
FEER14	ARDL	2%	HP1600
FEER15	ARDL	2%	Linear trend

Figure 30: Different FEERs



	1998Q1	1998Q2	1998Q3	1998Q4	1999Q1	1999Q2	1999Q3	1999Q4	2000Q1	2000Q2	2000Q3	2000Q4	2001Q1	2001Q2	2001Q3
Lowest FEER	-4	-3,2	-0,5	-4,9	-3,8	1,03	1,97	-2,5	-2,1	-4,6	-3,6	-2,1	-3,8	-3,1	-1,9
Highest FEER	-0,1	0,64	3,45	-1,2	-0,2	4,9	5,91	1,31	1,69	-0,9	0,16	1,75	-0,1	0,61	1,82

	2001Q4	2002Q1	2002Q2	2002Q3	2002Q4	2003Q1	2003Q2	2003Q3	2003Q4	2004Q1	2004Q2	2004Q3	2004Q4	2005Q1	2005Q2	2005Q3
Lowest FEER	-1,5	-1,1	-1,8	-0,5	-0,6	-0,6	-2,5	-0,9	-1,9	-3,3	-0,8	0,14	-1,6	-0,5	1,11	1,87
Highest FEER	2,18	2,34	1,53	2,64	2,44	2,17	0,03	1,39	0,17	-1,4	1,2	2,21	0,44	1,58	3,28	4,09

A few things can be noticed at Figure 30. The REER would seem to be generally close to the FEER. No large misalignment can be identified. The table below the figure shows the misalignments of the REER from the highest and the lowest value of the FEER in every period, in percentages of the value of the REER, where a positive value indicates that the FEER is higher than the REER, i.e. an undervaluation of the denar. Except in two periods, 1999q2 and 1999q3, when there is a significant fall in the REER, in no other period do the misalignments exceed 5%. This is, however, much less than some of the misalignments found in the literature[22]. Also, as obvious from the figure, and as stressed above, all the FEERs show similar increasing trends, due to the increased net transfers. Finally, in the last four periods the REER exhibits a tendency to fall, while the FEER continues to show a tendency to rise. These trends, if they continue in the future, might cause the denar to become undervalued.

3.9. Potential drawbacks

Having estimated the FEER, in the final section of this chapter we conclude the analysis with a discussion of potential drawbacks. Two lines of arguments will be presented: the first one pointing out the weaknesses of the analysis; the second one assessing the appropriateness of the FEER methodology for the Macedonian economy.

Even though it was a partial equilibrium approach, which models only the current account, that was employed for estimating the FEER, in our case only the trade flows were modeled, and everything else – trade prices, transfers, interest flows, was treated as an exogenous input in the model. This is especially problematic given the importance of some of the factors treated as exogenous inputs for the analysis, i.e. the net transfers.

Furthermore, the trade flows model itself is not without weaknesses. Although the two approaches to obtaining the trade elasticities yielded similar and rather plausible results, a

[22] For example, Smidkova (1998) finds overvaluation of the Czech crown even in the restrictive scenarios by 2%-8,5% in 1996, Smidkova et al. (2002) find misalignments of roughly 10%, 20%, 20% and 30% for Czech, Poland, Estonia and Hungary, respectively, Egert and Lahreche-Revil (2003) find misalignments of up to 10% for Hungary, 15% for Czech and 10% for Slovakia.

few points should be stressed. In the first stage of the ARDL approach, when the existence of the long-run relationship was tested, the results were rather ambiguous in the import regression. Furthermore, they were conditional upon whether the dummy variables were included, in both import and export regressions. On a more conceptual level, it is highly questionable whether cointegration methods are appropriate when working with a sample with a time span of 8 years.

The short time span is a direct consequence of the unavailability of data for preceding and subsequent periods. Talking about data unavailability, no import unit values data were available for 4 of the major trading partners, and US PPI was used instead; although this was fairly justified as probably the second best option, it should be said that the analysis might have been different had data been available. Also, the quality of one variable is particularly questionable – domestic GDP, as it is calculated as the GDP in the current period in prices from 1997.

Next, the foreign activity variable, which has been constructed following Genorio and Kozamernik (2004) as weighted imports of the major trading partners, can be criticized too. First, it is unclear whether GDP of the trading partners would be more appropriate as a measure of the activity, particularly when GDP is taken as a measure of domestic activity. Also, the dynamics of the variable, constructed as it is, is dominated by the dynamics of the largest countries (e.g. the USA), while the demand for Macedonian exports is arguably driven by smaller countries (e.g. Serbia and Montenegro and Greece), which can cause trends in the variable not to reflect the real trends in demand.

The next line of criticism is focused on the REER variable. Although it comes from the IMF's IFS, a reliable source, the way it is constructed, i.e. the currencies and the respective weights included, is not known, which makes it impossible to transform the FEER into bilateral exchange rates. Also, the factors behind the dynamics of the REER are not known, which further limits the analysis. It might have been more appropriate to construct our own REER variable; this actually traces the path for one possible improvement, if the research is revised sometime.

The appropriateness of the FEER approach as a method for assessing the alignment of the currencies of the transition economies has been questioned by Maeso-Fernandez et al. (2005). First they point out the problem with the external balance condition, questioning whether the current account target for the transition economies can be set up on the grounds of past developments. They also argue that the internal balance, as well, is problematic for the transitional countries, in a sense that applying a HP filter on the actual series is not entirely appropriate when these are short and with many structural changes. Next, they argue that the trade elasticities found in many studies turn out to be either insignificant or implausible. Finally, the FEER approach is adequate for economies fluctuating around an equilibrium state, while the transition countries in the observed periods have rather been in a process of approaching equilibrium.

This study, however, would not seem to suffer from all these drawbacks. The trade elasticities obtained, for example, appeared significant, plausible and robust. The external balance was well argued also; high trade deficits, when observed alone, may not reflect 'thrift and productivity', but one has to take into account the high net transfers, as well.

However, the issue of the internal balance is more problematic. It is hard to believe that running a filter on the domestic GDP series would give the level of output consistent with the NAIRU, as the level of unemployment throughout all the period has been extremely high (about 35%). The problem is not immanent only to the case of Macedonia; many transitional economies are characterized with high unemployment rates. However, this does not render the FEER methodology inappropriate for the transition countries, as the NAIRU itself might be high for them[23].

Finally, we dismiss the question of the appropriateness of the FEER method for assessing the exchange rate of the denar as out of the scope of this analysis. Actually, we conducted the analysis as it was appropriate. Not so much due to our belief that it is; rather because we

[23] For example, Borowski et al. (2004) state that the actual unemployment in Poland is 18%, while the NAIRU has been estimated at around 14-15%

thought that skepticism regarding the appropriateness of any method might lead only to no researches being done at all.

CHAPTER 4

Main findings, conclusions and recommendations for further research

Having originally emerged as an accompaniment to proposals for global macroeconomic management and coordination, and being in principle a benchmark for judging the right parity of a currency, the Fundamental Equilibrium Exchange Rate (FEER) has mainly been calculated in the literature as a consequence of the decision to accede to the EU, i.e. the ERM. In contrast, the motivation behind this study lies partly within the present debate in academic circles regarding the right parity of the Macedonian denar. Namely, due to the persistently high, and increasing, trade deficits, many advocates are of the opinion that the denar is overvalued. In the absence of arguments based on sound research, the debate has mainly been grounded in subjective views and judgements; the latter, however, lack the rigour of the former. The second motive behind this study is of a purely academic nature – to provoke and stimulate further similar research.

This study is, therefore, first and foremost inspired by the wish to contribute to filling of this knowledge gap. Being an MA dissertation, this study is limited in its focus and ambition. Its aim is not to argue whether or not the denar is misaligned. Rather, the aim is to show how one of the methods available in the literature for this purpose, the FEER method, can be applied on the case of Macedonia. The framework is therefore clear: first the concept of the FEER was explained, followed by a discussion on the theoretical foundations; then the literature was surveyed on how the FEER has been calculated; finally, one of the approaches found in the literature was applied in order to calculate the FEER of the Macedonian denar for the 1998q1-2005q3 period.

Using a standard methodology for calculating the FEER, applied already on many occasions, and accounting for most of the acknowledged ambiguities surrounding the FEER estimates, through presenting a range of alternative estimates, the most important findings of this study are as follows.

1) The real effective exchange rate (REER) of the denar would in principle seem to be in alignment with the FEER, with the misalignment exceeding 5% just in one period

and for three of the eight final FEER estimates. This would imply that the price competitiveness is not inhibited.

2) The FEER estimates appeared to be most sensitive to the assumptions regarding the underlying income elasticities of imports and exports; however, both estimation methods applied for obtaining the trade elasticities yielded similar and sensible results, so we exclude the possibility of higher misalignments due to incorrect trade elasticities.

3) The variable that is of critical importance for the estimates obtained is the net current transfers; therefore special attention should be paid to the way these are modelled. We model them in the same manner as other studies do; as a result, the equilibrium net current transfers increase substantially in the later periods. As long as no research is done on the nature of the net transfers and the reasons for their increase, we consider this to be the only appropriate way to model them.

4) The FEER of the denar exhibits a tendency to appreciate over time. The appreciation of the FEER is driven by the rise in the net current transfers. This is entirely in accordance with economic theory, as it is well known that the currency of a country facing an increase in the capital inflows would tend to appreciate.

5) The REER of the denar, on the contrary, tends to depreciate in the last six periods. As a result, it is below all of the eight FEERs in the last two periods (being below meaning being undervalued). Despite the fact that none of these misalignments exceeds 5% yet, if the trends in the FEER and the REER continue, the concerns regarding the undervaluation of the REER might deserve more attention.

Concerning the net current transfers, no research has been conducted yet on their nature and causes, at least not to the knowledge of the author. It is, however, observable that the cash exchange component of the private transfers constitutes the biggest part of the net current transfers (61% and 68% in 2004 and 2005, respectively). It is this component that contributes entirely to the dramatic increase in the net current transfers (NBRM, 2004, 2005). Even though part of migrants' transfers is not recorded in the official remittances, and might fall into the cash exchange component, it is highly unlikely that the increase is due to this. It seems more sensible that one part of the cash exchange component represents unrecorded exports (Markiewicz 2006). Also, it might be the case that some unrecorded investments are recorded as cash exchange (Gutierrez 2006). Finally, the number of persons working abroad has increased significantly in the 2004 and 2005, and their earnings might contribute to the increase.

The FEER by definition is the REER that will emerge when the economy is in internal and external balance. Leaving aside the external balance, the internal balance is defined as a state when the economy is operating at the NAIRU. It is this notion where the first, and arguably the strongest, criticism on this study comes from. The Macedonian economy in the observed period can hardly be seen as functioning at the NAIRU – with low inflation rates, indeed, but extremely high unemployment rates (Table 3). In consequence, one could argue that the FEER method is not entirely appropriate for the Macedonian case. However, if this reasoning is accepted, an applied economist would be left with only a few, possibly uninteresting things to investigate. That is why this study is not the first one to calculate the FEER for a country with high unemployment; take Poland (Rubaszek, 2005) and Croatia (Gattin-Turkalj, 2005) for example.

The FEER in this study was estimated using the partial equilibrium approach; this approach calculates the FEER by modelling only the current account, and abstracting from all other sectors of the economy. In this study, however, only trade was modelled; more precisely, only trade volumes. Trade prices, amongst other things, were included as exogenous inputs. So much as this undermines the quality of the obtained FEER estimates it also traces one possible route for further improvements. To model the trade prices one just needs to take a look how this is done in the literature (Wren-Lewis and Driver, 1998, for example).

As was stressed above, this dissertation does not aim to argue whether the denar is misaligned or not. We feel that it would be overambitious to do that with an MA dissertation. If one had such intentions, however, they would have to take into considerations a few more methods used towards that end in the literature. The first one of them is certainly the Purchasing Power Parity method, briefly described and critically assessed in Chapter 2. By no means should one overlook the next most popular equilibrium exchange rate method – the Behavioural Equilibrium Exchange Rate (BEER) elaborated in Clark and MacDonald (1998). The BEER approach is advantageous over the FEER in that it is highly tractable, and that it does not use normative assumptions (MacDonald 1999). The next method to think about is the NATREX method, developed by Stein (1990, 1994), which is similar to the BEER. Finally, one might be interested into the Equilibrium Real Exchange Rate method, developed by Edwards (1994) and Elbadawi (1994), and built purposely for non-industrial countries.

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APPENDIX 1: DATA

Period	Macedonian GDP, index numbers	Foreign demand index numbers	REER of the denar, index numbers	Export prices, index numbers	Import prices, index numbers	Current account, real, million dollars	Export volumes	Import volumes	Debt interest flows, real, million dollars	Net current transfers, real, million dollars	US PPI, index numbers
1998Q1	1,000	1,000	1,000	1,000	1,000	-85,938	294,634	408,907	-14,049	41,623	0,973
1998Q2	1,040	1,035	0,994	1,000	0,998	-62,777	338,039	489,065	-3,415	88,229	0,972
1998Q3	1,048	1,024	0,969	0,990	0,990	-18,712	344,454	461,569	-19,880	112,879	0,967
1998Q4	1,091	1,099	1,016	1,010	0,986	-111,281	333,410	568,500	-9,086	119,386	0,961
1999Q1	0,997	1,060	1,006	0,984	0,940	-25,256	258,136	367,626	-13,982	78,819	0,954
1999Q2	1,069	1,114	0,959	0,915	0,919	38,130	273,746	397,028	-3,365	124,444	0,969
1999Q3	1,137	1,115	0,952	0,920	0,918	29,684	373,296	519,348	-20,804	144,061	0,987
1999Q4	1,158	1,195	0,996	0,920	0,941	-74,843	373,178	625,940	-5,153	126,307	0,996
2000Q1	1,116	1,187	0,993	0,901	0,978	-109,792	367,543	620,780	-21,015	144,198	1,009
2000Q2	1,133	1,231	1,020	0,863	0,933	15,067	368,032	515,579	-3,533	148,176	1,027
2000Q3	1,149	1,232	1,011	0,893	0,941	21,501	386,461	499,892	-20,231	132,411	1,040
2000Q4	1,160	1,310	0,997	0,840	0,937	0,505	391,169	571,451	0,247	170,156	1,055
2001Q1	1,045	1,240	1,016	0,857	1,031	-28,813	340,040	387,857	-15,362	77,212	1,072
2001Q2	1,089	1,237	1,010	0,673	1,025	-104,774	424,690	407,966	-3,188	44,823	1,060
2001Q3	1,076	1,188	1,000	0,705	1,063	-65,099	421,082	357,549	-16,775	47,068	1,038
2001Q4	1,143	1,256	0,999	0,707	0,946	-33,846	400,846	523,469	-3,436	162,363	1,007
2002Q1	1,032	1,181	0,998	0,823	0,926	-105,226	296,523	479,879	-17,356	100,866	1,003
2002Q2	1,085	1,265	1,008	0,866	0,986	-61,215	305,120	468,601	-4,469	124,165	1,018
2002Q3	1,084	1,260	0,999	0,911	1,034	-38,948	334,992	474,908	-10,696	140,673	1,025
2002Q4	1,188	1,329	1,004	0,902	1,163	-144,942	334,606	513,968	3,023	122,362	1,036
2003Q1	1,050	1,281	1,006	0,990	1,106	-97,444	297,548	481,740	-7,401	120,538	1,074
2003Q2	1,118	1,321	1,030	1,039	1,074	-33,079	343,506	542,077	-10,979	173,198	1,067
2003Q3	1,143	1,317	1,017	1,035	1,091	32,094	327,471	505,295	-10,052	211,354	1,074
2003Q4	1,203	1,438	1,031	1,074	1,125	-40,104	350,519	568,634	-1,006	183,862	1,084
2004Q1	1,086	1,393	1,047	1,045	1,094	-96,299	350,346	563,837	1,093	135,973	1,107
2004Q2	1,171	1,457	1,022	1,018	1,096	-152,743	361,461	653,757	-32,312	172,253	1,138
2004Q3	1,196	1,457	1,013	1,064	1,135	-4,190	416,579	623,789	-10,449	211,028	1,149
2004Q4	1,244	1,563	1,032	1,069	1,221	-110,659	466,305	728,626	7,122	172,331	1,171
2005Q1	1,117	1,457	1,021	1,126	1,314	-17,737	427,975	533,525	0,515	146,037	1,183
2005Q2	1,229	1,551	1,004	1,090	1,348	-95,134	470,255	666,492	-17,615	231,057	1,167
2005Q3	1,245	1,527	0,997	1,095	1,344	66,347	463,691	575,723	-37,922	289,483	1,181

APPENDIX 2: UNIT ROOT TESTS

The null hypothesis in all tests is that of a unit root, i.e. non-stationarity.
Test statistics below the critical value (in absolute values) at a certain level indicates insufficient evidence for rejecting the null hypothesis at that level, and vice versa.

EXPORT VOLUMES SERIES

	Test statistics	1% critical value	5% critical value	10% critical value	Note
ADF (intercept and no lags included)	-2.264	-3.716	-2.986	-2.624	Serial correlation test p value = .713*
ADF-GLS	-2.739	-3.770	-3.336	-3.011	
ADF-PERRON**	-4.922	-4.45			Serial correlation test p value = .476*
PP	-2.192	-3.716	-2.986	-2.624	

* INDICATES THAT INCLUDING ADDITIONAL LAGS IS NOT REQUIRED
** THE CRITICAL VALUE IS FROM TABLE IV-A (PERRON, 1989, P. 1376). TIME OF BREAK IS 55% OF THE SAMPLE. CRITICAL VALUES FOR OTHER LEVELS ARE NOT SHOWN AS ARE SMALLER THAN THE ONE SHOWN

IMPORT VOLUMES SERIES

	Test statistics	1% critical value	5% critical value	10% critical value	Note
ADF (intercept and no lags included)	-3.393	-3.716	-2.986	-2.624	Serial correlation test p value = .558*
ADF-GLS	-2.732	-3.770	-3.336	-3.011	
PP	-3.408	-3.716	-2.986	-2.624	

* INDICATES THAT INCLUDING ADDITIONAL LAGS IS NOT REQUIRED

DOMESTIC DEMAND SERIES

	Test statistics	1% critical value	5% critical value	10% critical value	Note
ADF (intercept and 4 lags included)	-2.564	-4.371	-3.596	-3.238	Serial correlation test p value = .259*
ADF-GLS	-2.157	-3.770	-3.082	-2.764	
PP	-3.435	-3.716	-2.986	-2.624	

* INDICATES THAT INCLUDING ADDITIONAL LAGS IS NOT REQUIRED

FOREIGN DEMAND SERIES

	Test statistics	1% critical value	5% critical value	10% critical value	Note
ADF (intercept, 4 lags and trend included; trend significant at 5%)	-3.462	-4.371	-3.596	-3.238	Serial correlation test p value = .286*
ADF-GLS	-3.113	-3.770	-3.082	-2.764	
PP	-1.130	-3.716	-2.986	-2.624	

* INDICATES THAT INCLUDING ADDITIONAL LAGS IS NOT REQUIRED

REAL EFFECTIVE EXCHANGE RATE SERIES

	Test statistics	1% critical value	5% critical value	10% critical value	Note
DF (no intercept, no lags, no trend included)	-2.941	-2.652	-1.950	-1.602	Serial correlation test p value = .614*
ADF-GLS	-3.766	-3.770	-3.336	-3.011	
PP	-2.957	-3.716	-2.986	-2.624	

* INDICATES THAT INCLUDING ADDITIONAL LAGS IS NOT REQUIRED

FIRST DIFFERENCED EXPORT VOLUMES SERIES

	Test statistics	1% critical value	5% critical value	10% critical value	Note
DF (no intercept, no lags, no trend included)	-5.868	-2.652	-1.950	-1.602	Serial correlation test p value = .404*
ADF-GLS	-4.913	-3.770	-3.348	-3.020	
PP	-6.224	-3.723	-2.989	-2.625	

* INDICATES THAT INCLUDING ADDITIONAL LAGS IS NOT REQUIRED

FIRST DIFFERENCED IMPORT VOLUMES SERIES

	Test statistics	1% critical value	5% critical value	10% critical value	Note
DF (no intercept, no lags, no trend included)	-8.442	-2.652	-1.950	-1.602	Serial correlation test p value = .342*
ADF-GLS	-3.324	-3.770	-3.348	-3.020	
PP	-11.986	-3.723	-2.989	-2.625	

* INDICATES THAT INCLUDING ADDITIONAL LAGS IS NOT REQUIRED

FIRST DIFFERENCED FOREIGN DEMAND SERIES

	Test statistics	1% critical value	5% critical value	10% critical value	Note
ADF (intercept and 2 lags included)	-4.028	-3.736	-2.994	-2.628	Serial correlation test p value = .118*
ADF-GLS	-3.990	-3.770	-3.348	-3.020	
PP	-9.397	-3.723	-2.989	-2.625	

* INDICATES THAT INCLUDING ADDITIONAL LAGS IS NOT REQUIRED

FIRST DIFFERENCED DOMESTIC DEMAND SERIES

	Test statistics	1% critical value	5% critical value	10% critical value	Note
DF (no intercept, no lags, no trend included)	-9.516	-2.652	-1.950	-1.602	Serial correlation test p value = .000*
ADF-GLS	-5.308	-3.770	-3.348	-3.020	
PP	-14.617	-3.723	-2.989	-2.625	

* INCLUDING LAGS DID NOT HELP ELIMINATE SERRIAL CORRELATION

FIRST DIFFERENCED REAL EFFECTIVE EXCHANGE RATE SERIES

	Test statistics	1% critical value	5% critical value	10% critical value	Note
DF (no intercept, one lag, no trend included)	-6.709	-2.655	-1.950	-1.601	Serial correlation test p value = .151*
ADF-GLS	-6.649	-3.770	-3.348	-3.020	
PP	-7.156	-3.723	-2.989	-2.625	

* INDICATES THAT INCLUDING ADDITIONAL LAGS IS NOT REQUIRED

APPENDIX 3: ARDL ESTIMATES OF THE TRADE EQUATIONS

Determination of the maximum number of lags in the ARDL

Dependent variable: First difference of log of **IMPORTS**

	1 lag	**2 lags**	**3 lags**	**4 lags**
Constant	5.641	6.251	7.401	4.154
	(3.43)	(2.83)	(2.62)	(0.73)
2001 Crisis Dummy	-0.320	-0.332	-0.374	-0.333
	(4.04)	(3.65)	(3.95)	(3.55)
L. DLOGIM	-0.035	0.004	0.194	-0.292
	(0.15)	(0.01)	(0.52)	(0.51)
L. DREER	-2.213	-3.371	-1.729	-1.044
	(1.64)	(1.97)	(0.71)	(0.39)
L. DLGDP	-1.364	-1.575	-3.052	1.035
	(2.04)	(1.45)	(2.11)	(0.53)
L. LOGIMDOL	-0.934	-1.035	-1.243	-0.666
	(3.40)	(2.77)	(2.60)	(0.69)
L. LNREERI	-1.145	-0.050	-0.982	2.794
	(0.75)	(0.02)	(0.44)	(1.00)
L. LNGDPI	2.209	2.401	3.921	0.302
	(2.48)	(1.72)	(2.23)	(0.10)
L2. DLOGIM		0.201	0.226	-0.429
		(0.78)	(0.72)	(0.82)
L2. DREER		-2.104	-1.904	-3.420
		(1.32)	(0.98)	(1.46)
L2. DLGDP		-0.425	-1.805	1.734
		(0.55)	(1.67)	(1.04)
L3. DLOGIM			0.086	-0.309
			(0.31)	(0.80)
L3. DREER			-1.148	-1.035
			(0.67)	(0.54)
L3. DLGDP			-1.232	0.869
			(1.58)	(0.57)
L4. DLOGIM				-0.442
				(1.48)
L4. DREER				-0.739
				(0.44)
L4. DLGDP				2.358
				(1.71)
Observations	29	28	27	26
SBC	11.50	7.21	4.65	6.77
AIC	16.96	14.54	13.72	17.47
Lagrange multiplier test of residual serial correlation	.359	.653	.062	.027
Ramsey's RESET test for functional form	.109	.192	.179	.550
Normality test, based on a test of skewness and kurtosis of residuals	.612	.713	.886	.426
Heteroskedasticity test (Koenker-Basset)	.452	.551	.786	.400

Absolute value of t statistics in parentheses

Dependent variable: First difference of log of **EXPORTS**

	1 lag	**2 lags**	**3 lags**	**4 lags**
Constant	5.182	5.996	7.070	4.087
	(5.19)	(4.88)	(3.76)	(1.22)
After 2001 Dummy	-0.181	-0.219	-0.285	-0.155
	(3.39)	(4.09)	(3.32)	(1.11)
L. DLOGEX	0.336	0.275	0.265	-0.112
	(2.04)	(1.61)	(1.12)	(0.26)
L. DREER	-0.786	0.502	2.306	-0.445
	(0.75)	(0.38)	(1.12)	(0.14)
L. DFORDEM	-1.415	-2.260	-2.467	-0.713
	(3.38)	(3.73)	(3.55)	(0.47)
L. LOGEXDOL	-0.918	-1.070	-1.273	-0.729
	(5.21)	(4.95)	(3.83)	(1.21)
L. LNREERI	-1.284	-3.021	-4.576	0.223
	(0.95)	(1.73)	(2.06)	(0.05)
L. LNFD2I	1.465	2.010	2.743	1.163
	(4.18)	(4.87)	(3.83)	(0.79)
L2. DLOGEX		-0.002	-0.076	-0.232
		(0.01)	(0.37)	(0.69)
L2. DREER		0.194	1.006	-2.568
		(0.18)	(0.71)	(0.80)
L2. DFORDEM		-0.850	-1.348	-0.296
		(1.37)	(1.48)	(0.22)
L3. DLOGEX			-0.004	-0.106
			(0.02)	(0.40)
L3. DREER			0.222	-1.348
			(0.19)	(0.76)
L3. DFORDEM			-0.619	0.991
			(0.66)	(0.59)
L4. DLOGEX				-0.083
				(0.32)
L4. DREER				-1.688
				(1.01)
L4. DFORDEM				2.011
				(1.23)
Observations	29	28	27	26
SBC	22.66	20.58	16.58	12.45
AIC	28.13	27.90	25.65	23.14
Lagrange multiplier test of residual **serial correlation**	.553	.246	.022	.047
Ramsey's RESET test for **functional form**	.783	.578	.247	.219
Normality test, based on test of skewness and kurtosis of residuals	.733	.412	.175	.025
Heteroskedasticity test (Koenker-Basset)	.917	.446	.499	.900

Absolute value of t statistics in parentheses

The ARDL estimates of the **IMPORT** regression

ARDL (0, 0, 0) selected based on Schwarz Bayesian Criterion

Constant	6.011
	(138.72)
LNGDPI	2.100
	(6.06)
LNREERI	1.196
	(1.22)
Dummy 2001q3	-0.285
	(2.66)
Observations	30
Lagrange multiplier test of residual **serial correlation**	.497
Ramsey's RESET test for **functional form**	.709
Normality test, based on test of skewness and kurtosis of residuals	.585
Heteroskedasticity test (Koenker-Basset)	.826

Absolute value of t statistics in parentheses

The ARDL estimates of the **EXPORT** regression

ARDL (0, 0, 0) selected based on Schwarz Bayesian Criterion

Constant	5.668
	(149.44)
LNFORDEMI	1.508
	(7.92)
LNREERI	-2.243
	(2.49)
After 2001 dummy	-0.224
	(5.72)
Dummy 1999q1	-0.190
	(2.42)
Dummy 1999q2	-0.313
	(3.84)
Observations	30
Lagrange multiplier test of residual **serial correlation**	.265
Ramsey's RESET test for **functional form**	.280
Normality test, based on test of skewness and kurtosis of residuals	.666
Heteroskedasticity test (Koenker-Basset)	.096

Absolute value of t statistics in parentheses

APPENDIX 4: JOHANSEN ESTIMATES OF THE TRADE EQUATIONS

Determination of the order of the VAR for the **IMPORTS**
Dependent variable appearing in heading row

VAR(1)

	LOGIMDOL	**LNREERI**	**LNGDPI**
Constant	4.972	-0.180	0.186
	(2.96)	(0.98)	(0.30)
Dummy 2001q3	-0.314	-0.000	-0.038
	(1.86)	(0.00)	(0.61)
L. LOGIMDOL	0.193	0.029	-0.019
	(0.69)	(0.93)	(0.18)
L. LNREERI	-0.691	0.387	0.141
	(0.45)	(2.31)	(0.25)
L. LNGDPI	0.771	0.050	0.410
	(0.93)	(0.55)	(1.36)
Lagrange multiplier test of residual **serial correlation**	.353	.726	.002
Ramsey's RESET test for **functional form**	.468	.369	.279
Normality test, based on a test of skewness and kurtosis of residuals	.450	.878	.538
Heteroskedasticity test (Koenker-Basset)	.329	.798	.028
Observations	30	30	30

Absolute value of t statistics in parentheses

VAR(2)

	LOGIMDOL	LNREERI	LNGDPI
Constant	4.375	-0.087	-0.680
	(2.11)	(0.37)	(1.04)
Dummy 2001q3	-0.258	0.006	-0.006
	(1.51)	(0.29)	(0.11)
L. LOGIMDOL	0.218	0.021	-0.026
	(0.73)	(0.61)	(0.27)
L. LNREERI	-3.362	0.282	-1.212
	(1.77)	(1.30)	(2.02)
L. LNGDPI	0.621	0.049	0.328
	(0.70)	(0.48)	(1.18)
L2. LOGIMDOL	0.060	-0.010	0.147
	(0.20)	(0.29)	(1.59)
L2. LNREERI	2.608	-0.058	1.289
	(1.52)	(0.30)	(2.39)
L2. LNGDPI	0.831	0.148	0.060
	(1.00)	(1.55)	(0.23)
Lagrange multiplier test of residual **serial correlation**	.856	.123	.166
Ramsey's RESET test for **functional form**	.051	.128	.720
Normality test, based on a test of skewness and kurtosis of residuals	.024	.963	.608
Heteroskedasticity test (Koenker-Basset)	.219	.147	.880
Observations	29	29	29

Absolute value of t statistics in parentheses

VAR(3)

	LOGIMDOL	**LNREERI**	**LNGDPI**
Constant	4.285	-0.191	-0.885
	(1.51)	(0.69)	(0.96)
Dummy 2001q3	-0.168	0.024	-0.007
	(0.83)	(1.22)	(0.11)
L. LOGIMDOL	0.234	0.041	-0.005
	(0.67)	(1.19)	(0.04)
L. LNREERI	-2.975	0.378	-1.208
	(1.40)	(1.82)	(1.76)
L. LNGDPI	0.808	0.021	0.200
	(0.68)	(0.18)	(0.52)
L2. LOGIMDOL	0.247	0.027	0.139
	(0.66)	(0.75)	(1.15)
L2. LNREERI	2.831	-0.027	1.128
	(1.22)	(0.12)	(1.50)
L2. LNGDPI	0.517	0.049	0.048
	(0.52)	(0.51)	(0.15)
L3. LOGIMDOL	-0.182	-0.037	0.022
	(0.53)	(1.12)	(0.20)
L3. LNREERI	1.037	0.301	0.243
	(0.48)	(1.44)	(0.35)
L3. LNGDPI	-0.410	-0.085	-0.002
	(0.42)	(0.90)	(0.01)
Lagrange multiplier test of residual **serial correlation**	.300	.068	.177
Ramsey's RESET test for **functional form**	.443	.063	.516
Normality test, based on a test of skewness and kurtosis of residuals	.015	.993	.599
Heteroskedasticity test (Koenker-Basset)	.445	.869	.796
Observations	28	28	28

Absolute value of t statistics in parentheses

VAR(4)

	LOGIMDOL	LNREERI	LNGDPI
Constant	6.485	0.251	-0.926
	(1.62)	(0.85)	(0.95)
Dummy 2001q3	-0.334	0.024	-0.077
	(1.34)	(1.29)	(1.27)
L. LOGIMDOL	0.157	0.042	0.073
	(0.37)	(1.34)	(0.70)
L. LNREERI	-2.497	0.594	-0.827
	(0.95)	(3.06)	(1.30)
L. LNGDPI	1.001	0.042	-0.005
	(0.73)	(0.41)	(0.02)
L2. LOGIMDOL	0.015	-0.014	0.057
	(0.03)	(0.43)	(0.52)
L2. LNREERI	1.814	-0.165	0.391
	(0.68)	(0.83)	(0.60)
L2. LNGDPI	0.689	0.211	-0.180
	(0.53)	(2.21)	(0.57)
L3. LOGIMDOL	0.002	-0.032	0.044
	(0.00)	(1.06)	(0.44)
L3. LNREERI	-0.785	0.465	-0.642
	(0.26)	(2.11)	(0.88)
L3. LNGDPI	-0.429	-0.093	-0.052
	(0.39)	(1.15)	(0.20)
L4. LOGIMDOL	-0.257	-0.041	-0.015
	(0.67)	(1.43)	(0.16)
L4. LNREERI	1.702	-0.419	0.489
	(0.66)	(2.21)	(0.78)
L4. LNGDPI	1.442	0.139	0.882
	(1.25)	(1.63)	(3.15)
Lagrange multiplier test of residual **serial correlation**	.081	.073	.054
Ramsey's RESET test for **functional form**	.618	.053	.746
Normality test, based on a test of skewness and kurtosis of residuals	.625	.530	.604
Heteroskedasticity test (Koenker-Basset)	.863	.756	.182
Observations	27	27	27

Absolute value of t statistics in parentheses

Determination of the order of the VAR for the **EXPORTS**
Dependent variable appearing in heading row

VAR(1)

	LOGEXDOL	**LNREERI**	**LNFD2I**
Constant	4.697	0.003	0.024
	(4.30)	(0.02)	(0.05)
After 2001 dummy	-0.171	0.005	0.029
	(2.76)	(0.49)	(0.94)
Dummy 1999q1	-0.294	0.001	-0.059
	(2.85)	(0.08)	(1.15)
Dummy 1999q2	-0.158	-0.042	0.020
	(1.44)	(2.20)	(0.38)
L. LOGEXDOL	0.184	-0.001	0.003
	(0.96)	(0.04)	(0.03)
L. LNREERI	-0.379	0.349	-0.139
	(0.32)	(1.70)	(0.24)
L. LNFD2I	0.960	0.026	0.822
	(2.70)	(0.43)	(4.68)
Lagrange multiplier test of residual **serial correlation**	.073	.048	.000
Ramsey's RESET test for **functional form**	.693	.718	.799
Normality test, based on a test of skewness and kurtosis of residuals	.182	.999	.742
Heteroskedasticity test (Koenker-Basset)	.103	.705	.150
Observations	30	30	30

Absolute value of t statistics in parentheses

VAR(2)

	LOGEXDOL	LNREERI	LNFD2I
Constant	5.392	0.042	0.348
	(5.41)	(0.19)	(0.81)
After 2001 dummy	-0.194	0.004	0.016
	(3.67)	(0.35)	(0.69)
Dummy 1999q1	-0.136	0.003	0.013
	(1.38)	(0.12)	(0.30)
Dummy 1999q2	-0.141	-0.040	0.007
	(1.41)	(1.88)	(0.16)
L. LOGEXDOL	0.312	-0.006	0.026
	(1.61)	(0.14)	(0.31)
L. LNREERI	-1.353	0.364	-0.512
	(1.21)	(1.50)	(1.05)
L. LNFD2I	0.087	-0.036	0.201
	(0.19)	(0.38)	(1.04)
L2. LOGEXDOL	-0.258	-0.003	-0.082
	(1.56)	(0.08)	(1.15)
L2. LNREERI	0.780	-0.222	0.141
	(0.73)	(0.97)	(0.31)
L2. LNFD2I	1.239	0.100	0.793
	(2.95)	(1.10)	(4.35)
Lagrange multiplier test of residual **serial correlation**	.842	.396	.543
Ramsey's RESET test for **functional form**	.028	.283	.472
Normality test, based on a test of skewness and kurtosis of residuals	.213	.559	.880
Heteroskedasticity test (Koenker-Basset)	.394	.906	.834
Observations	29	29	29

Absolute value of t statistics in parentheses

VAR(3)

	LOGEXDOL	LNREERI	LNFD2I
Constant	5.941	-0.100	0.405
	(4.60)	(0.39)	(0.73)
After 2001 dummy	-0.222	0.011	0.023
	(4.02)	(0.98)	(0.99)
Dummy 1999q1	-0.087	-0.014	0.011
	(0.79)	(0.63)	(0.23)
Dummy 1999q2	-0.097	-0.050	-0.012
	(0.94)	(2.47)	(0.26)
L. LOGEXDOL	0.171	0.027	0.050
	(0.78)	(0.64)	(0.54)
L. LNREERI	-1.943	0.552	-0.533
	(1.50)	(2.16)	(0.96)
L. LNFD2I	-0.193	0.054	0.387
	(0.34)	(0.47)	(1.58)
L2. LOGEXDOL	-0.248	0.003	-0.041
	(1.20)	(0.07)	(0.46)
L2. LNREERI	-0.187	-0.009	0.694
	(0.15)	(0.04)	(1.27)
L2. LNFD2I	1.318	0.087	0.752
	(2.80)	(0.94)	(3.75)
L3. LOGEXDOL	0.024	-0.011	-0.073
	(0.13)	(0.31)	(0.95)
L3. LNREERI	-0.062	0.147	-0.224
	(0.05)	(0.64)	(0.45)
L3. LNFD2I	0.694	-0.216	-0.239
	(1.07)	(1.70)	(0.87)
Lagrange multiplier test of residual **serial correlation**	.415	.112	.226
Ramsey's RESET test for **functional form**	.069	.004	.310
Normality test, based on a test of skewness and kurtosis of residuals	.059	.773	.547
Heteroskedasticity test (Koenker-Basset)	.598	.129	.415
Observations	28	28	28

Absolute value of t statistics in parentheses

VAR(4)

	LOGEXDOL	LNREERI	LNFD2I
Constant	7.017	0.533	0.804
	(3.42)	(1.71)	(1.01)
After 2001 dummy	-0.286	-0.012	-0.006
	(3.03)	(0.81)	(0.15)
Dummy 1999q1	-0.038	-0.004	0.048
	(0.29)	(0.18)	(0.94)
Dummy 1999q2	-0.075	-0.033	0.018
	(0.59)	(1.71)	(0.37)
L. LOGEXDOL	-0.026	-0.029	-0.047
	(0.08)	(0.60)	(0.37)
L. LNREERI	-2.107	0.582	-0.557
	(1.47)	(2.68)	(1.00)
L. LNFD2I	0.295	0.155	0.696
	(0.33)	(1.14)	(2.01)
L2. LOGEXDOL	-0.317	-0.040	-0.048
	(1.30)	(1.08)	(0.51)
L2. LNREERI	-0.883	-0.370	0.128
	(0.53)	(1.46)	(0.20)
L2. LNFD2I	1.060	-0.042	0.512
	(1.28)	(0.34)	(1.60)
L3. LOGEXDOL	0.083	0.039	-0.100
	(0.34)	(1.05)	(1.08)
L3. LNREERI	-0.863	0.108	-0.471
	(0.53)	(0.44)	(0.75)
L3. LNFD2I	0.658	-0.274	-0.378
	(0.85)	(2.32)	(1.26)
L4. LOGEXDOL	0.003	-0.065	0.050
	(0.02)	(1.96)	(0.60)
L4. LNREERI	0.147	-0.206	-0.685
	(0.11)	(1.00)	(1.30)
L4. LNFD2I	0.545	0.351	0.518
	(0.54)	(2.28)	(1.32)
Lagrange multiplier test of residual **serial correlation**	.022	.002	.107
Ramsey's RESET test for **functional form**	.681	.082	.021
Normality test, based on a test of skewness and kurtosis of residuals	.054	.927	.551
Heteroskedasticity test (Koenker-Basset)	.469	.723	.461
Observations	27	27	27

Absolute value of t statistics in parentheses