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On the Impact of Kuna Exchange Rate on Croatian Foreign Trade Results: Elasticity Approach

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Summary

The aim of this paper is to analyze Croatian trade balance and its determinants. Hence four models were proposed: a "catch all" model with all influencing variables included, and three disaggregated models concerning Croatian bilateral relationships with three important trade partners. The models were estimated in order to answer a question often disscused by policy makers, academics and the public: what is the impact of the kuna exchange rate on Croatian trade flows, i.e. how does the monetary transmission mechanism through the exchange rate channel really work in terms of its results on trade balance? The impact of the eventual kuna devaluation on Croatian trade results was modelled using cointegration and error correction model. The analysis showed that Croatian economy exhibits a gap between the real and monetary economic system, and that unfavourable foreign trade results cannot be addressed by monetary instruments and measures.

Keywords: cointegration, ECM, trade balance, exchange rate

1. Introduction

The problem of permanently unfavourable Croatian foreign trade results has often been emphasized by Croatian policy makers, but so far it hasn't been adequately accompanied by researchers' attention. In every month from Croatian independence a negative trade balance (TB) has been seen as a result of stagnating exports and growing imports of goods and services. Thus the main question here is what caused this state and what are the possible solutions to the problem. Can trade results be improved by monetary measures or are they just a consequence and a derivative of the total real Croatian economic conditions? It is thus in the best interest of all structures directly or indirectly involved in the above mentioned problematics to analyze foreign trade and its determinants. That is essentially needed to form an economic policy or development strategy of any kind. The aim of this paper is to explore the Croatian foreign trade aggregate components' determinants, and the way they influence real economic variables. Also, due to the lack of applied empirical econometric analysis of the observed matter, this paper should give a certain contribution to the debate of overvalued kuna exchange rate.

2. Empirical models

Standard economic literature emphasizes that the trade balance can be disaggregated in two main components: exports and imports. The mentioned aggregate variables can be modelled as follows (Blanchard, 2003):

$$exports = f(income^{*}, rer), \qquad (1)$$

$$imports = f(income, rer) \qquad (2)$$

where *income** stands for foreign income (i.e. trade partner's income), and *rer* stands for real exchange rate.

The main empirical model observed in this paper will cover incomes and real exchange rates of Croatia and its three important trade partner countries. That way it will unite the two above mentioned functions through a sistem with the following variables:

1. ***tb*** (Croatian trade balance[1])

- ***gdp_cro*** (Croatian gross domestic product)
- ***gdp_de*** (German gross domestic product)
- ***gdp_aut*** (Austrian gross domestic product)
- ***gdp_ita*** (Italian gross domestic product)

- ***rer_de*** (ITL/HRK real exchange rate)
- ***rer_aut*** (ATS/HRK real exchange rate)
- ***rer_ita*** (ITL/HRK real exchange rate)

The selection of these particular partner countries can be justified by the fact that they generate up to 37.61% of the total Croatian foreign trade (Croatian Statistical Yearbook, 2007) and by data availability.

All variables are in quarterly frequencies, ranging from 1996Q1 to 2007Q4[2]. They are also seasonallly adjusted and in logarithms, so the estimated parameters obtained in cointegration vectors could be interpreted as elasticity coefficients. All GDP and trade balance data is expressed in constant prices. That way it will be possible, on the basis of the *rer* cointegration coefficient, to determine the effect of a 1% kuna devaluation on Croatian trade balance. Namely, precisely the eventual kuna devaluation has often been imposed as a *conditio sine qua non* for trade balance improvements. The efficiency of such measure will primarily depend on exchange rate elasticity of exports and imports. Therefore this paper will emphasize the analysis of the so-called "classical dichotomy" existence in the Croatian economy. In other words, the impact of a monetary variable (kuna exchange rate) on the real economy and the possibility of manipulating the exchange rate in order to balance the Croatian foreign trade will be analyzed. Four models will be suggested and analyzed in the paper.

The first one will capture the relationship between the Croatian trade balance and all other above mentioned variables, so it will be formulated in the following way:

$$tb = f(gdp\_cro, gdp\_de, gdp\_aut, gdp\_ita, rer\_de, rer\_aut, rer\_ita) \quad (3)$$

Starting hypothesis of the paper is that *gdp_cro* will have a positive impact on *tb*, whereas *gdp_de, gdp_aut, gdp_ita, rer_de, rer_aut* and *rer_ita* will have negative long run coefficients. More detailed reasons for such presumptions will be elaborated in the following theoretical part of the paper. The other three models will deal with bilateral trade relationships, i.e. the relationship between Croatian trade balance and its main trade partners' income and real exchange rates.

[1] Trade balance data is obtained as *tb = ln(exports) – ln(imports)*, where imports and exports reffer to goods and services

[2] Real exchange rates used in the analysis are expressed in indirect quotation (i.e. 1 kuna= x foreign currency units), so exchange rate increase is interpreted as appreciation, and its decrease as depreciation. They are corrected for the ratio of foreign and domestic price levels, calculated from consumer price indices. Croatian CPI series is avaliable only from the year 1998, so retail price index is used as an approximation for previous period.

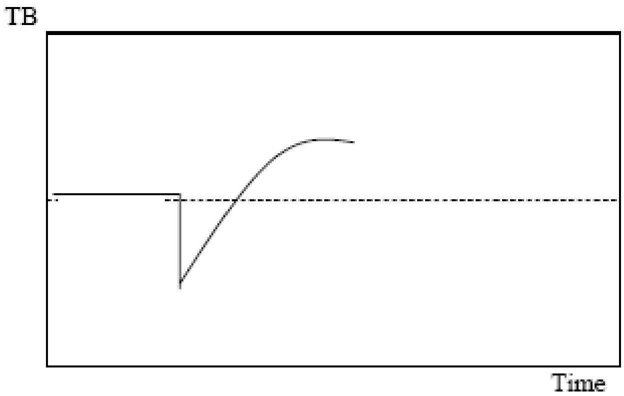
Conclusions drawn from the first model should be confirmed by the latter three. Through the specified models this paper will cover the main Croatian foreign trade relations and explore the functioning of the monetary transmission mechanism i.e. the influence of kuna exchange rate on the chosen real economic variables. In exploration of the relationship between the mentioned variables Johansen's multivariate cointegration approach and the error correction model (ECM) will be used. In that way, the elasticity analysis will be enriched by the time horizon aspect, and the existence of J-curve in Croatian economy will be estimated. It, in fact, grafically summarizes the theoretically expected short-run negative influence of devaluation on the trade balance, and the trade balance equilibration as an expected long-run devaluation effect (Ahearn, 2002).
Other papers analyzing the relationship between the exchange rate and net exports known to the author are quite inconclusive (Miles, 1979.; Stučka, 2004.; Haynes and Stone, 1982.), so the results of the analyzed models could shed some light on this issue in case of Croatia.

3. Theoretical background of the problem

Devaluation as a monetary policy measure implies a decrease of the domestic currency value. Given the existence of a permanent trade balance deficit, economic policy makers often settle for devaluation as a possible problem solution, especially in the case of a continuously high deficit such as the one in Croatia. There are several approaches to devaluation success analysis: absorption approach, monetaristic approach and the elasticity approach (Rincon, 1999) In this paper, in order to make a conclusion on the effect of the devaluation on trade balance, the latter approach will be applied.
The impact of devaluation on the trade balance arises from the fact that the exchange rate change stimulates an alternation in terms of trade, i.e. the relationship between the domestic and foreign price level. Namely, a devaluation of 1% will result in an export price reduction by the same percentage. The way that will finally reflect on the movement of the export volume depends on the export exchange rate elasticity The reverse scenario happens with the imports. Devaluation of the domestic currency makes foreign goods more expensive, and the final effect is determined by the imports exchange rate elasticity. Incorporating the above theoretical framework to the context of this paper, one can conclude that the overall devaluation effect on trade balance would be positive if the sum of export and imports elasticities is greater than 1 (the so-called Marshall-Lerner condition) (Blanchard, 2003). Hence, in that case the estimated long run coefficient for real exchange rate variables in our model should be negative.

The issue that makes the devaluation influence so complex is the time aspect of it's functioning. Namely, the expected short run effect is negative, hence it widens the deficit due to the existence of long-term contracts and the already formed demand habits. The positive effect, i.e. the balancing of the trade deficit, happens in a much longer time period. Because of that, the devaluation effects are often summarized by a so-called J-curve:

Picture 1: J-curve



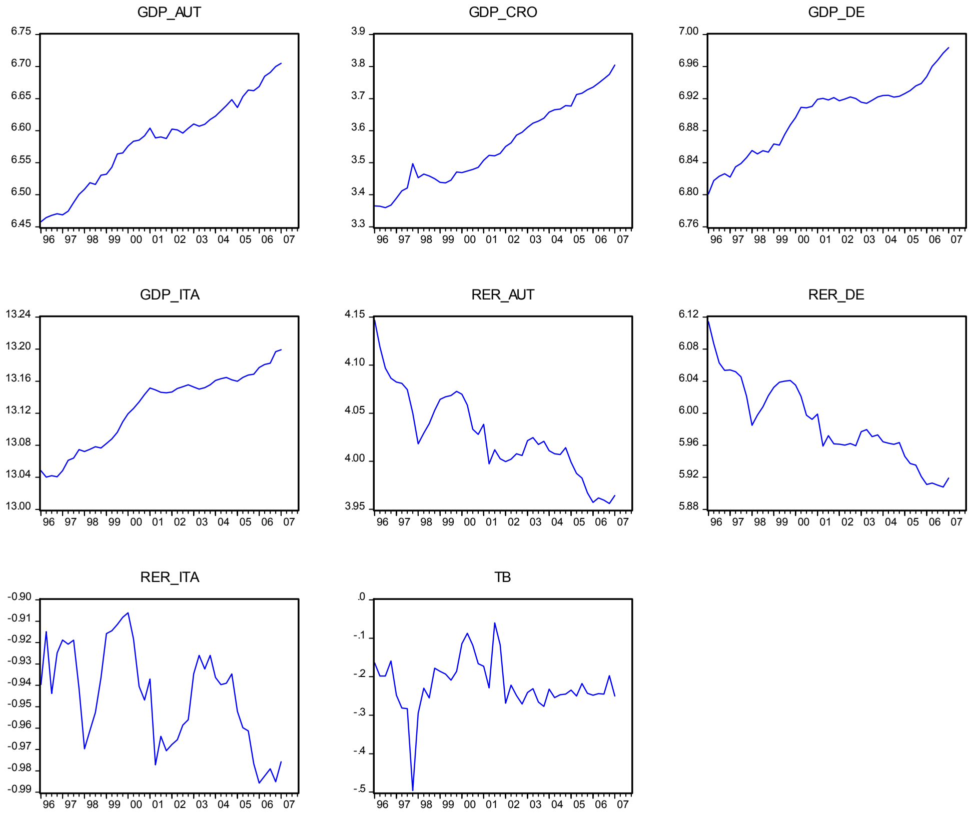
Source: (Ahearn, 2002)

Since in this paper both long run and the short run estimates will be obtained by cointegration and error correction model estimation, certain conclusions about the existence of J-curve in Croatia could be made.

4. Testing for unit root presence

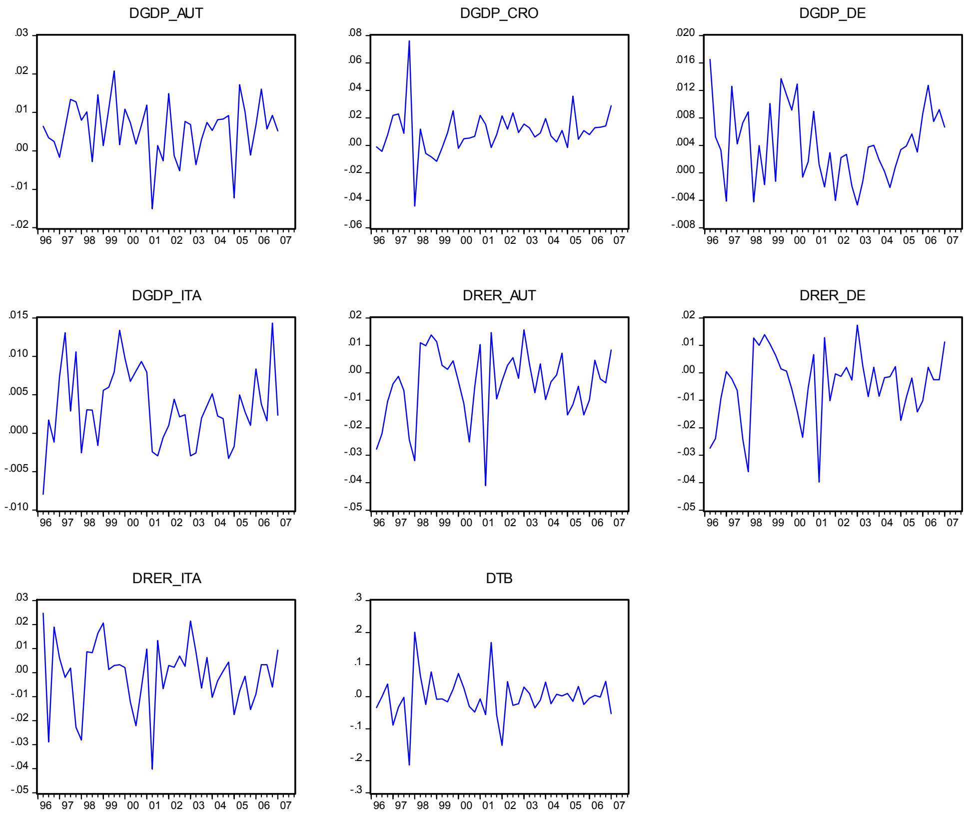
The empirical section of the paper starts with unit root tests. Before formally testing for stationarity of analyzed time series, the graphs with series in levels and first differences is displayed in order to get an intuition abouth mean reverting properties of the series

Picture 2: time series in levels



When observing the graphs, one can remark that all observed series in levels except *tb* are characterized by trending behaviour, which could suggest that *tb* is the only series of interest which doesn't contain a unit root. In other words, it could be stationary.

Picture 3: Time series in first differences



Viewing series in first differences indicates that all series revert to their mean, i.e. all series should be at the most I(1). Such indications wil be additionaly corroborated by formal unit root test results:

Table 2. ADF unit root test – levels

Name of the variable	Deterministic trend components	Lag	t-value (ADF)	p-value
tb	trend and constant	11	-4.353433*	0.0080
tb	constant	9	-2.723994	0.0802
rer_de	trend and constant	12	-2.163770	0.4925
rer_de	constant	12	-1.225180	0.6512
rer_aut	trend and constant	4	-3.317794	0.0780
rer_aut	constant	3	-1.271966	0.6334
rer_ita	trend and constant	4	-3.232291	0.0926
rer_ita	constant	4	-2.415842	0.1439

gdp_cro	trend and constant	0	-2.023006	0.5729
gdp_cro	constant	0	0.616223	0.9887
gdp_de	trend and constant	10	-2.775082	0.2156
gdp_de	constant	2	-0.196189	0.9310
gdp_aut	trend and constant	11	-3.525786	0.0529
gdp_aut	constant	0	-0.453146	0.8905
gdp_ita	trend and constant	5	-1.891279	0.6399
gdp_ita	constant	1	-1.421681	0.5629

Source: Author's calculation

Note: ADF-Augmented Dickey-Fuller test; optimal time lag selected using Akaike information criteria; * indicates rejection of the null hypothesis of unit root existence at the 1% level, ** indicates rejection at the 5% level

Table 2. ADF unit root test – first differences

Name of the variable	Deterministic trend components	Lag	t-value (ADF)	p-value
Δtb	trend and constant	12	-3.325667	0.0808
Δtb	constant	12	-3.978599*	0.0045
Δrer_de	trend and constant	12	-4.267270**	0.0101
Δrer_de	constant	11	-4.406788*	0.0015
Δrer_aut	trend and constant	0	-5.925747*	0.0001
Δrer_aut	constant	0	-5.945573*	0.0000
Δrer_ita	trend and constant	0	-7.117003*	0.0000
Δrer_ita	constant	0	-7.239829*	0.0000
Δgdp_cro	trend and constant	0	-8.415101*	0.0000
Δgdp_cro	constant	5	-2.878936	0.0572
Δgdp_de	trend and constant	0	-5.632754*	0.0002
Δgdp_de	constant	9	-0.952**	0.03
Δgdp_aut	trend and constant	0	-7.467732*	0.0000

Δgdp_aut	constant	0	-7.559289*	0.0000
Δgdp_ita	trend and constant	0	-5.161695*	0.0007
Δgdp_ita	constant	0	-5.143641*	0.0001

Source: Author's calculation
Note: ADF-Augmented Dickey-Fuller test; optimal time lag selected using Akaike information criteria; * indicates rejection of the null hypothesis of unit root existence at the 1% level, ** indicates rejection at the 5% level

ADF test results mostly confirm the graphical indications. As expected, the only variable whose test results were rather vague is *tb*. Namely, for the series in levels the obtained t-statistics for the model with constant and trend is smaller then the critical one, which points to series stationarity. However, *tb* series doesn't intersect the imagined line which represents its mean value, which gives us the right to assume it being I(1). The latter hypothesis can be proclaimed valid if the Johansen approach doesn't result in a full rank cointegration matrix Π (Asteriou, 2006). Hence, if all series are I(1), they can be used in futher steps of Johansen's cointegration test (Dickey and Fuller, 1979). The first model observed in this paper is a "catch all" model, including all above explained variables.

5. "Catch all" model

As the first step of Johansen's procedure, a VAR was modelled, where the optimal time lag $k=1$ was obtained using Akaike information criteria and F-test on significance of each lag. Any set of variables can be called cointegrated if and only if the previously modelled VAR can be reformulated in a VEC model (Harris, 1995) with the following form:

$$\Delta Z_t = \Gamma_1 \Delta Z_{t-1} + \Gamma_2 \Delta Z_{t-2} + \ldots + \Gamma_{k-1} \Delta Z_{t-k+1} + \Pi Z_{t-1} + u_t \quad (4)$$

where Z_t is a vector of all 8 system variables. Matrix Π contains information about the long run relationship between the variables of interest, and can be additionaly disaggregated as:

$$\Pi = \alpha \, x \, \beta' \quad (5),$$

where α is the speed of adjustment to equilibrium coefficients, and β' is the long run parameters matrix.

Guided by the Johansen cointegration test (Table 4) we can conclude that all variables included in the observed model form more than one cointegration relationship. To be more specific, at 5% significance level, *tb*, *gdp_cro, gdp_de, gdp_aut, gdp_ita, rer_de, rer_aut* and *rer_ita* form 3 cointegrating vectors, while at 10% level they form four cointegrating vectors.

Table 4: Results of Johansen's cointegration test

rank	eigenvalue	trace	p-value
0	0.86921	274.18	0.000*
1	0.75404	184.67	0.000*
2	0.65149	122.96	0.001*
3	0.49563	76.577	0.052***
4	0.34848	46.461	0.202
5	0.27234	27.610	0.263
6	0.17118	13.621	0.324
7	0.11469	5.3601	0.255

Source: Author's calculation
Note: *denotes rejection of the null hypothesis of no cointegration at 1% significance level, ***denotes rejection of the null hypothesis of no cointegration at 10% significance level

Regardless of what significance level we choose as refferent, it is obligatory to test a number of restrictions to the cointegration space in order to identify a unique cointegration vector parameters. Due to the fact that the analyzed model consists of 8 variables, we must impose 8 restrictions to obtain long run parameters and corresponding adjustment coefficients.

The following restrictions were imposed:

- *tb*, trade balance was normalized ($\beta_{tb} = 1$);
- schilling/kuna exchange rate, Italian GDP, Austrian GDP and Croatian GDP are weakly exogenous with respect to other variables in the system ($\alpha_{rer\_aut} = \alpha_{gdp\_ita} = \alpha_{gdp\_aut} = \alpha_{gdp\_cro} = 0$);
- in the long run, trade balance is unit elastic with regards to changes in Croatian GDP ($\beta_{gdp\_cro} = -1$);
- adjustment coefficients of deutsch mark/kuna and schilling/ kuna are the same ($\alpha_{rer\_aut} = \alpha_{rer\_de}$);
- in the long run, trade balance is unit elastic with regards to both Austrian GDP and German GDP, but with opposite signs ($\beta_{gdp\_aut} = -\beta_{gdp\_de}$).

All restrictions were jointly tested by an LR test ($\chi^2(7) = 8.8401$), with the corresponding p-value of 0.2670. Hence we can conclude that the tested restrictions were jointly accepted, enabling us to obtain a cointegration vector with unique long run (β) and short run/adjustment (α) coefficients, given in Table 5.

Table 5: Long run and adjustment coefficients of the cointegration vector

Variable	β	α
tb	1.0000	-0.0191
gdp_cro	1.0000	-0.0000
gdp_de	-2.8804	-0.0164
gdp_aut	2.8804	-0.0000
gdp_ita	5.0341	-0.0000
rer_de	6.6309	0.0377
rer_aut	8.3989	0.0377
rer_ita	-11.880	-0.0000

That way the cointegrating vector can be expressed as follows:

$$\boldsymbol{tb_t} = -153.60 + \boldsymbol{gdp\_cro_t} - 2.8804\ \boldsymbol{gdp\_de_t} + 2.8804\ \boldsymbol{gdp\_aut_t} + 5.0341\ \boldsymbol{gdp\_ita_t} + 6.6309\ \boldsymbol{rer\_de_t} + 8.3989\ \boldsymbol{rer\_aut_t} - 11.880\ \boldsymbol{rer\_ita_t} \qquad (6)$$

Just like expected (as a result of the imposed restriction), Croatian trade balance is unit elastic with regards to domestic GDP. Such results correspond to the positive impact of domestic GDP on Croatian trade flows, concluded by other papers (Erjavec, Cota and Bahovec, 2004, Mervar, 2003). Foreign incomes long run parameters, on the other hand, significantly differ. 1 percent rise of Austrian and Italian GDP, as suggested by the theory, improve the Croatian trade balance by 2.88 and 5.034 percent respectively (*ceteris paribus*). German GDP, unexpectedly, has a quite strong negative long run impact on Croatian trade balance. Such a result could indicate that the Croatian exporters' goods and services stucture doesn't correspond to the structure of German import demand. Exchange rate analysis results are also quite contradictory. Namelly, it can be concluded that kuna devaluation with respect to Autrian schilling or German mark would lead to a significant worsening of the Croatian trade balance. Such results strongly oppose to economic theory (Blanchard, 2003), but also to some empirical studies (Stučka, 2003). Estimated ***rer_ita*** long run coefficient shows that the long run effect of a 1% kuna devaluation would be, all other variables held constant, a 11.88% percent ***tb*** improvement. Very high obtained coefficient could be justified by the fact that Italy is the Croatian most important trading partner (Croatian Statistical Yearbook, 2007), so changes in bilateral exchange rates could easily influence their foreign trade relationship.

A glance at the adjustment coefficients reveal that, due to imposed restrictions, only ***tb***, ***gdp_de, rer_de*** and ***rer_aut*** react in the short run to the disequilibrium occurrence, while ***gdp_cro***, ***gdp_au, tgdp_it*** and ***rer_ita*** are weakly exogenous with respect to other variables in the system..

After estimating the long run steady state of variables in the model, it is now essential to examine their short run relationship (relation 4) in order to detect the existence of J-curve in Croatian economy. The obtained VEC model[3] is presented here:

Table 6: VEC model

variable	coefficient	t-value	variable	coefficient	t-value
Δtb_{t-1}	0.460790	0.898	Δgdp_aut_{t-2}	5.41158	1.89
Δtb_{t-2}	-0.230929	-0.468	Δgdp_aut_{t-3}	1.17847	0.409
Δtb_{t-3}	0.150000	0.346	Δgdp_aut_{t-4}	5.40780	1.83
Δtb_{t-4}	-0.684785	-1.62	Δrer_de_{t-1}	-12.9903	-0.976
Δgdp_cro_{t-1}	4.11479	2.35	Δrer_de_{t-2}	5.78325	0.452
Δgdp_cro_{t-2}	-3.56807	-1.51	Δrer_de_{t-3}	4.88599	0.411
Δgdp_cro_{t-3}	-1.56398	-1.03	Δrer_de_{t-4}	3.04197	0.204
Δgdp_cro_{t-4}	-2.80733	-2.22	Δrer_ita_{t-1}	10.4275	1.84
Δgdp_de_{t-1}	-7.13117	-1.18	Δrer_ita_{t-2}	0.461034	0.121
Δgdp_de_{t-2}	-1.15130	-0.189	Δrer_ita_{t-3}	-2.63489	0.891
Δgdp_de_{t-3}	5.85703	0.918	Δrer_ita_{t-4}	-4.88785	-1.75
Δgdp_de_{t-4}	0.0664882	0.0113	Δrer_aut_{t-1}	0.397508	0.0324
Δgdp_ita_{t-1}	-3.30309	-0.659	Δrer_aut_{t-2}	-7.80636	-0.666
Δgdp_ita_{t-2}	9.45495	1.80	Δrer_aut_{t-3}	-0.628294	-0.0569
Δgdp_ita_{t-3}	-8.92433	-1.33	Δrer_aut_{t-4}	0.623153	0.0468
Δgdp_ita_{t-4}	1.72359	0.413	constant	106.568	1.78
Δgdp_aut_{t-1}	-2.99187	-1.22	ECT_{t-1}	-0.347350	-1.78

Firstly, since the errror correction term has an expected negatice sign, it implies that 34.735 percent of the disequilibrium is corrected in each quarter. With such pace, the system reaches the long run equilibrium in less then three quarters. The belonging t-value suggests its statistical significance at 5% level. It is visible that the obtained *rer* coefficients' signs alternate in different time lags, so it is not possible to detect permanent negative influence of the real exchange rate devaluation on the trade balance in the short run. In other words, we cannot describe the relationship between real kuna exchange rate and Croatian trade balance with a J-

[3] The VEC model was first estimated with k=1 lag length (obtained in the VAR analysis), but afterwards conducted normality, autocorrelation and heteroscedasticity tests showed that the suggested model wasn't appropriate. Hence a VEC model with four lags was analysed. Such step is justified by its undertaking in other papers (see, for example, Sekine, 2001)).

curve. Another evidence in favour of that hypothesis is the statistical insignificance of all obtained *rer* coefficinets at 5% level, except for Δrer_ita $_{t-1}$ and Δrer_ita $_{t-4}$.

The VEC model was additionaly tested on normality, heteroscedasticity, and autocorrelation, with test results in the folowing table:

Table 7: Properties of VECM residuals

test	test statistics	p-value
AR 1-1 test	F(1,5) = 2.7624	0.1574
ARCH 1-1 test	F(1,4) =0.0036441	0.9548
Normality test	χ^2(2) = 5.3125	0.0702
RESET test	F(1,5) = 0.54866	0.4922

As visible, all test results for the estimated short run model seem satisfactory.

The long run exchange rate influence is still quite ambiguous, and the fact that analysis results significantly differ with respect to different Croatian trading partners gives the author a reason to analyze Croatian bilateral trade relationships separately. Thus the following three models will reffer to Croatian-German, Croatian-Italian and Croatian-Austrian trade analysis. Again total Croatian ***tb*** data have been used, so in fact we analyzed the influence of Croatian bilateral trade relations on total trade flows. Considering that it was previously proved that all variabls are I(1), what remains to be done is to form the appropriate VAR model and reformulate it in a VEC model.

5.1 Croatia vs. Germany bilateral trade model

In this model only variables concerning the two observed countries were analyzed (***tb***, ***gdp_cro, gdp_de*** and ***rer_de***). Using Akaike information criteria and F-test on significance of each lag, optimal VAR model lag length *k=1* was obtained. Afterwards the cointegration matrix rank test was conducted, with results given in the next table:

Table 6: Results of Johansen's cointegration test for CRO vs. DE model

rank	eigenvalue	l trace	p-value
0	0.48061	54.234	0.010*
1	0.40020	25.410	0.152
2	0.048563	2.9185	0.963
3	0.72814	0.72814	0.393

Hence, the results point to the existence of a single cointegration vector, whose corresponding obtained coefficients are presented in the following table:

Table 7: Long run and adjustment coefficients of the cointegration vector for CRO vs. DE model

Variable	**β**	**α**
tb	1.0000	-0.66102
gdp_cro	-0.38565	0.046708
gdp_de	2.6554	0.015950
rer_de	1.4348	0.036884

Expressed simbolically, the cointegration vector has the following form:

$$\boldsymbol{tb_t} = -0.38565\boldsymbol{gdp\_cro_t} + 2.26554\ \boldsymbol{gdp\_de_t} + 1.4348\ \boldsymbol{rer\_de_t} \quad (7)$$

According to this system, obtained Croatian and German GDP elasticity coefficients (0.38% and 2.26%, respectively) actually confirm economic theory, pointing that an increase of domestic income leads to an upturn in the imports level, which in the long run results in trade balance widening. Foreign income growth, on the other hand, boosts exports (Blanchard, 2003). Positive bilateral exchange rate elasticity coefficient is somewhat more interesting, because it implies, ceteris paribus, 1% kuna devaluation causing total trade balance to deteriorate by 1.43 percent. That is not only diametrically opposed to economic theory, but also to the only domestic empirical research of Croatian and German bilateral trade known to the author (Cota and Erjavec, 2006).

5.2. Croatia vs. Italy bilateral trade model

Variables analyzed in this model are ***tb***, ***gdp_cro, gdp_ita*** and ***rer_ita.*** Optimal lag length for the used VAR model was set to k=1 using Akaike information criteria and F-test on significance of each lag.

Table 8: Results of Johansen's cointegration test for CRO vs. ITA model

rank	eigenvalue	l trace	p-value
0	0.45911	39.342	0.250
1	0.19462	12.302	0.917
2	0.061125	2.7784	0.969
3	7.099E-005	0.00312	0.955

Results presented in the latter table undoubtedly lead to the conclusion of nonexistence of cointegration between the observed variables. Quite surprising, despite of the fact that Italy is the most important Croatian trade partner, it seems that system variables don't form a long run relationship. Hence the appropriate VAR model was formed with all variables in first differences (Enders, 2004), and Granger causality test was performed.

Table 9: Granger causality test results

Direction of causality	**F-statistic**	**Probability**
dgdp_cro → dtb	0.31761	0.72985
dtb → dgdp_cro	0.20864	0.81263
dgdp_ita → dtb	0.00535	0.99467
dtb → dgdp_ita	0.51184	0.60357
drer_ita → dtb	1.73082	0.19117
dtb → drer_ita	0.93491	0.40170
dgdp_ita → dgdp_cro	0.17043	0.84396
dgdp_cro → dgdp_ita	2.57628	0.08964
drer_ita → dgdp_cro	0.42935	0.65413
dgdp_cro → drer_ita	3.63060	**0.03633**
drer_ita → dgdp_ita	0.43403	0.65115
dgdp_ita → drer_ita	2.04470	0.14379

The null hypothesis implies nonexistence of Granger causality, so the obtained F statistics and p-values enable us to conclude that the only pair of variables for which we can reject the null hypothesis of no causality is ***dgdp_cro*** and ***drer_ita.*** Hence, at 5% significance level, Croatian GDP changes seem to cause bilateral ITL/HRK exchange rate changes. Thus it seems that the relationship direction is somewhat different than expected. On the basis of this Granger causality test it is possible to conclude that it is more likely that shifts in real economic variables precede to changes in monetary variables, such as ITL/HRK exchange rate. Nevertheless, it seems to be confirmed again that the monetary transmission mechanism in Croatia doesn't function via kuna exchange rate impact on Croatian trade balancel[4]. We now move to our last model, with Croatian and Austrian variables included.

5.3. Croatia vs. Austria bilateral trade model

Here again *k=1* was set as the optimal lag length using Akaike information criteria and F-test on significance of each lag.

Table 10: Results of Johansen's cointegration test for CRO vs. AUT model

rank	eigenvalue	l trace	p-value
0	0.47123	48.181	0.045*
1	0.31109	20.143	0.424
2	0.073882	3.7473	0.916
3	0.0083767	0.37013	0.543

Results presented in the latter table point to the existence of one cointegrating vector, whose parameters are given as followed:

Table 11: Long run and adjustment coefficients of the cointegration vector for CRO vs. AUT model

Variable	**β**	**α**
tb	1.0000	-0.79502
gdp_cro	-0.82482	0.063460
gdp_aut	1.9094	-0.0033602
rer_aut	0.70711	0.017203

Thus the long run relationship is given in the following form:

$$\boldsymbol{tb_t} = -0.82482\boldsymbol{gdp\_cro_t} + 1.9094\ \boldsymbol{gdp\_aut_t} + 0.70711\ \boldsymbol{rer\_aut_t} \qquad (8)$$

Again the estimated long run coefficients have the exactly same signs as the ones for the Croatia vs. Germany model. The behavior of Croatian and Austrian GDP is quite expected (-0.82 and 1.90 elasticity coefficients, respectively), while ATS/HRK bilateral exchange rate seems to have a positive impact on ***tb***. Economically speaking, a kuna devaluation with respect to Austrian schilling would, other variables held constant, result in trade balance worsening.

After observing the starting "catch all" model, and disaggregating it to three more models corresponding to three important Croatian trade partners, it is now possible to draw conclusions on the basis of so far obtained results. On the basis of the three bilateral models' results one can

[4] It is quite interesting to notice that there exists empirical evidence of sucessfull monetary transmission through

only conclude that the Marshall-Lerner condition isn't valid in Croatia, due to the negative impact of the eventual kuna devaluation on ***tb***.

6. Concluding remarks

The basic and main intention of this paper was to establish the strength and direction of the connection between the kuna exchange rate and Croatian foreign trade flows. To be more specific, we wanted to question if the overall effect of kuna devaluation on Croatian foreign trade would be trade balance improvement, and to what extent. Also, the analysis was additionally expanded by the time aspect with the analysis of the J-curve in Croatia. The first model with all domestic, German, Italian and Austrian determinants of the Croatian trade balance showed that the estimated long run parameters of ***gdp_cro, gdp_aut, gdp_ita*** and ***rer_ita*** all have theoretically expected signs. Opposed to that, ***gdp_de, rer_de*** and ***rer_aut*** long run parameters show that an increase in German GDP, just as the devaluation of kuna exchange rate with respect to Austrian schilling and German mark would, ceteris paribus, result in a ***tb*** deterioration. It was later showed that the above drawn conclusions in fact announced the results of the other three models. Thus in other models it was shown that gross domestic products of Germany and Austria have a positive impact on the Croatian trade balance. The most intriguing question in this paper was the influence of the real bilateral exchange rates. Surprisingly, the analysis showed that ATS/HRK and ITL/HRK exchange rates have just the opposite of the expected effect. Not only that real kuna devaluation with regards to schilling or mark wouldn't result in ***tb*** improvement, but it would significantly deteriorate the trade balance. Hence, all obtained results can be summarized by the conclusion of Marshall-Lerner condition nonvalidity in Croatia. That way it was shown that Croatian economy exibits a gap between the real and monetary economy. There seems to be no space for stimulating improvement of real economic variables such as trade balance by manipulating the exchange rate. Not only that there exists the so-called "classical dichotomy" in Croatian economy, but according to the Granger causality test results in the Croatia vs. Italy model, the connection direction may be just the opposite, meaning that some real variables could determine the monetary variables' movements. The "catch all" model was also used to examine the short run relationship between all included variables, showing that there doesn't exist a statictically significant negative influence of kuna devaluation on the trade balance. Hence, a J-curve cannot be used to approximate exchange rate and trade balance interaction in Croatia.

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kuna exchange rate influence on Croatian industrial production (Vizek, 2006)

This paper covered only a small part of complex Croatian foreign trade relations. For getting a wider perspective it would be crucial to additionaly consider the absorption approach (through domestic income and total expenditure modelling) and the monetary approach (through other monetary variables such as monetary aggregate M1). If concentrating only on monetary transmission mechanism through kuna exchange rate, a holistic approach would demand analyzing the kuna devaluation effects on Croatia's foreign debt servicing and commercial banks' loans structure with regards to currency clause. However, the impact of a permanent monetary expansion on inflation developements and on fulfillment of the Maastricht criteria (especially regarding the tolerated exchange rate fluctuations range) should be considered before all.

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