FIW – Working Paper

FIW Working Paper N° 106
March 2013

AGGREGATION BIAS IN TRADE ELASTICITIES: THE CASE OF MACEDONIA

Branimir Jovanovic[1]

Abstract

This paper evaluates the bias which may occur when trade elasticities are estimated using data on aggregate trade, instead of using data on bilateral trade. The exercise is done on the case of Macedonia. Elasticities obtained from aggregate-trade data, using the Autoregressive Distributed Lag approach, are compared with the elasticities obtained from bilateral-trade data, using dynamic heterogenous panels techniques. Results point out that the aggregation bias is sizeable and that relying on aggregate data can lead to wrong conclusions about the trade elasticities.

JEL: F10, F14, F4
Keywords: trade elasticities, aggregation bias, dynamic panel, heterogenous panel, ARDL, Macedonia

Author

[1] University of Rome "Tor Vergata", National Bank of the Republic of Macedonia, E-mail: branimir.jovanovic@uniroma2.it

AGGREGATION BIAS IN TRADE ELASTICITIES: THE CASE OF MACEDONIA*

Branimir Jovanovic

PhD candidate, University of Rome "Tor Vergata"

Analyst, National Bank of the Republic of Macedonia

branimir.jovanovic@uniroma2.it

October 30, 2012

ABSTRACT

This paper evaluates the bias which may occur when trade elasticities are estimated using data on aggregate trade, instead of using data on bilateral trade. The exercise is done on the case of Macedonia. Elasticities obtained from aggregate-trade data, using the Autoregressive Distributed Lag approach, are compared with the elasticities obtained from bilateral-trade data, using dynamic heterogenous panels techniques. Results point out that the aggregation bias is sizeable and that relying on aggregate data can lead to wrong conclusions about the trade elasticities.

Keywords: trade elasticities, aggregation bias, dynamic panel, heterogenous panel, ARDL, Macedonia

JEL classification: F10, F14, F4

I. Introduction

Trade elasticities show how exports and imports respond to changes in economic activity (income) and the real exchange rate (relative prices). Consequently, they are very important for the

*The author would like to thank Matthieu Bussiere for very useful suggestions.

policy makers because they basically show if depreciation of the exchange rate can have positive effects on the trade balance and how the economy would respond to various demand shocks. They further have implications for the choice of the optimal exchange-rate regime. After being in the focus of the economic discipline in the 70s and 80s (Houthakker and Magee, 1969, Goldstein and Khan, 1985), researchers' interest in them started reviving again recently, due to the global crisis and the great trade collapse (see Bussiere et al. 2011, Cheung et al. 2012).

Traditionally, trade elasticities have been estimated using aggregate data: total exports are regressed on a foreign-demand variable (i.e. trade-weighted foreign GDP) and relative-prices variable (i.e. real effective exchange rate), while total imports are regressed on domestic GDP and the real effective exchange rate. However, estimating trade elasticities using aggregate data can be problematic for countries with short time series. In addition, as Marquez (2005) has argued, using aggregate data on trade can lead to wrong estimates of the elasticities, due to the aggregation bias.

The aim of this paper is to evaluate the conventional approach to estimating trade elasticities using aggregate data, through the prism of the aggregation bias. Towards that end, it will first estimate price and income elasticities of Macedonian exports and imports using data on *aggregate* trade, using the Autoregressive Distributed Lag technique. Then, it will estimate the elasticities using data on *bilateral* trade, using dynamic heterogenous panels techniques. Finally, it will compare these two.

Results indicate that the aggregation bias in Macedonian trade elasticities is sizeable, and that relying on aggregate-trade data can lead to wrong conclusions, and possibly, suboptimal policy decisions. Hence, we propose using bilateral-trade data for estimating trade elasticities.

The paper is structured as follows. Section II briefly surveys the existing literature on estimating trade elasticities, on Macedonian trade elasticities and on the aggregation bias. Section III estimates trade elasticities using aggregate data, while section IV estimates the trade elasticities using bilateral trade data. The final section concludes.

II. Literature review

II.A. Trade elasticities

Rich literature exists on econometric modelling of exports and imports. Some of the studies include Houthakker and Magee (1969), Goldstein and Khan (1978, 1982 and 1985), Krugman (1989), Holly and Wade (1991), Riedel (1984 and 1988), Muscatelli et al. (1990a and 1990b). The traditional approach is to model them as a *demand function* (see Houthakker and Magee, 1969, Goldstein and Khan, 1985), assuming that supply can meet whatever quantity is demanded. Econometrically, this approach to modelling implies regressing total exports/imports on an income variable (usually GDP) and price variable (relative prices, i.e. real exchange rate). Goldstein and Khan (1978), however, argue that supply conditions can be as much important for the exports as the demand conditions, especially for small countries: there is always demand for the exports of the small countries, because of their small size, so their exports depend on their supply. Recently, Bussiere et al. (2011) revisited the question of how properly to estimate trade elasticities in the light of the trade collapse during the global crisis, arguing that the demand variable should be a weighted average of the various GDP components, due to the fact that different components have different import intensity. Imbs and Mejean (2010) estimate price elasticities of exports and imports for 33 countries using a novel approach - using elasticities of substitution between different goods, obtained from ComTrade data. Cheung et al. (2012), in the context of the global saving glut discussion, estimate trade elasticities for China, in order to assess whether appreciation of the Chinese currency would lead to adjustment in international trade flows.

II.B. Macedonian trade elasticities

Several existing studies estimate some form of trade elasticities for Macedonia – Jovanovic (2007), Jovanovic and Petreski (2008), Kadievska-Vojnovic and Unevska (2008). Their results point to different conclusion about the relative magnitude of the Macedonian elasticities, as can be seen from Table 1.

Table 1: Macedonian trade elasticities from existing studies

Study		Income	Price
Jovanovic (2007)	Imports	2.1 and 2.5	1.2 and 1.3
	Exports	1.5 and 1.6	-2.2 and -2.8
Kadievska-Vojnovic and	Imports	3.5	1.6[1]
Unevska (2007)	Exports	1.5	-0.7
Jovanovic and Petreski (2008)	Imports	1.4	0
	Exports	4.7	-1.5

Regarding imports, the income elasticity is estimated in the range 1.4-3.5, while the price elasticity ranges from 0 to 1.6. Income elasticity of exports ranges from 1.5 to 4.7, while exports price elasticity is in between -0.7 and -2.8. These differences are to some extent a consequence of the different ways the variables have been constructed in the studies: different studies include different countries with different weights in the construction of the foreign demand and the relative prices variables. Also, they might be due to the different period which they refer to or due to different econometric techniques used. Finally, they might also be due to the low number of observations and the insufficient variability in the aggregate data.

II.C. Aggregation bias

Aggregation bias is first discussed by Theil (1954), who defines it as a systematic deviation of the macro parameters from the average of the corresponding micro parameters. It has received a lot of attention in the literature; see, for instance, Malinvaud (1956), Grunfeld and Griliches (1960), Orcutt et al. (1968), Gupta (1971), Lee et al. (1990). More recently, its presence and implications have been investigated in many areas - Lee (1997) evaluates its consequences for forecasting output growth, Teulings (2000) discusses it in the substitution of labour, while Hahn (2004) - in the demand for labour demand. Altissimo et al. (2007) and Byrne and Fiess (2010) discuss aggregation bias in inflation, Imbs et al. (2005) and Robertson et al. (2009) discuss it

1. This coefficient in the original study is -1.6, but the definition of the price variable is opposite of the other two studies, so it is multiplied by -1 here, to enable comparison.

in the light of the Purchasing Power Parity hypothesis, while Kelaher and Sarafidis (2011) in the relationship between crime and punishment. However, only two studies, at least to our knowledge, discuss aggregation bias in trade elasticities - Marquez (2005), who discusses it in the US trade in services and Kaplan and Kalyoncu (2011), who discuss the effects of devaluation on the trade balance.

III. Elasticities from aggregate-trade data

III.A. Data

The data refer to the period 1998Q1-2011Q2. The analysis features six variables: five basic (real exports, real imports, foreign demand, Macedonian GDP, real effective exchange rate) and one additional variable for the exports, capturing the supply side (industrial production). The data are from the National Statistical Office and the National Bank of Macedonia. They are all in real terms and have been seasonally adjusted. The foreign demand and the real effective exchange rate (REER) are those used by the Macedonian central bank in its decision-making process, regularly reported in the central bank reports; increase in the REER stands for real appreciation[2]. The series are shown on Figure I in the Appendix. They are all integrated of order one (formal stationarity tests are available upon request), hence - suitable for cointegration analysis.

III.B. Estimation technique

We will be using the Autoregressive Distributed Lag (ARDL) approach to cointegration, developed by Pesaran and Shin (1997) and Pesaran, Shin and Smith (2001) to estimate the trade elasticities from aggregate data. This techniques is considered to possess solid small-sample properties. The Johansen technique (Johansen, 1988, 1991) was also tried, but its results did not seem to be robust, which may be due to the short sample that we have.

The ARDL technique is based on an OLS estimation of a regression where the dependent variable is regressed on its own lags and current and lagged values of the explanatory variables:

2. The foreign demand is constructed as a weighted average of the real GDP of the following 9 countries: Germany, Greece, Italy, Netherlands, Belgium, Spain, Serbia, Croatia, Bulgaria. Weights are the normalized shares in the exports in 2005-2010.
The REER is based on the Producer Price Index. It is constructed as a weighted average of the real exchange rates against the following 12 countries: Austria, Bulgaria, Croatia, Germany, Greece, Italy, Netherlands, Russia, Slovenia, Turkey, USA and Serbia. The weights are the shares in the total trade in 2006.

$$y_t = \sum_{j=1}^{p} \lambda_j y_{t-j} + \sum_{h=0}^{q} \delta_h x_{t-h} + \mu + \epsilon_t \tag{1}$$

where y is the dependent variable, x is a vector of explanatory variables, t is the time index, μ is the contant term, ϵ are the residuals, λ are the coefficients of the lags of the dependent variable and δ are the coefficients of the explanatory variables. The above ARDL is said to be of order $(p, q, q, ...)$, since there are p lags of the dependent variable in the regression and q lags of the explanatory variables (it is not required that all explanatory variables are included with same number of lags).

The above equation can be rewritten as:

$$\Delta y_t = \phi y_{t-1} + \gamma x_t + \sum_{j=1}^{p-1} \lambda_j^* \Delta y_{t-j} + \sum_{h=0}^{q-1} \delta_h^* \Delta x_{t-h} + \mu + \epsilon_t \tag{2}$$

For example, let us rewrite the ARDL(2,2) model:

$$y_t = \alpha_o + \alpha_1 y_{t-1} + \alpha_2 y_{t-2} + \beta_1 x_t + \beta_2 x_{t-1} + \beta_3 x_{t-2} + \mu + \epsilon_t$$

Substract y_{t-1} from both sides:

$$\begin{aligned} y_t - y_{t-1} &= \alpha_o + \alpha_1 y_{t-1} - y_{t-1} + \alpha_2 y_{t-2} \\ &\quad + \beta_1 x_t + \beta_2 x_{t-1} + \beta_3 x_{t-2} + \mu + \epsilon_t \end{aligned}$$

Rewrite y_{t-2} as $y_{t-1} - \Delta y_{t-1}$,x_t as $x_{t-1} + \Delta x_t$ and x_{t-2} as $x_{t-1} - \Delta x_{t-1}$:

$$\begin{aligned} y_t - y_{t-1} &= \alpha_o + \alpha_1 y_{t-1} - y_{t-1} + \alpha_2 (y_{t-1} - \Delta y_{t-1}) \\ &\quad + \beta_1 (x_{t-1} + \Delta x_t) + \beta_2 x_{t-1} + \beta_3 (x_{t-1} - \Delta x_{t-1}) + \mu + \epsilon_t \end{aligned}$$

Collect terms, to get the representation from equation (2):

$$(3) \quad \Delta y_t = \alpha_o + (\alpha_1 + \alpha_2 - 1)y_{t-1} + (\beta_1 + \beta_2 + \beta_3)x_{t-1} - \alpha_2 \Delta y_{t-1} + \beta_1 \Delta x_t - \beta_3 \Delta x_{t-1} + \mu + \epsilon_t$$

In this representtion, the terms in first differences give the short-run dynamics, while the terms in levels give the long-run relationship.

There are several steps in applying the ARDL technique. First, the maximum number of lags of the variables that should be included is determined. This is done on the ground of the standard information criteria, but also on the grounds of the residual tests, since the residuals need to be independent and identically distributed (see Pesaran and Shin, 1997). Then, cointegration is tested by testing the significance of the coefficients in front of the levels of the variables in equation 3. Finally, the exact number of lags od each variable is determined, on the grounds of the information criteria, and the long-run and short-run equations are obtained.

To conserve space, we will not report the details of the first two steps. Suffice it to say that up to 1 lag of the variables will be included, and that the cointegration test indicated that the variables are cointegrated, both in the exports and in the imports case.

III.C. Results

The results of the **exports** equation are discussed first. The initial specification, which featured one lag of the exports and of the REER, is shown below[3].

$$\begin{aligned}
\text{Long-run relationship} &: \\
log(exports) &= 3.2^{***} \cdot log(foreign_demand) + 2.2^{*} \cdot log(REER) \\
\text{Short-run relationship} &: \\
dlog(exports) &= -0.22^{***} \cdot ECM + 3.1^{**} \cdot dlog(foreign_demand) \\
&\quad +0.5 \cdot dlog(REER)
\end{aligned}$$

3. The constant term is omitted, for clarity. The residuals of this regression were well behaved - the hypotheses of normality, homoscedasticity and absence of serial correlation could not be rejected.

The first thing to be noted from the results is the implausible positive coefficient in front of the REER, which suggests that exports increase by 2.2% when the real exchange rate appreciates by 1%. The positive price elasticity could be due to the omission of some important variables which are positively correlated with both the exports and the real exchange rate. One such variable come to mind – industrial production. As noted in the literature review section, supply is important determinant of exports in small countries, and this is particularly evident in Macedonia, where restarting some big production capacities in the 2002-2006 period lead to an increase in both the industrial production and the exports. Since industrial production is positively correlated with the the REER and with the exports, its ommission could bias the REER coefficient upwards.The results with the industrial production are shown next.[4]

$$
\begin{aligned}
\text{Long-run relationship} \quad &: \\
log(exports) \quad &= \quad 2.5^{***} \cdot log(foreign\_demand) + 1.5 \cdot log(REER) \\
&\quad\quad +0.7^{*} \cdot log(industrial) \\
\text{Short-run relationship} \quad &: \\
dlog(exports) \quad &= \quad -0.2^{***} \cdot ECM + 2.9^{***} \cdot dlog(foreign\_demand) \\
&\quad\quad +0.4 \cdot dlog(REER) + 0.2 \cdot d\log(industrial)
\end{aligned}
$$

The positive and significant coefficient in front of the industrial production in the long-run equation gives some evidence in favour of the thesis that supply factors explain aggregate Macedonian exports. The GDP coefficient drops slightly, to 2.5, and the REER coefficient becomes insignificant when the industrial production is included. Hence, these results would suggest that Macedonian exports are highly income elastic, increasing by 2.5% when foreign demand increases by 1%, and price inelastic, i.e. insensitive to real exchange rate movements.

The **imports** equation is examined next. The results are shown below[5].

4. The constant is not shown, for clarity. One lag of the exports and of the REER was included. The residuals of this regression were well behaved - the hypotheses of normality, homoscedasticity and absence of serial correlation could not be rejected.

5. Constant not shown, for clarity. One lag of the imports and of the GDP was included. The residuals of this regression were well behaved - the hypotheses of normality, homoscedasticity and absence of serial correlation could not be rejected.

$$
\begin{aligned}
\text{Long-run relationship} &: \\
log(imports) &= 1.6^{***} \cdot log(GDP) + 0.1 \cdot log(REER) \\
\text{Short-run relationship} &: \\
dlog(imports) &= -0.46^{***} \cdot ECM + 1.6^{***} \cdot dlog(GDP) \\
&\quad +0.15 \cdot dlog(REER)
\end{aligned}
$$

.

The results suggest that the income elasticity of the imports is 1.6 while the price elasticity is zero (insignificant).

IV. Elasticities from bilateral-trade data

IV.A. Advantages of using bilateral data

The first advantage of working with disaggregated data, i.e. data on bilateral trade, is that the researcher can identify the homogeneity of the coefficients by different countries, i.e. the presence of the aggregation bias. There can be several additional econometric advantages. First, the number of observations increases greatly, by a factor equal to the number of countries included in the analysis (in our case, roughly by 25 times). More observations further translate into more variability, which may imply more precise estimates.[6] Second, the demand approach to modelling exports and imports is more appropriate when the analysis is done on a country-by-country level, than on an aggregate level. On aggregate level supply factors can also be very important, and failure to control for this can lead to biased estimates. Finally, working with disaggregated data has an advantage that the results are less likely to be biased by the endogeneity between the dependent variable and the regressors. For instance, exports can affect the REER - higher exports imply higher domestic prices, which translates into higher REER, and imports affect the domestic GDP, since they are part of it. These biases will be much smaller in the disaggregated analysis,

6. For instance, while the coefficient of variation of the real effective exchange rate used in the aggregate analysis is only 8%, the coefficient of variation of the corresponding variable from the bilateral-trade analysis (the bilateral real exchange rate) is 20% (see Tables 7 and 8 in the Appendix).

since trade with one country is much less likely to affect domestic GDP and the price level than aggregate trade.

On the other hand, the main problem with working with bilateral-trade data is that these data can often be noisy, because of factors which are not taken into account in the analysis (certain administrative and political factors, one-time shocks etc.). Therefore, one must carefully examine the data prior to the analysis, to make sure that there are no huge outliers or structural breaks.

IV.B. Data

Quarterly data will be employed in the analysis. The structure of the regressions remains as previously explained. The main sources of data are the International Financial Statistics (IFS) and the Directions od Trade Statistics (DOTS) of the International Monetary Fund. Data on exports/imports by countries are from DOTS. Data on GDP, PPI (producer price index) and the nominal exchange rate are from IFS.

Data on exports/imports from DOTS are nominal, so they were deflationed by dividing with the Macedonian PPI index. This is only an approximation, but, arguably, it is as good as one could get. The real exchange rate is based on PPI and is constructed so that increase stands for real appreciation (i.e. RER=domestic PPI * nominal exchange rate/foreign PPI).

The countries were selected on the grounds of their share in Macedonian exports/imports for the period 1997-2010. First, 30 countries with highest shares were selected. Then, countries which did not have quarterly data were discarded (China and Kosovo). Finally, some countries which had high shares for only some periods and negligible shares for the majority of the perids were left out (India in the exports, Poland, Romania, Hungary, UK and Kazakhstan in the imports). This, as already discussed, is very important, because high jumps in the series, driven by exceptional factors, can potentially bias the results. The finally-chosen countries are reported in Table 2; 27 countries are included in the exports analysis and 25 in the imports.

Table 2: Exports and imports by countries

Exports		Imports	
Country	Share (%)	Country	Share (%)
Germany	18.13	Germany	11.3
Serbia*	14.92	Russia	10.4
Greece	11.4	Greece	8.83
Italy	8.05	Serbia*	6.66
Bulgaria	5.75	Italy	5.97
Croatia	4.81	Bulgaria	5.66
US	3.87	Slovenia	4.55
Netherlands	2.61	Ukraine	3.36
Bosnia	2.37	Croatia	2.44
Belgium	2.26	US	2.26
UK	2.07	Switzerland	2.17
Slovenia	2.03	Austria	2.12
Albania	1.97	France	1.9
Spain	1.94	Netherlands	1.73
Switzerland	1.35	Brazil	1.2
France	1.16	Japan	0.89
Russia	1.06	Spain	0.88
Austria	0.71	Czech	0.86
Romania	0.59	Sweden	0.85
Montenegro	0.43	Korea	0.81
Portugal	0.4	Belgium	0.7
Sweden	0.37	Slovakia	0.47
Czech	0.36	India	0.41
Poland	0.32		
Slovakia	0.23		
Hungary	0.21		
Ukraine	0.2		
Total	89.58	Total	76.42

*Serbian data until 2009 include trade with Kosovo.

The plots of the variables are given in the Appendix (Figures II-VII). All the variables are non-stationary (results of the formal unit root tests are available on request).

IV.C. Estimation technique

Two features of our dataset determine the appropriate estimation technique. The first is that our panels consist of, roughly, 25 cross sections and 50 periods, i.e. are "moderate N, moderate T", which suggests that the coefficients might differ across groups. The second one is that our variables are non-stationary. Dynamic heterogenous panels techniques are appropriate in such cases (see Pesaran and Smith, 1995, Pesaran, Shin, Smith, 1999 and Blackburne and Frank, 2007). These techniques are based on the ARDL approach that was explained above, adapted to the panel case. Hence, the main equation is:

$$\Delta y_{it} = \phi_i y_{i,t-1} + \gamma_i x_{it} + \sum_{j=1}^{p-1} \lambda_{ij}^* \Delta y_{i,t-j} + \sum_{h=0}^{q-1} \delta_{ih}^* \Delta x_{i,t-h} + \mu_i + \epsilon_{it} \tag{4}$$

where the index i represents the cross-sectional units, and the other symbols are as above.

Three different dynamic heterogenous methods exist: dynamic fixed effects (DFE), the mean group (MG) estimator of Pesaran and Smith (1995) and the pooled mean group (PMG) estimator of Pesaran, Shin and Smith (1999). The DFE assumes homogenous coefficients across all the cross sections, i.e. $\phi_i, \gamma_i, \lambda_{ij}^*$ and δ_{ih}^* from equation 4 are same for all i. The MG assumes different coefficients for every cross section (i.e. $\phi_i, \gamma_i, \lambda_{ij}^*$ and δ_{ih}^* are different for all i) and the PMG assumes that the *short-run coefficients differ between the units*, while the *long-run coefficients are same for all units* (i.e. ϕ_i and γ_i are same, λ_{ij}^* and δ_{ih}^* are different for different i).

The test of the appropriate of the three estimators is, at the same time, a test for the presence of the aggregation bias - if the DFE turns out to be the most appropriate method, that it can be said that there is no aggregation bias; if the MG or the PMG are selected, then it can be said that there is aggregation bias (see Theil, 1954, and Lee at al., 2000, for tests of aggregation bias). We will first compare the MG and the PMG estimators, and will use the familiar Hausman test to discriminate between them. Namely, under the null hypothesis of homogeneity of the coefficients, the PMG estimates are efficient and consistent, while the MG are only consistent. On the other hand, if the long-run coefficients are different between cross sections, the PMG is inconsistent, while MG is still consistent. Hence, if the difference between the two estimators is statistically significant, this means that the consistent estimator is prefered (MG in our case) and if the difference is insignificant, the efficient estimator (PMG in our case) is preferred . If the PMG turns out to be preferred in this first step, we will then compare the PMG and the DFE in the same way - if they are different, this would imply that the PMG is preferred.

IV.D. Results

The application of the heterogenous panels estimators is similar to the time-series ARDL explained previously. The first step is to determine the appropriate lag length, trying to make sure that the residuals are serially uncorrelated and uncorrelated between different cross sections. However, we could not achieve this even when we included 5 lags from all the regressors, so we continued the analysis with the lag order suggested by the information criteria (we will return to this issue with the residuals later). Three criteria were consulted when the number of lags was decided - the Schwarz IC, the Akaike IC and the $\overline{R}^2$. We estimated regression for each individual country allowing for up to 4 lags of each explanatory variable. Then, we chose the optimal number of lags for each country - we determined which lag structure is suggested by most of the criteria (if all criteria gave different suggestions, we chose the lag structure suggested by the Schwarz IC). Finally, we saw which option is most common (i.e. which option is optimal for most of the countries). Results are in the Appendix (Tables 9 and 10), and the choice was (1,0,0) for both the exports and the imports, i.e. 1 lag of the trade variable and no lags of the price and income variable. The residuals from these regressions are shown in the Appendix (Figures VIII and IX), just to gain some insight about the seriousness of the serial correlation and the cross-equations correlation. Our subjective judgement is that serial correlation seems to be present only in some cases, and even then – it is not that strong. We also tested if the residuals were stationary, the null of unit root was strongly rejected.

The next step is to test for cointegration. Slighly differently from the time-series case, cointegration in the panel case is tested by the test developed by Westerlund (2007), which is based on testing the significance of the error correction mechanism from the error correction transformation of the ARDL model. The results are shown in Table 3 and indicate that the null of no cointegration can be rejected[7].

TABLE 3: WESTERLUND TEST FOR COINTEGRATION.

H_0: NO COINTEGRATION.

Exports		Imports	
Test	P value	Test	P value
Gt	0.00	Gt	0.00
Ga	0.00	Ga	0.00
Pt	0.00	Pt	0.00
Pa	0.00	Pa	0.00

The results of the PMG estimator for the exports are shown below. Here we show only the aggregate short-run results, the results for each country are not reported, to conserve space, but are available upon request.

$$\begin{aligned}
\text{Long-run relationship} &: \\
log(exports) &= 1.9^{***} \cdot log(GDP) - 0.4^{*} \cdot log(RER) \\
\text{Short-run relationship} &: \\
dlog(exports) &= -0.26^{***} \cdot ECM + 2.9^{**} \cdot dlog(GDP) \\
&\quad +0.64 \cdot dlog(RER)
\end{aligned}$$

***, **, * denotes significance at 1%, 5% and 10%, respectvely. Period of estimation: 1995Q1-2011Q2, 1301 observations. Number of cross sections: 27. Observations per cross section: min 16, max 66, average 48. Log likelihood: -260.6; after 8 iterations. The short-run coefficients are the averages. The regression includes a dummy which takes value of 1 for Serbia, for 2007 and 2008 (not shown, for clarity).

The aggregate MG results are shown below. Usually, the MG estimates are the unweighted averages of the coefficients from each cross section regression. Here we present the weighted averages, since this is more appropriate given our interpretation of the long-run coefficients as an

7. We allowed for a constant in the long-run regression and limited the number of lags to 1, as this was suggested by the information criteria from above.

aggregate trade elasticities. The weights that are used are the shares of each corresponding country in total exports/imports, shown previously. The estimates of the individual regressions are not shown, due to space limitation, but are available upon request.

$$\begin{aligned}
\text{Long-run relationship} &: \\
log(exports) &= 2.8^{***} \cdot log(GDP) - 0.6^{*} \cdot log(RER) \\
\text{Short-run relationship} &: \\
dlog(exports) &= -0.45^{***} \cdot ECM + 2.9^{**} \cdot dlog(GDP) \\
&\quad +0.07 \cdot dlog(RER)
\end{aligned}$$

***, **, * denotes significance at 1%, 5% and 10%, respectvely. Period of estimation: 1995Q1-2011Q2, 1301 observations. Number of cross sections: 27. Observations per cross section: min 16, max 66, average 48. The regression for Serbia includes a dummy which takes value of 1 in 2007 and 2008, to control for some high values of exports (not shown, for clarity).

The PMG and MG coefficients seem fairly similar: 1.9 vs 2.8 for the income elasticity of exports and -0.4 vs. -0.6 for the price elasticity. As already said, we distinguish between the two on the grounds of the Hausman test. The p value of the Hausman test was 0.43, which means that we cannot reject the null hypothesis that the estimates are same, so we choose the PMG.

Next, we compared the PMG estimates with the DFE, to see if the short-run coefficients are maybe homogenous, too. The DFE results are:

$$\begin{aligned}
\text{Long-run relationship} &: \\
log(exports) &= 1.4^{***} \cdot log(GDP) - 2.0^{***} \cdot log(RER) \\
\text{Short-run relationship} &: \\
dlog(exports) &= -0.23^{***} \cdot ECM + 0.3 \cdot dlog(GDP) \\
&\quad +0.5 \cdot dlog(RER)
\end{aligned}$$

The p-value of the Hausman test of the difference between the PMG and the DFE was 0.04, which means that we can reject the null that the two estimators are same, i.e. we prefer the PMG results.

Therefore, we could say that exports are highly income-elastic, increasing by 1.9% in the long run when foreign demand increases by 1%. The high income elasticity, which points out to high sensitivity to external shocks, becomes more apparent when the short-run income elasticity is observed (it is around 3). This is in accordance with the behaviour of the exports during the crisis of 2008-9, when exports fell substantially, particularly in the begining of the crisis. On the other hand, the price-elasticity is low, implying that exports increase by 0.4 in the long-run when the price competitiveness improves by 1%. This points out that improving price competitiveness, through exchange rate depreciation for example, will lead only to minor improvements in the exports. This is in accordance with the devaluation episode from 1997, when the 17%-devaluation of the currency did not result in any significant improvements in the trade balance.

Regarding the aggregation bias, the fact that the PMG was preferred to the DFE points out that there is an aggregation bias in the exports trade elasticities. Comparing the PMG results with those obtained from aggregate data, one can note that the price and income elasticity from the aggregate data are biased upwards - the income elasticity was estimated to be around 2.5, instead of 1.9, while the price elasticity was estimated at zero, instead of -0.4.

The imports results are shown next. We first present the PMG results.

$$
\begin{aligned}
\text{Long-run relationship} \quad &: \\
log(imports) \quad &= \quad 1.5^{***} \cdot log(GDP) - 0.6^{**} \cdot log(RER) \\
\text{Short-run relationship} \quad &: \\
dlog(imports) \quad &= \quad -0.37^{***} \cdot ECM + 1.1^{***} \cdot dlog(GDP) \\
&\quad\quad -0.38 \cdot dlog(RER)
\end{aligned}
$$

***, **, * denotes significance at 1%, 5% and 10%, respectvely. Period of estimation: 1997Q1-2011Q2, 1245 observations. Number of cross sections: 23. Observations per cross section: min 17, max 57, average 54. Log likelihood: -14.8; after 10 iterations.

The weighted MG results are:

$$\begin{aligned}
\text{Long-run relationship} &: \\
log(imports) &= 1.9^{***} \cdot log(GDP) + 0.5 \cdot log(RER) \\
\text{Short-run relationship} &: \\
dlog(imports) &= -0.49^{***} \cdot ECM + 0.8^{***} \cdot dlog(GDP) \\
&\quad -0.57 \cdot dlog(RER)
\end{aligned}$$

***, **, * denotes significance at 1%, 5% and 10%, respectvely. Period of estimation: 1997Q1-2011Q2, 1245 observations. Number of cross sections: 23. Observations per cross section: min 17, max 57, average 54.

The p-value of the Hausman test is 0.02, which means that the null hypothesis of equality between the PMG and the MG imports coefficients can be rejected with very small probability of making an error. In other words, the MG estimates are prefered. This is not strange, since long-run-coefficient homogenity in the imports equation implies similar shares of imports from all countries, in the long run (since the demand variable for all countries is the same – Macedonian GDP), something which is not observed in the data.

So, similarly to the exports, imports appear to have high income elasticity (1.9), and low price elasticity (0.5). The income elasticity of 1.9 is above 1, which is usually considered to be questionable, since it implies that the ratio of imports to GDP whould be above 100% in the long run (the Houthakker-Magee puzzle). However, we do not consider this to be a problem in our case, because our sample covers a period during which the Macedonian economy is not in equilibrium, but is rather approaching it, and it is plausible that the income elasticity of imports is above 1 during the early stage of the catching-up process, but falls to one or below one in the later stages. In addition, the short-run demand elasticity is rather low (0.8), suggesting that episodes of a fall in domestic GDP initially result in small contraction of the imports, which eventually becomes higher. This is exactly how imports behaved during the crisis in 2008/9. The price elasticity of imports is low (0.5), implying that depreciations will lead to a small fall in the imports, which is not strange, given the high import dependance of the economy.

Regarding the aggregation bias, the fact that the MG is preferred to the PMG implies that it indeed exists in the Macedonian import elasticities. Comparing the MG estimates with the aggregate estimates, it can be seen that the elasticities obtained from aggregate data are biased downwards - the income elasticity was estimated at 1.4, instead of 1.9, while the price elasticity at zero, instead at 0.5.

IV.E. Further analysis

As already pointed out, heterogenous panel techniques are based on the assumption that the residuals are serially uncorrelated and uncorrelated between cross sections. We already saw that the assumption of no serial correlation is not met, but we did not consider this to be a serious problem, because we could not get rid of the serrial correlation and because it did not seem to be widespread, judging by the visual inspection of the residuals. Now we test for cross-sectional correlation between the residuals, using the CD test proposed by Pesaran (2004). The results are shown in Table 4.

Table 4: CD test for cross-error correlation.
H_0: No correlation.

	Exports	Imports
Number of groups:	27	23
Average number of obs. per group:	41.5	53.9
Correlation	0.042	0.068
Abs. Correlation	0.335	0.272
CD test	5.92	7.04
P value	0.00	0.00

As can be seen, the residuals seem to be cross-sectionally correlated. This is most likely due to an omitted common factor affecting all cross sections (gradual development of the financial sector, gradual technological advance, global economic environment). Econometric techniques for modelling common factors are fairly recent, and currently there are two such techniques – the common correlated effects (CCE) model of Pesaran (2006) and the augmented mean group (AMG) estimator of Bond and Eberhardt (2009). Bond and Eberhardt (2009) argue that the two estimators are rather similar. Loosely speaking, the CCE controls for the common factors by including means of the explanatory variables across the cross-sections, while the AMG includes time dummies. The latter approach seems to be more appropriate in our case. So, we next apply the AMG estimator, to see if those results are different from the baseline results that were presented in the previous section.

The basic regressions are the same as in PMG and MG – one lag of the dependent variable is included on the right hand side. In addition, trends are included in the individual country reggressions, to avoid spurious identification of the common factor. We also control for outliers, by using the option "robust" in Stata. The results are shown below. Only the transformed long-run coefficients are reported, for brevity.

$$log(exports) = 1.9 \cdot log(GDP) - 0.4 \cdot log(RER) + 0.78^{***} \cdot common$$

***, **, * denotes significance at 1%, 5% and 10%, respectvely. Period of estimation: 1995Q1-2011Q2, 1301 observations. The trends are significant in 6 countries.

$$log(imports) = 1.4^{***} \cdot log(GDP) + 0.2 \cdot log(RER) + 0.29^{***} \cdot common$$

***, **, * denotes significance at 1%, 5% and 10%, respectvely. Period of estimation: 1997Q1-2011Q2, 1245 observations. The trends are significant in 5 countries.

It can be seen that these results are similar to those presented in the previous sub-section. The only notable difference between these AMG results and the baseline is that the AMG coefficients are less significant. The statistical tests of equality of the AMG estimates with the previously obtained ones could not reject the null hypothesis that they are equal. Therefore, we take this is an evidence that the serial and across-unit correlation in residuals from the heterogenous panels estimators is not biasing our results.

IV.F. Robustness and structural stability

Finally, we check how stable the results are, by carrying out the above estimations for the exports and the imports on drastically reduced samples, i.e. on samples consisting of fewer countries (the first half and the second half of the countries). The results are in Table 5 and Table 6. The results from the estimations over reduced samples seem very similar to the baseline results.

Table 5: Robustness of the exports results.

	-1-	**-2-**	**-3-**
	baseline	**first 14 countr.**	**last 13 countr.**
	long-run		
log(gdp)	1.9	1.9	2.4
	***	***	***
log(rer)	-0.4	-0.4	-0.7
	*		**
	short-run		
ECM	-0.26	-0.27	-0.3
	***	***	***
dlog(gdp)	2.9	3.2	4
	**	**	
dlog(rer)	0.64	-0.2	1.7
No. Obs.	1301	663	638
No. Cross s.	27	14	13

Table 6: Robustness of the imports results.

	-1- baseline	-2- first 11 countr.	-3- last 12 countr.
	long-run		
log(gdp)	1.9	1.5	2.3
	***	***	***
log(rer)	0.5	0.5	0.5
	short-run		
ECM	-0.49	-0.67	-0.33
	***	***	***
dlog(gdp)	0.8	0	1.6
	***		***
dlog(rer)	-0.6	-0.4	-0.7
			***
No. Obs.	1245	619	626
No. Cross s.	23	11	12

V. Conclusion

Trade elasticities are very important for the policy makers - the demand elasticities show how exports and imports react to changes in foreign/domestic demand, the price elasticities show how exports and imports react to changes in the exchange rate. Therefore, policy makers should have reasonably good estimates of these elasticities. In this paper we evaluate the aggregation bias in estimating Macedonian trade elasticities - we compare the estimates obtained from data on aggregate trade, with the estimates obtained from data on bilateral trade. We find that the aggregation bias is indeed present - the aggregate estimates differ systematically from the bilateral-trade estimates. This is especially evident in the income elasticities - the exports income elasticity from the aggregate data is overestimated, while the imports income elasticity is underestimated. This points out that predictions for the response of the current account balance to unpredicted external demand shocks, based on estimates from aggregate data, would produce higher current account deficits than those that would be realized. Hence, we make the case that trade elasticities should be estimated on bilateral-trade data.

Turning the discussion to the characteristics of the Macedonian economy, our analysis suggests that Macedonian *exports* have high income elasticity (1.9) and low price elasticity (-0.4). The short-run income elasticity of exports is higher than the long-run. This all suggests that adverse shocks in foreign demand will affect Macedonian economy severely, especially in the short-run, and that real exchange rate depreciation will have only minor positive effects on Macedonian exports. Macedonian *imports*, similarly, are more elastic to changes in income than to changes in prices (1.9 vs. 0.5), but the short-run income elasticity is lower than the long-run. This implies that negative shocks to the domestic demand will result in more than proportional fall in the imports, but only after some time, and that real exchange rate depreciation will decrease imports only marginally. The sum of the price elasticity of the imports and the exports is below 1, which implies that Macedonian economy would not satisfy the Marshall-Lerner condition, the necessary condition for exchange rate depreciation to have positive effects on the trade. Adding to this the relatively high pass-through from the nominal exchange rate to domestic inflation, which is estimated to be around 0.4 (see Besimi et al., 2006 and Vrboska, 2006), it seems that depreciation of the nominal exchange rate is likely to worsen the trade balance in Macedonia, rather than improve it.

References

Altissimo, Filippo, Mojon, B. and Zaffaroni, P. (2007). "Fast micro and Slow macro: Can aggregation explain the persistence of inflation?", ECB Working Paper No. 729

Besimi, F., G. Pugh and N. Adnett (2006). "The monetary transmission mechanism in Macedonia: implications for monetary policy", Working Paper No. 02/2006, Institute for environment and sustainability research

Blackburne Edward F., III & Mark W. Frank (2007). "Estimation of nonstationary heterogeneous panels", Stata Journal, StataCorp LP, vol. 7(2), pages 197-208, June.

Bond, Steve and Markus Eberhardt (2009). "Cross-section dependence in nonstationary panel models: a novel estimator", paper presented at the Nordic Econometrics Conference in Lund

Bussiere, Matthieu, Giovanni Callegari, Fabio Ghironi, Giulia Sestieri, Norihiko Yamano (2011). "Estimating Trade Elasticities: Demand Composition and the Trade Collapse of 2008-09", NBER Working Paper No. 17712

Byrne, J.P., and Fiess, N. (2010). "Euro area inflation: aggregation bias and convergence". Review of World Economics, 146 (2). pp. 339-357.

Cheung Yin-Wong, Menzie D. Chinn and XingWang Qian (2012) "Are Chinese Trade Flows Different?", NBER Working Paper No. 17875

Goldstein, M. and M. S. Khan (1978). "The supply and demand for exports: A simultaneous approach", The Review of Economics and Statistics, vol. 60, 275–286

Goldstein, M. and M.S. Khan (1982). "Effects of slow-down in industrial countries on growth in non-oil developing countries", Ocassional paper No. 12, International Monetary fund

Goldstein, M. and M.S. Khan (1985). "Income and Price Effects in Foreign Trade", in Handbook of International Economics, ed. R.W. Jones and P.B. Kenen, Elsevier Science Publishers Amsterdam

Grunfeld Y. and Griliches Z. (1960). "Is aggregation necessarily bad?", The Review of Economic and Statistics, vol. 17, no. 1.

Gupta K.L. (1971). "Aggregation bias in linear economic models", International Economic Review, no.12, pp 293-305

Hahn, Franz (2004). "Long-run homogeneity of labour demand. Panel evidence from OECD countries," Applied Economics, Taylor and Francis Journals, vol. 36(11), pages 1199-1203.

Holly, S. and K. Wade (1991). "UK exports of manufactures: the role of supply-side factors", Scottish Journal of Political Economy, vol. 38, pp.1-18

Houthakker, H. S. and S. P. Magee (1969). "Income and Price Elasticities in World Trade", The Review of Economics and Statistics, Vol. 51, No. 2, pp. 111-125

Imbs Jean and Isabelle Mejean (2010). "Trade Elasticities: A Final Report for the European Commission," European Economy - Economic Papers 432, Directorate General Economic and Monetary Affairs, European Commission.

Imbs Jean, Haroon Mumtaz, Morten O. Ravn and Helene Rey (2005). "PPP Strikes Back: Aggregation and the Real Exchange Rate", The Quarterly Journal of Economics, Vol. 120, No. 1 (Feb., 2005), pp. 1-43

Johansen, S. (1988). "Statistical Analysis of Cointegration Vectors", Journal of Economic Dynamics and Control 12, pp. 231-254.

Johansen, S. (1991). "Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models", Econometrica, 59, (6), pp. 1551-1580

Jovanovic, B. (2007). "The Fundamental Equilibrium Exchange Rate of the denar", Unpublished Master Thesis, Staffordshire University, UK

Jovanovic Branimir and Petreski Marjan (2008). "Keynesian Macroeconomic Model of the Republic of Macedonia: Economic theory and Behavioural Equations", Ministry of Finance of the Republic of Macedonia, Bulletin

Juselius Katarina (1996). The Cointegrated VAR Model: Methodology and Applications, Oxford University Press

Kaplan, Muhittin and Huseyin Kalyoncu (2011). "Testing Aggregation Bias for the Impact of Devaluation on the Trade Balance: An Application to Turkey", Pennsylvania Economic Review, Vol. 18, No. 2

Kadievska-Vojnovic, M. and D. Unevska (2007). "Price and Income Elasticities of Export and Import and Economic Growth in the case of the Republic of Macedonia", Working Paper, National Bank of the Republic of Macedonia

Kelaher, Richard & Sarafidis, Vasilis (2011). "Crime and Punishment Revisited," MPRA Paper 28213, University Library of Munich, Germany.

Krugman, P. (1989). "Income elasticities and the Real Exchange Rates", European Economic Review, vol. 33, pp. 1031-1054

Lee, Kevin (1997). "Modelling economic growth in the UK: An econometric case for disaggregated sectoral analysis," Economic Modelling, Elsevier, vol. 14(3), pages 369-394, July.

Lee K.C., Pesaran M.C. and Pierse R.G. (1990), "Testing for aggregation bias in linear models", The Economic Journal (Supplement), vol. 100, pp 137-150.

Malinvaud E. (1956), “L’aggrgation dans le modles conomiques”, Cahiers du seminaire d’econometrie, no. 4, pp 69-146.

Marquez, Jaime (2005). "The Aggregate Of Elasticities Or The Elasticity Of The Aggregates: U.S. Trade In Services," Computing in Economics and Finance 2005 142, Society for Computational Economics.

Muscatelli, V.A., Srinivasan, T.G. and Vines, D. (1990a). "The empirical modelling of NIE exports: an evaluation of different approaches", CEPR discussion paper no. 426

Muscatelli, V.A., Srinivasan, T.G. and Vines, D. (1990b). " Demand and Supply Factors in the Determination of NIE Exports: A Simultaneous Error-Correction Model for Hong Kong", The Economic Journal, Vol. 102, No. 415 (Nov., 1992), pp. 1467-1477

Orcutt G. H., Watts H. W. and Edwards J. B (1968), “Data aggregation and information loss”, American Economic Review, vol. 58, no. 4.

Pesaran, M. Hashem (2004). "General Diagnostic Tests for Cross Section Dependence in Panels", IZA Discussion Paper No. 1240.

Pesaran, M. Hashem (2006). "Estimation and inference in large heterogeneous panels with a multifactor error structure." Econometrica, Vol. 74(4): pp.967-1012.

Pesaran, M. H. and Y. Shin (1997). “An Autoregressive Distributed Lag Modeling Approach to Cointegration Analysis”, Cambridge Working Papers in Economics, No. 9514

Pesaran, M. H., Y. Shin, and R. P. Smith (1999). "Pooled mean group estimation of dynamic heterogeneous panels". Journal of the American Statistical Association 94: 621-634.

Pesaran, M. H., Y. Shin and R. P. Smith (2001). “Bounds testing approaches to the analysis of level relationships”, Journal of Applied Econometrics, Vol. 16, Issue 3 , pp. 289 - 326

Pesaran, M. H., and R. P. Smith (1995). "Estimating long-run relationships from dynamic heterogeneous panels". Journal of Econometrics 68: 79-113.

Riedel, J. (1984). "Trade as the engine of growth in developing countries, revisited", Economic Journal, vol. 94, pp. 56-73

Riedel, J. (1988). "The demand for LDC Exports of Manufactures: Estimates from Hong-Kong", Economic Journal , vol 98, pp. 138-148

Robertson, Raymond & Kumar, Anil & Dutkowsky, Donald H., (2009). "Purchasing Power Parity and aggregation bias for a developing country: The case of Mexico," Journal of Development Economics, Elsevier, vol. 90(2), pages 237-243, November.

Teulings, Coen N. (2000). "Aggregation Bias in Elasticities of Substitution and the Minimum Wage Paradox," International Economic Review, Vol. 41, No. 2

Theil H. (1954), “Linear aggregation of economic relations”, Amsterdam, North Holland

Vrboska, A. (2006). "Choice of optimal monetary strategy for small and open economies", unpublished Master thesis, Faculty of Economics, Skopje.

Westerlund, J. (2007). "Testing for error correction in panel data". Oxford Bulletin of Economics and Statistics 69: 709–748.

VI. Appendix

Table 7: Descriptive statistics of the variables used in the aggregate-trade analysis

	exports	foreign demand	industrial	imports	GDP	REER
Mean	31838.4	112.3	102.1	45670.6	73555.6	98.7
Max	44889.5	128.8	118.6	67082.4	90329.3	118.6
Min	23559.2	93.9	86.9	29527.3	59446.5	88.6
Std.Dev.	5461.3	11.0	7.5	9165.4	9841.2	8.5
Coef.Var.	0.172	0.098	0.073	0.201	0.134	0.080
No.Obs.	54	54	54	54	54	54

Table 8: Descriptive statistics of the variables used in the bilateral-trade analysis

	export	GDP_for	RER_expo	imports	GDP_mk	RER_impo
Mean	1017.67	0.91	1.02	1570.33	0.84	1.05
Max	13208.33	1.41	2.16	10372.81	1.04	2.53
Min	0.00	0.56	0.68	0.00	0.65	0.64
Std.Dev.	1579.04	0.12	0.20	1802.97	0.12	0.20
Coef.Var.	1.55	0.13	0.20	1.15	0.14	0.20
No.Obs.	1321	1321	1321	1268	1268	1268

Table 9: Lag order in the imports equation

Number of lags of GDP, RER and imports, respectively

	AIC	SBC	Rbar2	Final choice
Austria	1,3,3	0,0,1	1,3,3	1,3,3
Belgium	0,0,0	0,0,0	0,0,0	0,0,0
Brazil	0,3,0	0,3,0	1,3,0	0,3,0
Bulgaria	1,0,3	0,0,1	3,0,3	0,0,1
Croatia	0,3,0	0,2,0	0,2,3	0,2,0
Czech	0,0,2	0,0,2	0,2,3	0,0,2
France	2,1,1	1,1,1	3,0,3	1,1,1
Germany	2,1,3	1,0,3	2,2,3	1,0,3
Greece	2,0,2	2,0,2	2,2,2	2,0,2
India	0,0,1	0,0,1	1,2,1	0,0,1
Italy	0,0,1	0,0,0	2,0,1	0,0,0
Japan	0,2,1	0,2,1	0,3,1	0,2,1
Korea	1,0,3	0,0,1	1,0,3	0,0,1
Netherlands	0,0,2	0,0,1	2,0,2	0,0,1
Russia	1,1,1	1,0,1	1,1,1	1,1,1
Serbia	1,1,1	1,1,0	1,1,1	1,1,1
Slovakia	1,0,1	1,0,1	1,0,3	1,0,1
Slovenia	0,0,1	0,0,1	1,0,2	0,0,1
Spain	0,0,2	0,0,2	3,0,2	0,0,2
Sweden	2,0,2	1,0,1	2,3,2	1,0,1
Switzerland	1,3,1	1,3,1	1,3,1	1,3,1
Ukraine	1,0,1	1,0,1	2,2,1	1,0,1
US	1,0,3	0,0,1	1,2,3	0,0,1

For most of the countries (6) order 0,0,1 is chosen

(i.e. no lags of GDP and RER and 1 lag of imports)

Table 10: Lag order in the exports equation

Number of lags of GDP, RER and exports, respectively				
	AIC	SBC	Rbar2	Final choice
Albania	0,0,1	0,0,1	0,0,1	0,0,1
Austria	0,0,1	0,0,1	0,1,1	0,0,1
Belgium	1,0,1	1,0,1	3,0,1	1,0,1
Bosnia	2,3,1	2,3,1	2,3,1	2,3,1
Bulgaria	0,0,1	0,0,0	0,0,1	0,0,1
Croatia	0,3,0	0,3,0	0,3,1	0,3,0
Czech	3,1,3	2,0,3	3,1,3	3,1,3
France	0,1,1	0,0,1	0,3,1	0,0,1
Germany	0,3,3	0,3,1	0,3,3	0,3,3
Greece	2,2,1	2,0,1	2,2,1	2,2,1
Hungary	3,3,2	0,0,2	3,3,2	3,3,2
Italy	0,3,2	0,3,2	2,3,2	0,3,2
Montenegro	2,3,0	2,3,0	2,3,0	2,3,0
Netherlands	1,2,1	0,0,1	2,3,2	0,0,1
Poland	0,0,1	0,0,1	1,0,3	0,0,1
Portugal	0,0,1	0,0,1	3,0,1	0,0,1
Romania	0,0,3	0,0,1	0,2,3	0,0,1
Russia	3,0,1	0,0,0	3,0,1	3,0,1
Serbia	3,3,3	3,3,3	3,3,3	3,3,3
Slovakia	3,3,1	0,0,1	3,3,3	0,0,1
Slovenia	3,0,1	1,0,1	3,0,3	1,0,1
Spain	0,0,1	0,0,1	1,0,1	0,0,1
Sweden	0,3,1	0,0,1	3,3,1	0,0,1
Switzerland	0,0,3	0,0,1	3,0,3	0,0,1
Ukraine	0,3,1	0,1,1	0,3,1	0,3,1
UK	3,3,1	0,3,1	3,3,1	3,3,1
US	1,0,3	1,0,3	2,2,3	1,0,3

For most of the countries (12) order 0,0,1 is chosen

(i.e. no lags of GDP and RER and 1 lag of exports)

Figure I: Plots of variables used in the aggregate trade analysis

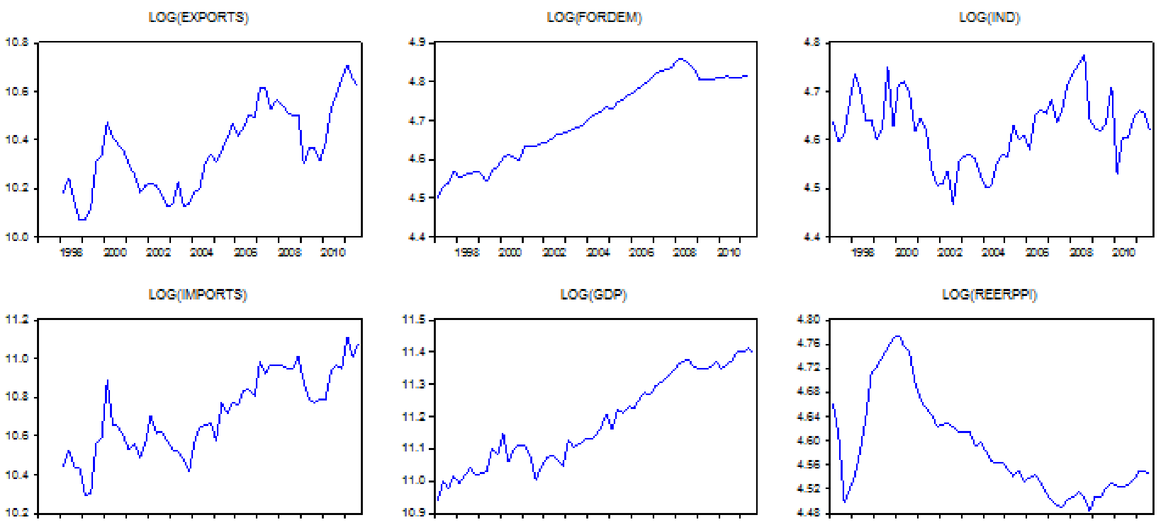

FIGURE II: LOGARITHM OF EXPORTS BY COUNTRIES

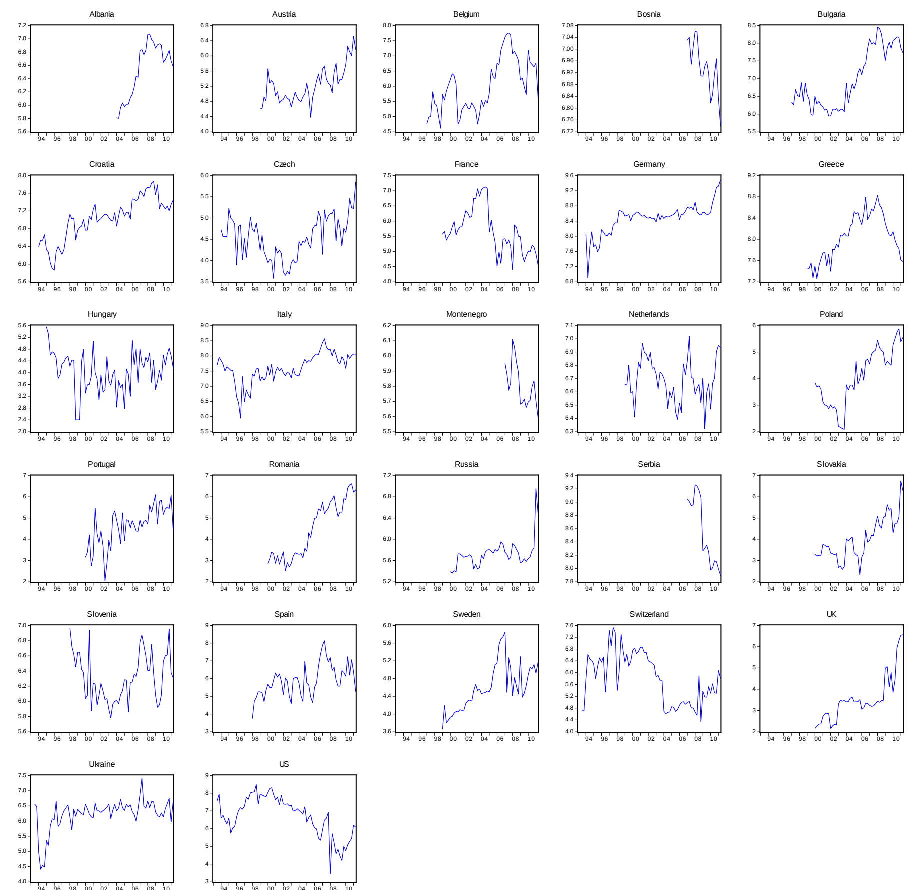

FIGURE III: LOGARITHM OF FOREIGN GDP

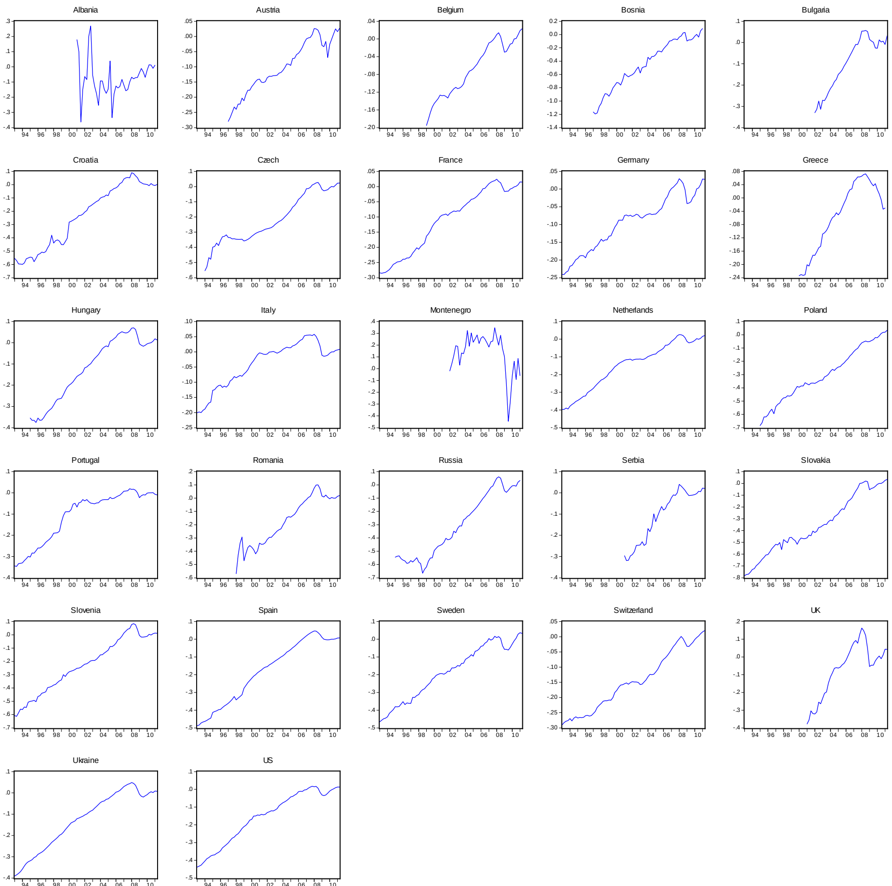

Figure IV: Logarithm of bilateral real exchange rate (exports regression)

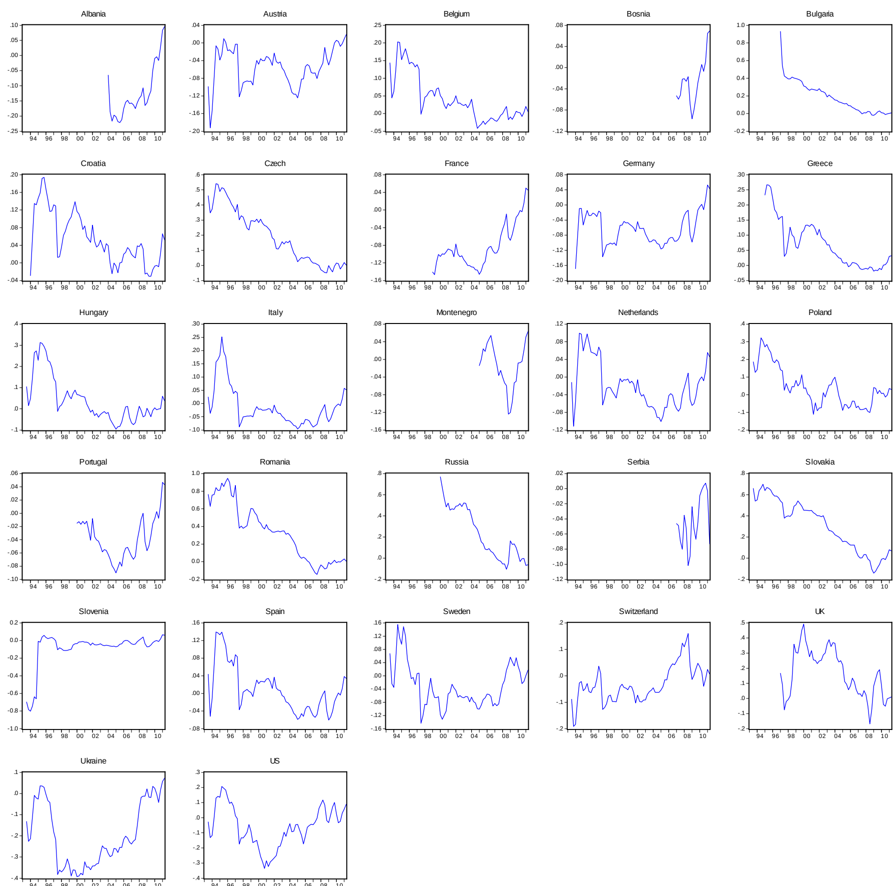

Figure V: Logarithm of imports by countries

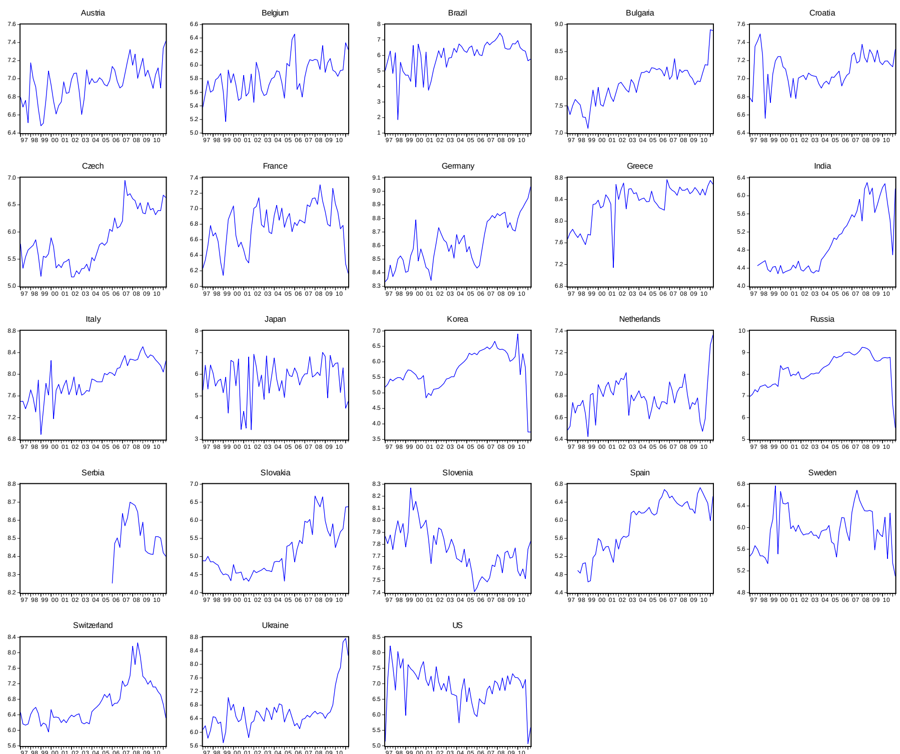

FIGURE VI: LOGARITHM OF MACEDONIAN GDP

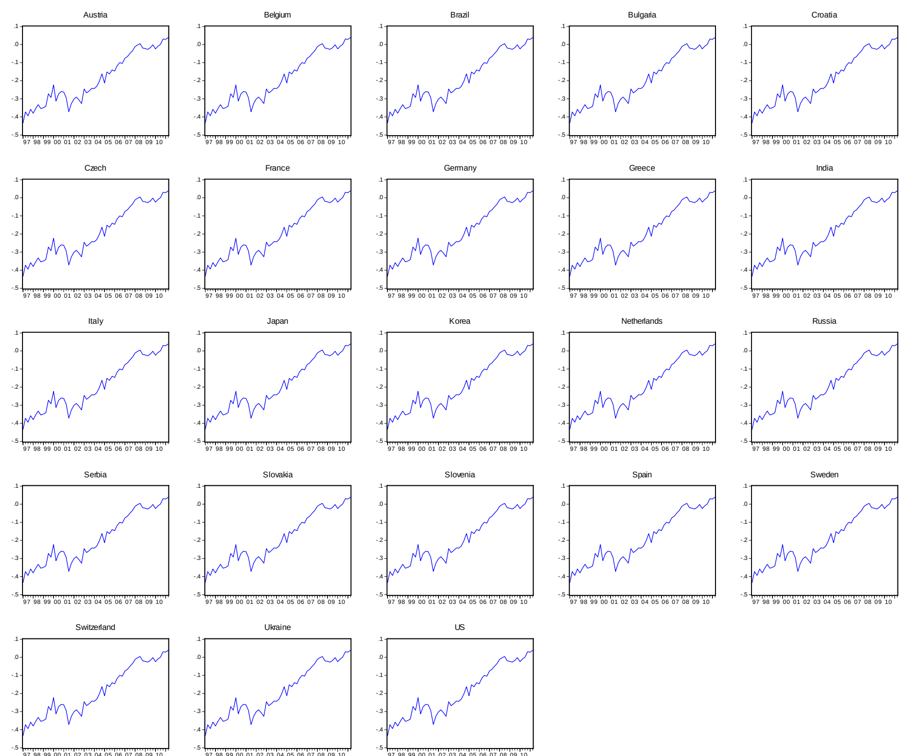

Figure VII: Logarithm of bilateral real exchange rate (imports regression)

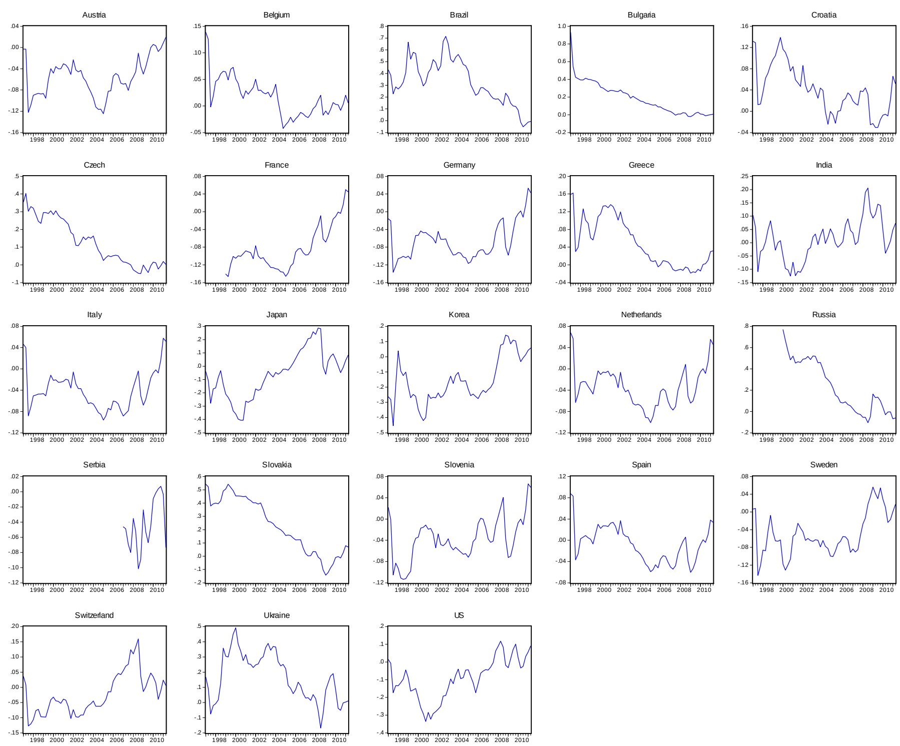

Figure VIII: Plot of the residuals from the exports ARDL

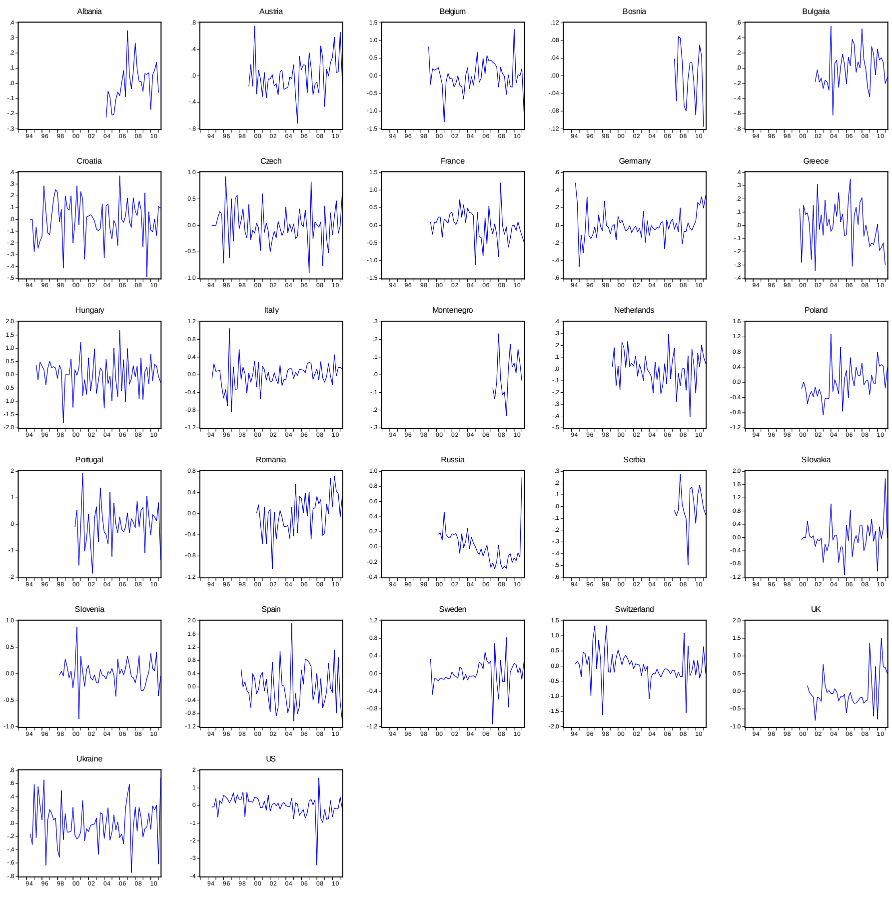

FIGURE IX: PLOT OF RESIDUALS FROM THE IMPORTS ARDL