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A FRACTIONALLY INTEGRATED MODEL FOR THE CROATIAN AGGREGATE OUTPUT (GDP) SERIES

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ABSTRACT

The general characteristics of output fluctuations in Croatia are examined under fractional integration framework. This paper evaluate the existence of long memory in real output decomposing fluctuations to transitory and permanent components. The results suggest that Croatian real output series behavior is best identified as ARFIMA model with order of integration $0.5 < d < 1.5$. This suggests that macroeconomic shocks in real output are highly persistent. Unlike other studies in Croatia that find real output to be *I(0)* or *I(1)* variable, test results from this study indicate that real output show the characteristics of long memory with mean reversion (fractional integration).

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I. INTRODUCTION

The study of real output behavior in Croatia has been a central point in the large body of literature but it is still not well understood and call for explanation. It is a well known fact that most macroeconomic and econometrics studies in Croatia identify real GDP series as I(0) or I(1) process. However, in reality real output rarely behaves like I(0) nor I(1) series. It is more likely for real output in Croatia to behave like fractionally integrated process distinct both from stationary and integrated processes. Fractionally integrated models try to identify and capture different short and long memory characteristics present in real output series. Real output macroeconomic time series are characterized by persistence and long memory with long lasting but mean reverting effects of a shock. Croatian real output nature can not be explained by the means of I(0) nor I(1) models. Correct identification and descriptions of general characteristics of fluctuation in real output is of major importance for policy makers. It is virtually impossible to determine whether fluctuations in output are transitory or permanent in nature if source of non-stationarity in real output series is explained. Nelson and Plosser (1982) following the work of Box and Jenkins (1976) try to explain the nature of fluctuations in output using I(1) models implying output fluctuations stochastic nature in contrast to the traditional view that output series in levels are stationary around a deterministic trend. Diebold and Rudebusch (1989) observes the presence of large permanent component in aggregate output conflicts with traditional economic theories. Persistence in aggregate output implies that all fluctuations in output are of a permanent nature. If this is the case, stochastic economic theory to explain output fluctuations can be developed at the best. Developing a highly complex deterministic economic model to account for these temporary deviations is not expected since in their opinion the reversion to deterministic equilibrium path is absent. Correct identification of the memory in real output is imperative for the correct model specification.

Understanding the true nature in real output fluctuation demand correct memory identification and thus model to be estimated. This is important for at least two reasons. First, implied assumption that real output series behave like I(1) and differenced real output series like I(0) processes it is likely to result in model misspecification. In real world as shown by Haubrich and Lo, 2001 real output time series neither looks like random walk nor white noise suggesting some degree of fractional integration. Thus, stochastic properties of real output series should be investigated using fractionally integrated models. Without knowing the true persistence and long memory in real output, i.e. transitory and permanent components in output fluctuations, overshooting or undershooting of the targeted real output values is certain. Miss-specified economic policies have a permanent, almost infinite impact on real output over time. For Croatia, the effects of a shock in output will dissipate after 30 quarters and real GDP will return to its equilibrium values. Faster convergence to equilibrium values (mean) can be achieved if correct set of policy measures is used. On the other hand, if wrong economic policy is used, negative effects of a shock in real output will last almost infinitely having permanent effects on GDP.

New studies trying to explain the non-stationary nature in real output turn to the fractionally integrated models characterized by persistence and long memory. Output changes decomposition to permanent and transitory component as pointed out by Michelacci and Zaffaroni, 2000, Silverberg and Verspagen, 2000, Mayoral, 2006, Caporale and Gil-Alana, 2009 requires series appropriate order determination (knife edge distinction problem between I(0) and I(1) series). Following Gil-Alana, 2004 fractionally integrated model

$$y_t = \alpha + \beta_t + x_t,\ t = 1, 2... \tag{1}$$

$$(1-L)^d x_t = u_t,\ t = 1,2\ldots, \tag{2}$$

is used.

When d (long memory or fractional integration parameter) equals zero ($d = 0$, $x_t = v_t$) real output series is stationary, exhibiting short memory and mean reversion with finite variance. In this case, the effects of a shock in real output are transitory, decaying geometrically depending on the structure defining output short run dynamics. If $0 < d < 0.5$, real output series behave like fractionally integrated process implying strong dependence between past observation, long memory, mean reversion and covariance stationarity. The effects of a shock in real output lasts in the long run decaying at a slower, hyperbolic rate. When $0.5 < d < 1$, real output series is no more covariance stationary but still mean reverting. Effects of a shock in real output is long lasting and decays at an even slower rate. With $d = 1$ real output series is integrated, having unit root (nonstationary) with infinite memory and non-mean reverting. With real output as integrated series the effects of a shock in real output is permanent having a long run effect on output (forever persistent). In the case of $d > 1$, real output series is non stationary, non mean reverting with infinite memory and shocks effect diverging forever.

This paper evaluates the existence of long memory in real output in Croatia. Research studies making no distinction between fractionally integrated real output series ($0.5 < d < 1$) and simple I(0) or I(1) misidentify short/long memory characteristics violating standard classical assumptions. Ignoring this fact when computing tests and confidence intervals for the mean result in model misspecification and strong bias (Beran, 1989). This paper looks at the real output dynamics in Croatia allowing for short/long memory components and fractional integration contrasting existent literature in Croatia modeling real output series simply as I(0) or I(1) process.

Using a battery of non-parametric, semi-parametric and parametric fractional integration tests the general characteristics of fluctuations in real output is identified. Implementing various ARFIMA models on real output series this paper study how long typical recession or expansion last and whether fluctuations in real output for Croatia are mostly transitory or permanent. Study results validate real output time series in Croatia are best modeled as fractionally integrated models having strong importance for existent literature body and very large practical importance for policy makers in Croatia.

The rest of the paper is organized as follows: section 2 describes data and methodological framework. Section 3 discuss empirical results obtained from applying tests to different measures of real output time series in Croatia. Concluding remarks and possible extension for further research are presented in section 4.

II. DATA AND METHODOLOGICAL CONSIDERATIONS

Data used for this study includes real GDP, real GDP per capita and per employed person time series data. The data are quarterly with starting dates from 1996 to 2012 in all cases except for real GDP per capita with quarterly observations from 2000 – 2012. All series used in the study includes series in levels, first difference and transformed to natural logs adjusted series, seasonally adjusted input series with Census Bureau X-12-ARIMA with and without natural log transformation. Series are expressed in 2005 constant prices derived from Croatian statistical office data and publications for various years.

Table 1 provides the descriptive statistics for the series used in the analysis. Table 1 shows series are negatively skewed around zero indicating series are generally normally distributed. GDP per capita series meets all normal distribution conditions best among different measures of aggregate output used in this study. Different aggregate output measures (BDP, BDPE, BDPP) in levels generally follow normal distribution (Gaussian) while transformed input series (first-second differences, log transformation and seasonally adjusted) generally reject the null of data normal distribution (results from the Jarque-Bera, Doornik-Hansen, Shapiro-Wilk and Liliefors tests)[1].

TABLE 1 DESCRIPTIVE STATISTICS

Series	Mean	Median	Min.	Max.	Std. Dev.	C.V.	Skewness	Ex. kurtosis
BDP	51365	52373.8	37139.0	66063.7	7951.91	0.1548	-0.03680	-1.20118
BDPE	35105	35584.5	27097.3	41002.3	3432.10	0.09776	-0.38964	-0.79288
BDPP	12526	12676.8	9755.50	14866.8	1288.82	0.1028	-0.26594	-0.56844
BDP_d11	51414	52462.1	38665.4	63048.1	7597.80	0.1477	-0.15865	-1.42007
BDP_d11log	51413	52477.7	38775.4	63293.2	7600.67	0.1478	-0.15792	-1.41738
BDPE_d11	35140	36268.4	28513.4	41637.0	3196.20	0.09095	-0.49036	-0.71069
BDPE_d11log	35145	36214.5	28602.0	41780.2	3202.71	0.09112	-0.47149	-0.70979
ld_BDP	0.00634	0.0299906	-0.107442	0.106050	0.0653559	10.2944	-0.24907	-1.52209
ld_BDPE	0.00129	0.0205782	-0.136211	0.105401	0.0629246	48.4619	-0.21258	-1.33783
ld_BDPP	0.00616	0.0242789	-0.126716	0.120370	0.0743988	12.0582	-0.32735	-1.29916
BDPP_d11	12543.9	12959.4	10454.9	14269.5	1125.52	0.08972	-0.52110	-0.98515
BDPP_d11log	12544.4	12959.8	10454.1	14329.6	1127.60	0.08988	-0.51603	-0.98202
d_BDP	290.891	1413.50	-6407.44	5649.56	3476.38	11.9508	-0.31678	-1.2943
d_BDPE	49.8344	776.037	-4943.37	3642.53	2202.96	44.2056	-0.27293	-1.2386
d_BDPP	69.1541	337.626	-1627.24	1476.90	940.839	13.6050	-0.41975	-1.2075

Source: Author calculations on data provided by Croatian Statistical Office (quarterly data in 2005 constant prices)

Notes: BDP (real GDP), BDP_d11(seasonally adjusted), BDP_d11log(seasonally adjusted in log), dBDP(BDP first difference), ldBDP(BDP log differenced)

BDPE (real GDP per employed person), BDPE_d11(seasonally adjusted), BDPE_d11log(seasonally adjusted in log), dBDPE(BDPE first difference), ldBDPE(BDPE log differenced)

BDPP (real GDP per capita), BDPP_d11(seasonally adjusted), BDPP_d11log(seasonally adjusted in log), dBDP(BDPP first difference), ldBDPP(BDPP log differenced)

Figure 1 shows various aggregate output measure series (input and transformed) with their corresponding periodograms. Figure 1 displays a large peak in the periodogram of series in levels and seasonally adjusted series across zero frequency implying possible fractional integrated structure for the aggregate output series in Croatia. First and second differenced series show values close to zero at zero frequency with a large peak at 0.5 suggesting possible series overdifferencing issue. In the search of long memory in the series figure 2 shows corresponding series correlogram.

[1]This is no limitation for our analysis since we retain large sample observations.

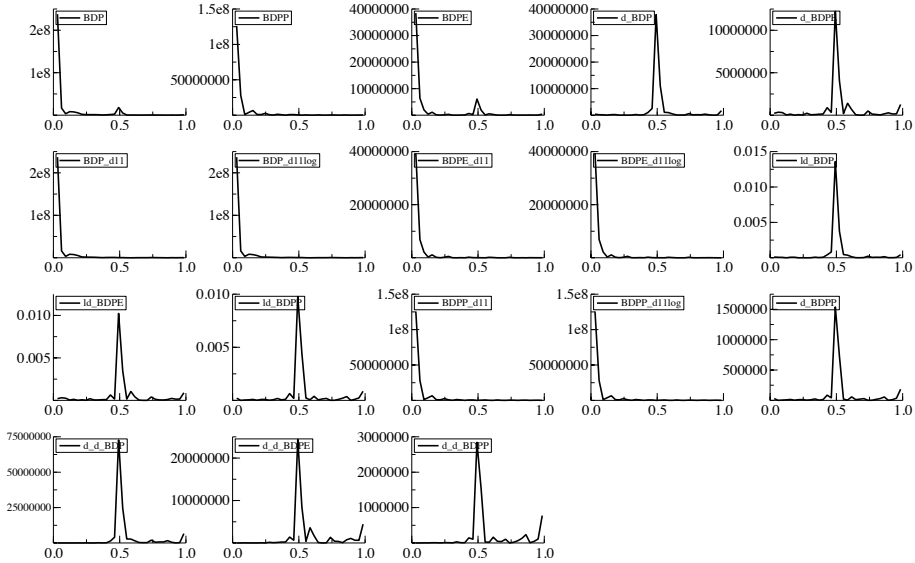

FIGURE 1—PERIODOGRAM OF INPUT AND TRANSFORMED BDP, BDPE, BDPP SERIES

Source: Author calculation on data from Croatian Statistical Office

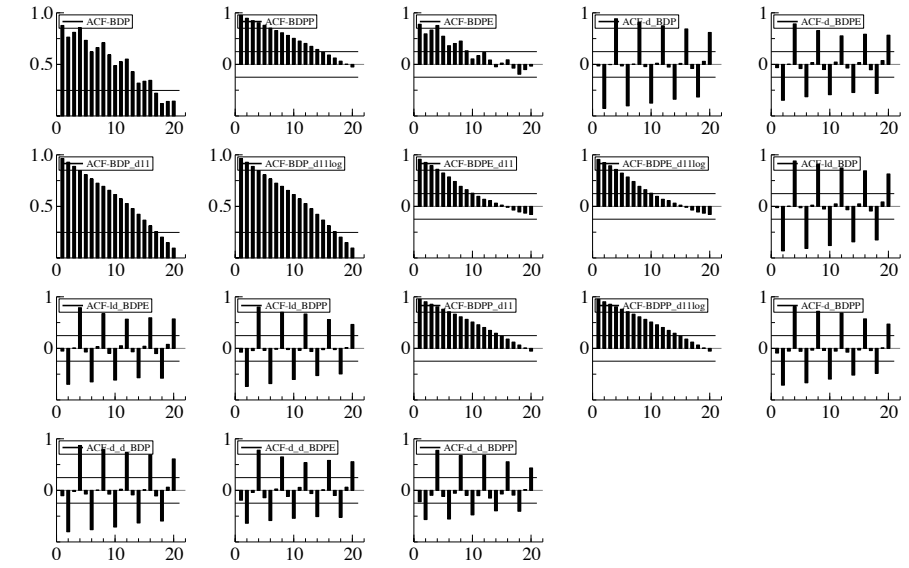

FIGURE 2—CORRELOGRAM OF INPUT AND TRANSFORMED BDP, BDPE, BDPP SERIES

Source: Author calculation on data from Croatian Statistical Office

Slow decay of in the aggregate output correlogram is another evidence of possible fractional integration in the series. Autocorrelation for the series under study decay very slowly as the lag length increases indicating aggregate output current values are dependent to own past distant values. The correlogram for the first and second differenced series still exhibit sluggish decline (first difference) or large oscillations (positive autocorrelations followed by a sequence of negative autocorrelations) in second differenced series.

Both periodogram (unbounded at zero frequency) and correlogram (slow decay with lag length) point to the possibility that aggregate output series in Croatia exhibit long memory.

To test for the series fractional integration and possible long run dependence in the series ADF and KPSS tests are used. Following Baillie et al., (1996) both ADF and KPSS tests series used in this study can be classified as stationary, unit root or fractionally integrated.

Said and Dickey, (1984) use an ARIMA model to test for the presence of the unit root in the time series of the form

$$(1+\alpha_1+...+\alpha_p)^{-1}(1+\beta_1+...+\beta_q)n(\hat{\rho}-1)\rightarrow\Gamma^{-1}\xi \tag{3}$$

under the null of $H_0: d = 1\ (\rho=1)$ for various values of p and q where

$d' = \rho - 1,\ d_i = (\alpha+\beta)(-\beta)^{i-1},\ d' = (d_0, d_1, ..., d_k)$.

Lee and Schmidt, (1996) use a two sided test for $I(0) = e_t$ against fractionally integrated alternatives $I(d),\ d < 0,\ or\ d > 0$ assuming ε_t are i.i.d. $N(0,\sigma^2)$ of the form

$$\omega = T^{-2}\sum_{t=1}^{T} S_t^2 / \hat{\sigma}^2 \tag{4}$$

to test for the presence of long memory in stationary time series.

A. NON PARAMETRIC APPROACHES

Hurst, (1951) and Mandelbrot, (1975) introduce a long memory statistical test of the form

$$R/S(n) = \frac{1}{s_n}\left[Max\sum_{j=1}^{k}(x_j-\bar{x}_n) - Min\sum_{j=1}^{k}(x_j-\bar{x}_n)\right], 1 \le k \le n \tag{5}$$

with s_n being maximum likelihood estimator for x standard deviation. Long memory test R/S empirical studies show the test is valid for detecting long memory in the series but very sensitive to series length influencing standard deviation and the mean (Granero et al., 2008).

Lo, (1991) observes classical R/S test is sensitive to the short memory presence with AR(1) component in DGP seriously biasing the R/S test statistics. To account for the possible bias caused by the short memory effects, Lo use Newey-West correction to derive a rescaled adjusted range or R/S test using modified standard deviation S_q to compensate for the effects of short memory in the test. Modified Lo's R/S have the form Teverovsky et al., (1999)

$$S_a(N) = \left(\frac{1}{N}\sum_{j=1}^{N}(X_j-\bar{X}_N)^2 + \frac{2}{N}\sum_{j=1}^{q}\omega_j(q)\left[\sum_{i=j+1}^{N}(X_i-\bar{X}_N)(X_{i-j}-\bar{X}_N)\right]\right)^{1/2} \tag{6}$$

$$V_q(N) = N^{-1/2} R(N) / S_q(N) \tag{7}$$

show evidence that modified R/S test is more robust than classical R/S test but still to be used within a battery of others long memory tests to investigate a true long record nature in the series. From (6) and (7) fractional differencing parameter (*d*) takes the form (Caporale and Gil-Alana, 2009)

$$d = \frac{Log(Q_T(q))}{Log(T)} \tag{8}$$

Giraitis et al., (2003) propose a rescaled variance test centering the KPSS statistics as rescaled sample second moment of partial sums. Rescaled variance test or V/S test

$$M_N = \frac{1}{\hat{s}^2_{N,q} N^2} \left[\sum_{k=1}^{N} \left(\sum_{j=1}^{k} (X_j - \bar{X}_N) \right) - \frac{1}{N} \left(\sum_{k=1}^{N} \sum_{j=1}^{k} (X_j - \bar{X}_N \right)^2 \right] \tag{9}$$

corrected for M_n proved more robust for high volatile series (Caporale and Gil-Alana, 2009) and less sensitive to the choice of optimal bandwidth parameter *q* ($2 \leq q \geq 10$). Fixed bandwidth values do not perform well under short range dependence. V/S statistics show higher power in relation to the KPSS statistics but still remains weak to the shifts in the series levels (Alptekin, 2006). Under the null, V/S follows $V / S \Rightarrow \eta(t)$. Small values of test statistics reject the null hypothesis of short memory.

Lobato and Robinson, (1998) build a log periodogram nonparametric test of *I(0)* with the t-statistics

$$LM = m\hat{e}' \hat{E}^{-1} \hat{e} \,. \tag{10}$$

Under the null of series as *I(0)* process *LM* provides a test against the alternative *d > 0* or series is a long memory process and *d < 0* series show antipersistence, i.e. series is a mean reverting process. This would imply that increase in output would most likely be followed by a decrease in output exhibiting a highly cyclical dynamics in the economy.

Davidson and Hashimzade, (2009; Davidson, 2009) develop a bootstrap test of I(0) to overcome nonparametric tests great dependence on optimal bandwidth choice. Test performance in this case depends on how well estimated model fit DGP as well as the choice of the shock distribution (Student's t/Gaussian). In this study Gaussian shock distribution is assumed. Using Breitung, 2002 test statistics

$$\hat{\rho}_T = \frac{\sum_{t=1}^{T} U_t^2}{T \sum_{t=1}^{T} u_t^2} \tag{11}$$

and Kolmogorov-Smirnov test for equality of empirical distribution with the benchmark case a bootstrap test for I(0) is implemented with calculated *p*-values. Large test statistics show bootstrap test rejects the null of I(0) under the null distribution of Breitung's statistics.

B. SEMI-PARAMETRIC APPROACHES

Semi-parametric approaches avoid the misspecification issue emerging in fully specific parsimonious parametric models. They permit to explore the *I(d)* structure of the series constraining the long run behavior to be an *I(0)* process. By doing so, potential misspecifications and loss of power under short run effect is avoided since no short run components modeling is required (no ARMA parameter of the series clear specification). Diverse semi-parametric approaches for measuring fractional differencing parameter *(d)* exist. Geweke and Porter Hudak, (1983) propose a log periodogram estimate of fractional parameter *d* having the form

$$\log(I(\lambda_j)) = const + d\log\left(\left\{2\sin\frac{(\lambda_j}{2}\right\}^{-2}\right) + error \tag{12}$$

with

$$\hat{d} = \frac{\sum_{s=1}^{m} x_s \log I_x(\lambda_s)}{2\sum_{s=1}^{m} x_s^2} \tag{13}$$

Their approach was latter modified by Künsch, (1986), Robinson, (1995b), Hurvich and Ray, (1995; Hurvich and Ray, 2003; Hurvich et al., 2005), Shimotsu and Phillips, (2006) proposing different methods for the choice of Fourier frequency number *m* and to improve consistency and asymptotic normality when $d \geq 0$.

The appropriate choice of the frequency periodogram ordinates and regression sample length greatly influence estimated *d*. Semi-parametric methods developed prior to research of Phillips and Moon, (1999; Phillips, 1999a; Phillips, 1999b) were not based on the particular representation of the discrete Fourier transformation under the presence of unit root, i.e. $d = 1$. Phillips point out that GPH test behave poorly in the case $d > 1$ and *d* exhibiting asymptotic bias toward unity. To correct for the GPH test inconsistencies, Phillips develops a modified form of the GPH test with modified log periodogram regression estimator to reflect the distribution of *d* under the null hypothesis that $d = 1$ see Baum and Wiggins, (2000). Phillip's modified GPH test takes the form

$$\omega_x(\lambda_s) = \frac{\omega_u(\lambda_s)}{1-e^{i\lambda s}} - \frac{e^{i\lambda s}}{1-e^{i\lambda s}}\frac{X_n}{\sqrt{2\pi n}} \tag{14}$$

and

$$\tilde{d} = \frac{\sum_{s=1}^{m} x_s \log I_v(\lambda_s)}{2\sum_{s=1}^{m} x_s^2} \tag{15}$$

Unlike previous semi-parametric tests, (11) proved to be consistent for d < 1 and d > 1 fractional alternatives.

In order to improve efficiency, Robinson, (1995b) advance a pooled log periodogram estimate for a stationary and invertible time series of the form Velasco, (2006)

$$\hat{d}_m^{LP} = \left(\sum_j \Lambda_j^2 \right)^{-1} \left(\sum_j \Lambda_j Y_{X,j}^{(K)} \right). \tag{16}$$

Allowing for multivariate semiparametric estimate of the long memory in the series (multivariate model under the hypothesis that different series can share a common fractional integration parameter *d*) consistency and asymptotic normality of the log periodogram estimator is achieved.

In his other study Robinson, (1995a) propose a spectral maximum likelihood estimator based on trimmed Whittle estimator of the form (Hauser, 1997)

$$\log(L_n(d,\sigma_u^2)) = -\sum_{j=1}^{m} \log(f(\lambda_j \Big| d,\sigma_u^2)) - \sum_{j=1}^{m} \frac{I(\lambda_j)}{f(\lambda_j \Big| d,\sigma_u^2} \tag{17}$$

with (Caporale and Gil-Alana, 2009)

$$\hat{d} = \arg\min_d \left(\log \overline{C(d)} - 2d \frac{1}{m} \sum_{s=1}^{m} \log \lambda_s \right). \tag{18}$$

Robinson, (1995a) find his Gaussian semi-parametric estimate to be consistent, asymptotically normal and more efficient

$\sqrt{m}(\hat{d} - d_O) \rightarrow_d N(0,1/4), T \rightarrow \infty$ compared to other semi-parametric approaches.

Phillips and Shimotsu, (2004; Shimotsu and Phillips, 2006) find (13) to be inconsistent when approaching unity. Asymptotic properties of Robinson's Gaussian semi-parametric and local Whittle tests were limited to the -0.5 < d < 0.5 interval while Velasco, 1999 propose a modified log periodogram test valid even when d > 3.75 without differencing or detrending the data.

Harris et al., (2008) develop a test statistics for short memory process under the null hypothesis against the alternative d > 0 of long memory process. In relation to other fractional integration tests (testing the null of white noise against memory) here the null of short against long memory is tested ensuring statistics consistency. Test statistics takes the form

$$\hat{S}_k = \frac{\hat{N}_k + \hat{b}}{\hat{\omega}_l}. \tag{19}$$

The test is based on long-range autocovariances under N(0,1) with large values of test statistics rejecting the null of short memory.

Robinson and Henry, (1999) investigate properties of the semiparametric Gaussian method for estimating long memory parameters under conditional heteroscedasticity. They develop a method for estimating *d* for testing the null I(0) in the presence of conditional heteroscedasticity taking the form

$$\hat{H} = \arg\min_{\Delta_1 \le h \le \Delta_2} R(h)$$
$$R(h) = \log\left\{\frac{1}{m}\sum_{j=1}^{m}\frac{I(\lambda_j)}{\lambda_j^{1-2h}}\right\} - (2h-1)\frac{1}{m}\sum_{j=1}^{m}\log\lambda_j \quad . \tag{20}$$

They find conditional heteroscedasticity to exercise a troubling impact on the behavior of semiparametric estimates of long memory in moderate sample size.

Moulines-Soulier log-periodogram regression (Moulines and Soulier, 1999) estimate long memory time series properties using spectral density. Their semiparametric estimation of the fractional differencing coefficient *d* is defined as

$$\hat{d}_{p,n} = \arg\min_{\bar{d},\bar{\theta}_0,\ldots,\bar{\theta}_p} \sum_{k=1}^{K_n}\left(Y_{n,k} - \bar{d}g(y_k) - \sum_{j=0}^{p}\bar{\theta}_j h_j(y_k)\right)^2 . \tag{21}$$

Under assumptions of Gaussian process and spectral density estimator is consistent and asymptotically normal.

C. PARAMETRIC APPROACHES

Granger and Joyeux, (1980) and Hosking, (1981) introduce a widely used parametric model

$$(1-L)^d = \sum_{k=0}^{\infty}\frac{\Gamma(k-d)L^k}{\Gamma(-d)\Gamma(k+1)} \tag{22}$$

to capture both long run dynamics (long memory parameter *d*) and short memory dynamics (AR/MA parameters) of the time series. For each of the aggregate output series, different ARFIMA (*p,d,q*) models with *p, q* = 3 of the form

$$\Phi(L)(1-L)^d(y_t - \mu) = \Theta(L)u_t \tag{23}$$

is used. Following Sowell, (1992) fractional ARIMA model

$$\begin{aligned}&(1+\phi_1 L+\phi_2 L^2+\ldots+\phi_p L^p)(1-L)^d x_t\\ &=(1+\theta_1 L+\theta_2 L^2+\ldots+\theta_q L^q)\varepsilon_t\end{aligned} \tag{24}$$

a regression model of the form *(Gil-Alana, 2004)

$$\begin{aligned}&y_t = \alpha+\beta_t+x_t, t=1,2,\ldots\\ &(1-L)^d x_t = u_t, t=1,2\ldots,\end{aligned} \tag{22}$$

is used. This study employs Sowell, (1992) maximum likelihood procedure in time domain

$$\phi_p(L)(1-L)^d y_t = \theta_q(L)\varepsilon_t \tag{25}$$

with L being a lag operator, *d* is a fractional differencing parameter, y_t = Croatian aggregate output measures, $\phi_p(L)$ AR and $\theta_q(L)$ MA polynomials. To explain the degree of persistence in the time series, long memory (fractional integration) parameter *d* must be correctly measured. Parametric approach lacks of flexibility when it comes to model misspecification. Spurious or incorrectly specified model (particularly short memory dependence

component) significantly affects estimates of the long memory parameter *d* Gil Alana, (2001). The values of *d* describe time series dynamic behavior. With $d = 0$, series is a stationary *I(0)* process or a short-memory process and the effects of shocks on aggregate output ($t \rightarrow y_t$) decays geometrically to zero. Therefore, shocks in a stationary (short memory) time series have only transitory effect (short run fluctuations in aggregate output due to transitory shocks). For a nonstationary series with unit root *I(1)* and $d = 1$, shocks in *t* result in permanent output fluctuation (permanent shocks), i.e. effects on output do not disappear over time (non-mean reverting). A high value of *d* implies a long memory process with a fractionally integrated process still mean reverting as opposite to *I(1)* or *I(2)* integrated series. For $-0.5 < d < 0$ series exhibits negative dependence between $t \rightarrow y_t$, i.e. anti persistence or short memory with summable autocovariances (fractionally over-differenced). For $0 < d < 0.5$ series is covariance stationary and show long range dependence (persistence) for $t \rightarrow y_t$, revealing both short and long memory dynamics. Process is still mean-reverting (re-equilibrating) and a hybrid between white noise and random walk. The fractional integral of order $0.5 < d < 1$ show y_t is no more stationary but still mean reverting with infinite variance, effects of a shock on output die out with time. Non-stationary, integrated series with infinite variance and non-returning to its original values in the future (non mean-reversion) with $d = 1$ the process follow a unit root behavior with both short and infinite memory dynamics. Fluctuations in output (effects of a shock) therefore are largely permanent. For $d > 1$ series is non stationary and exhibits perfects or infinite memory with mean having no influence on series long run evolution. Series having $1 \leq d \leq 1.5$, Δy_t is mean reverting with finite variance. When $d > 1$ local Whittle *(LW)* estimator converges to unity and therefore become inconsistent Phillips and Shimotsu, (2004). Log periodogram based estimators in general are subject to inconsistency when series is nonstationary and $d > 0.75$. Several approach can be used to address this issue, from fractional differencing the series to tapering the data Nielsen, (2007) and the extended multivariate local Whittle is recommended Abadir et al., (2007)

$$\omega_a^x(\lambda_j) = (1-\exp(i\lambda_j))^{-p_a^0}\omega_{\Delta p_a^0 x_a}(\lambda_j) - \exp(i\lambda_j)\sum_{r_a=1}^{p_a^0}(1-\exp(i\lambda_j))^{-r_a}\omega_{\Delta r_a x_a} \tag{26}$$

$$= (1-\exp(i\lambda_j))^{-p_a^0}\omega_a^u(\lambda_j) - \exp(i\lambda_j)\sum_{r_a=1}^{p_a^0}(1-\exp(i\lambda_j))^{-r_a}\omega_{\Delta r_a x_a}, a = 1,\ldots,q,.$$

For each measure of aggregate output different ARFIMA(p,d,q) using Sowell, 1992 with p, $q \leq 3$ using maximum likelihood (Gaussian). To find a best model specification and avoid model misspecification and inconsistency, each aggregate output series was tested for fractional integration using ARFIMA(p,d,q) under normality, heteroscedasticity, ARCH and Ljung-Box diagnostic test. Models that passed all diagnostic tests for each of the series were in turn subdue to model selection tests based on LR (likelihood criterions) and Akaike (AIC), Bayesian (BIC) information criterion.

In order to decide on the best model specification under test results, selected models were tested for the general characteristics of fluctuations using (IRF) impulse response function (infinite moving average representation) for each series to confirm the results. MA coefficients in ARFIMA(p,d,q) model follows Javier Contreras-Reyes

$$\psi_j \sim \left(\frac{1+\sum_{i=1}^{q} \theta_i}{1-\sum_{i=1}^{p} \phi_i} \right) \frac{j^{d-1}}{\Gamma(d)} \tag{27}$$

with impulse response function defined as

$$R_j \sim \sum_{i=0}^{j} \psi_i \eta_{j-i} \tag{28}$$

$\eta_t = \frac{\Gamma(t+d)}{(\Gamma(t+1)\Gamma(d)}$ and for large *j* using asymptotic method

$$R_j \sim \frac{j^{d-1}}{\Gamma(d)} \sum_{i=0}^{\infty} \psi_i \,. \tag{29}$$

To evaluate the responses of aggregate output to a shock an impulse response function $1-\beta(L)^{-1}\delta(L)(1+\alpha((1-L)^{d_2}-1))\partial$ is used. The effects of a shock depend on the chosen model specification making possible to describe general characteristics of fluctuation in aggregate output for Croatia.

III. EMPIRICAL RESULTS

Table 2 shows the results of ADF, KPSS and two fractional integration tests (Whittle and GPH).

TABLE 2 UNIT ROOT AND FRACTIONAL INTEGRATION TEST

	Unit root tests						Fractional Integration tests	
Series	ADF			ADF-GLS		KPSS	Whittle	GPH
	no const.	const.	const. and trend	const.	const. + t		Test *d*	Test *d*
GDP_t	1.04	-1.07	-2.21	0.14	-2.03	1.60	6.89(1.04)*	7.68(0.99)*
dGDP	-1.55	-1.99	-2.03	-1.00	-1.54	0.52*	2.09(0.32)	1.82(0.38)
dlGDP	-1.62	-2.09	-2.20	-0.64	-0.34	0.61*	2.42(0.36)*	1.53(0.41)
GDP_{d11}	1.90	-1.64	-1.10	0.10	-1.43	1.61	6.98(1.05)*	7.83(1.01)*
GDP_{d11log}	1.92	-1.56	-1.15	0.18	-1.44	1.61	7.00(1.06)*	7.86(1.02)*
$GDPC_t$	1.04	-2.02	-2.19	-0.06	-1.89	0.99	2.67(0.40)*	2.25(0.63)*
dGDPC	-1.85	-2.31	-3.22	-0.60	-1.32	0.50*	-5.80(-0.88)*	-0.30(-0.15)
dlGDPC	-1.78	-2.19	-3.25	-0.47	-1.08	0.55*	-5.75(-0.87)*	-0.26(-0.14)
$GDPC_{d11}$	1.08	-2.02	-0.73	-0.20	-1.22	0.99	6.68(1.00)*	6.03(1.02)*

$GDPC_{d11log}$	1.21	-2.26	-0.67	-0.19	-1.16	1.00	6.60(0.99)*	5.56(1.02)*
$GDPE_t$	0.56	-1.05	-2.23	-1.24	-1.58	0.72*	9.08(1.37)*	6.61(1.63)*
dGDPE	-2.37*	-2.38	-2.69	-1.36	-2.27	0.32*	2.05(0.31)*	1.68(0.40)
dlGDPE	-2.37*	-2.38	-2.63	-1.43	-1.73	0.30*	2.18(0.33)*	1.96(0.41)
$GDPE_{d11}$	0.31	-0.57	-2.03	-0.68	-0.96	0.72*	8.25(1.24)*	6.76(1.45)*
$GDPE_{d11log}$	0.30	-0.57	-2.09	-0.67	-0.93	0.72*	8.12(1.23)*	6.89(1.41)*

Source: Author calculation on data from Croatian Statistical Office

Plots of the time series are given in figures (1) and (2). Visual inspection of the series shows series have different degrees of persistence and long memory structure. Series in level and seasonally adjusted series exhibit short and long memory. Differenced series (first and second) on the other hand show the presence of anti-persistence in aggregate output.

Table (2) shows unit root tests for the aggregate output series. For most series ADF tests do not rejects the null (except for dGDPE and dlGDPE series) so there is evidence GDP series in Croatia behave as I(1) processes.

KPSS tests for most series do not reject the null of I(0). Modeling these series either as I(0) or I (1) is too restrictive and show characteristics typical for fractionally integrated processes.

Rejection by ADF and ADF-GLS and failure to reject by KPSS for difference and log differenced GDP and GDPC series is to be considered as strong evidence of stationary I(0) processes. For the GDP per employed person series (all specifications) ADF and ADF-GLS rejects the null while KPSS fail to reject the null of stationarity pointing to the conclusion that series are I(0). For GDP_t, GDPd11 and GDP d11log ADF, ADF-GLS and KPSS reject the null indicating series are following fractionally integrated alternatives. The same is valid for difference and log differenced GDP per capita series.

Table 2 summarizes long memory test results (GPH and Whittle estimator) for all output series. GPH rejects the null of stationarity for most of the series except for differenced and log differenced series of GDP, GDPC and GDPE. The evidence of long memory is found for all of the series except for the one mentioned above. The estimated values for d range from 0.63 to 1.63. GDP series in levels and seasonally adjusted do not reject the hypothesis of $d = 1$. Same holds for seasonally adjusted GDP per capita series. GDP per capita in levels show evidence of long memory with $d = 0.63$. For GDP per employed person in levels the unit root null hypothesis is rejected while for it's seasonally adjusted series the null of unit root cannot be rejected. Whittle estimator test results confirm the GPH results. Test results differs only log differenced GDP series with $d = 0.63$ implying nonstationarity but mean reversion. The null of $d = 0$ and $d = 1$ is rejected for the GDP per capita series in level and seasonally adjusted GDP per person series. Anti-persistence (cyclical fluctuation in output) is found for differenced and log differenced GDP per capita series. For all other series the null of unit root cannot be rejected with d in the range 0.99 - 1.37. Seasonally adjusted series for GDP per employed persons appear to be highly persistent but mean reverting best modeled as fractionally integrated processes.

Results from the table 2, testing both ADF and KPSS tests, ADF test results reject the null of unit root in general, except for the dGDPE and dlGDPE series. In general, real GDP, real GDP per capita and real GDP per employed person series do not behave as I(1) processes. For most of the series (except for real GDP per employed person) KPSS test rejects the null of I(0).

For series with ADF test rejecting the I(1) hypothesis and KPSS rejecting the I(0) indicates that series are neither I(0) nor I(1) processes but can be described as fractionally integrated processes. It is evident that real GDP series is better described as fractionally integrated process. However, for first differenced and log differenced GDP series test results show strong evidence of stationary I(0) processes. The same stands for real GDP per capita series with $GDPC_t$, $GDPC_{d11}$, $GDPC_{d11log}$ following fractionally integrated distribution while dGDPC, dlGDPC are better described as I(0). For the real GDP per employed person series, rejection of ADF test and failure to reject the KPSS test is strong evidence of stationarity I(0).

First difference and log differenced real GDP per employed persons series show insufficient information on the long dependence properties (both ADF and KPSS tests fail to reject the null). When time trend is included in the KPSS test, $GDPE_t$, $GDPE_{d11}$, $GDPE_{d11log}$ test results reject the null of stationarity indicating series are better described as fractional integrated alternatives (in accordance with Whittle and GPH test results in the table). Therefore, real GDP per employed person series under the KPSS test should be modeled with the trend inclusion in the test since more evidence is found that series follows fractionally integrated processes then being I(0). The distinction between I(d) processes for different aggregate output series is important for measuring the degree of persistence in the series. Assuming that aggregate output is a stationary processes I(0) implies no change in the output equilibrium level. If this is a case, we shall conclude that aggregate output in Croatia is a short memory processes *(d=0)*, best described as stationary and invertible ARMA (rapidly decaying autocovariances) Beran, (1994).

Supposing that aggregate output series is better described by an I(1) process infers temporary deviations from equilibrium levels in the series (unit root presence). Autocorrelation function for this case linearly declines and series are nonstationary and non-mean reverting. Perron(1989, 1990) reason that mean shifts and break in the series lead to non rejection of integrated series hypothesis while in practice only few macroeconomic series are I(1). Thus, many series can contain fractionally integrated trends. Granger and Joyeux, (1980), Granger, (1980) observe macroeconomic series usually falls between white noise *(d=0)* and random walk *(d=1)* following fractionally integrated noise *(d=0.5)*. In this case, series are stationary with long range dependence or long memory, mean reverting process with shocks affecting the series in the long run but returning to the equilibrium path some point in time (Gil Alana and Brian Henry, 2003). Autocorrelation function for such a process slowly decays (Beran, 1994). To explain the degree of persistence in Croatian macroeconomic series a set of testing procedures for fractional integration is used. Since macroeconomic series under observation are neither I(0) nor I(1) as indicated by ADF and KPSS a fractionally differenced model may be an appropriate representation.

Table 3 show test results for a battery of non-parametric and semi-parametric methods used for modeling long range dependence in aggregate output series for Croatia. I(0) tests results in table 3 show majority of the tests rejects the null of stationarity. Most tests do not reject the null of stationarity for differenced and log differenced series of real GDP and real GDP per capita. The same holds for real GDP per employed person except for the Phillips test (with power 0.5) and HML test. Two series show distinct pattern from the rest of the observation. Differenced and log differenced real GDP, real GDP per capita and real GDP per employed person do not show

unit root behavior (ADF, ADF-GLS test reject the null of unit root). KPSS test for same series do not reject the null of stationarity. Therefore, results lead to the conclusion series are I(0). However, looking at the fractional integration test results, HML and Bootstrap tests strongly reject the null of stationarity. HML test do not reject the null of stationarity for difference and log differenced real GDP per capita series. Robinson/Henry, Moulines/Soulier, Phillips GPH show series exhibit anti persistence. Anti-persistence is clearly visible correlogram of the series. Whittle and GPH test show two series are anti-persistent or fractionally integrated with $d < 0.5$.

TABLE 3 FRACTIONAL INTEGRATION TESTS FOR OUTPUT SERIES

Series	R/S Hurst/ Mundelbrot	Phillips (1999) GPH			Lo R/S (1991) test	Robinson Test (1995)			*V/S test*
	t-stat	*0.5*	*0.75*	*0.9*	*t-stat*	*0.5*	*0.75*	*0.9*	*t-stat*
GDP	3.46	1.19**	0.58	0.62**	2.53	0.98**	0.86**	0.73**	0.32**
dGDP	0.56	0.44	-0.23	-0.10	0.57	0.58	-0.20	-0.08	0.14
dlGDP	0.53	0.38	-0.17	-0.14	0.54	0.51	-0.18	-0.14	0.12
GDP_{d11}	3.61	1.20**	1.03**	0.95**	2.57	0.99*	0.95**	0.76**	0.28**
GDP_{d11log}	3.61	1.21**	1.07**	1.02**	2.57	0.99*	0.94**	0.74**	0.28**
GDPC	3.63	1.42	0.45	0.61*	2.60	0.98**	0.80**	0.61**	0.22*
dGDPC	0.65	0.50	0.13	-0.19	0.68	0.55	-0.06	-0.22	0.17
dlGDPC	0.66	0.56	0.20	-0.13	0.68	0.81*	0.00	-0.23	0.15
$GDPC_{d11}$	3.65	1.43**	1.02**	0.92**	2.61	0.98**	0.88**	0.68**	0.21*
$GDPC_{d11log}$	3.65	1.40**	1.09**	0.98**	2.61	0.98**	0.88**	0.65**	0.21*
GDPE	3.22	1.67**	0.86**	1.05**	2.41	1.65**	0.89**	0.65**	0.32**
dGDPE	0.72	0.57*	0.05	0.00	0.75	0.62	-0.09	-0.06	0.11
dlGDPE	0.77	0.54*	0.11	0.03	0.79	0.54	0.01	-0.02	0.11
$GDPE_{d11}$	3.44	1.43**	1.26**	0.92**	2.49	1.64**	1.05**	0.81**	0.28**
$GDPE_{d11log}$	3.44	1.48**	1.26**	1.21**	2.49	1.63**	1.07**	0.82**	0.28**

(continued)

Robinson/ Henry (1998)	Moulines/ Soulier test	Robinson/ Lobato (1998) test	HML test (2008)	Bootstrap Test (2009)
d	d	t-stat	t-stat	t-stat
0.76**	0.93**	-	3.11**	2.27**
-0.42**	-0.14	-1.28	2.24*	7.04**
-0.44**	-0.18	-1.24	2.24*	6.96**
0.90**	1.02**	-	3.11**	2.13**
0.89**	1.01**	-	3.11**	2.91**
0.92**	0.80**	0.77	2.36**	7.03**
-0.39**	-0.22	-1.52	-1.60	7.04**
-0.36**	-0.20	-1.42	-1.60	7.04**
0.91**	1.00**	-	2.36**	7.03**

0.91**	0.97**	-	2.36**	7.03**
0.65**	0.88**	0.35	3.07**	2.98**
-0.28**	-0.11	-1.39	1.81*	6.96**
-0.26**	-0.03	-1.30	1.86*	7.03**
0.95**	1.34**	-	3.08**	2.20**
0.96**	1.16**	-	3.08**	2.27**

*Source: Author calculations on data provided by Croatian Statistical Office (quarterly data in 2005 constant prices), Notes: * , ** denotes significance at 5, 1% level. Future values of agregate output have a tendency to return to a long-term mean and an increase in aggregate output is more likely to be followed by an output decrease or vice versa. Additional fractional integration tests should be implemented on the two series (fractional integration under structural breaks, white noise, AR parameters) before final judgment on the behavior of the two series can be made. However, this study test results firmly put forward two series are not pure stationary process with d = 0.*

Parametric test results for the two series (see table 4) confirms above statements. Table 4 shows fractional integration parameter *d* value strongly depends on the appropriate model specification. For parametric test in table 4 estimated values of d ranges from -0.80 to 0.84. To determine the correct model specification for difference and log differenced series across different model presented table 4 diagnostic test (no serial correlation, functional form, normality, homoscedasticity) on the residuals and AIC (Akaike), SIC (Schwarz), Log likelihood information criteria along with LR (Langrange multiplier) test were used. Test results show differenced and log differenced aggregate output series in Croatia can be best described as fractionally integrated ARFIMA model.

The order of integration strongly depends on the short run components modeling of the series. Differenced series for real GDP is best modeled according to residuals diagnostic and LR tests as ARFIMA(0,-0.55,0), for real GDP per capita ARFIMA(0,-0.57,0) and for real GDP per person employed ARFIMA(0,-0.35,0). Using information criteria, best model specification for real GDP is ARFIMA(3,0.44,2), for real GDP per capita ARFIMA(3,0.47,1) and for real GDP per employed person ARFIMA(3,0.68,1).

Log differenced series for real GDP (passing diagnostic and LR tests) is best described as ARFIMA(2,0.44,3), for real GDP per capita ARFIMA(2,0.09,3) and for real GDP per employed person ARFIMA(3,0.14,3).Turning to the information criteria selection procedure, best model specification for real GDP is ARFIMA(3,0.63,1), for real GDP per capita ARFIMA(3,-1.12,2) and for real GDP per employed person ARFIMA(3,0.72,1).According to the residual diagnostic and LR tests best model specifications for differenced real GDP reject the null of unit root while the null of stationarity can not be rejected. Results are confirmed by information criteria model selection since AIC, BIC and LL best model selection rejects the null of unit root in favor of stationary series with long memory (fractional model).The order of integration for log differenced aggregate output series are greater in relation to differenced output series. Based on residual diagnostic and LR tests the null of stationarity cannot be rejected for log difference real GDP per capita and real GDP per employed person series. On the other hand, information criteria support non stationary and long memory models for real GDP and real GDP per employed person. For real GDP per capita, information criteria tests show stationary, anti-persistence and fast mean reversing behavior. Table 4 Best model specification for individual aggregate output series

TABLE 4 BEST MODEL SPECIFICATION

Series	ARFIMA (p, d, q)	t- tests'			AR parameters			MA parameters		
		$t_{d=0}$	$t_{d=1}$	$t_{d=2}$	ϕ_1	ϕ_2	ϕ_3	θ_1	θ_2	θ_3
GDP_t	(0, 0.75, 0)	67.8	7.48	187.3	-	-	-	-	-	-
	(0.09)									
	(3, 1.51, 2)	36.8	4.20	3.89	-0.74	-1.03	-0.74	-0.03	-0.68	-
	(0.25)									
dGDP	(0, -0.55, 0)	24.9	195.3	527.3	-	-	-	-	-	-
	(0.11)									
	(3, 0.44, 2)	2.02	3.16	24.8	-0.74	-1.03	-0.74	-0.08	-0.61	-
	(0.31)									
dlGDP	(2, 0.44, 3)	1.55	2.45	19.2	-0.01	-1.01	-	0.62	-0.85	0.42
	(0.36)									
	(3, 0.63, 1)	5.74	1.90	26.2	-0.89	-1.01	-0.86	-0.11	-	-
	(0.26)									
GDP_{d11}	(0, 1.29, 3)	39.8	2.02	11.9	-	-	-	0.27	-0.16	-0.03
	(0.20)									
	--	--	--	--	--	--	--	--	--	--
GDP_{d11log}	(0, 2.33, 3)	97.7	31.9	2.00	-	-	-	1.33	-0.48	0.15
	(0.24)									
	--	--	--	--	--	--	--	--	--	--
$GDPC_t$	(0, 1.14, 3)	52.1	0.77'	29.3	-	-	-	0.08	0.17	0.12
	(0.16)									
	--	--	--	--	--	--	--	--	--	--
dGDPC	(0. -0.57, 0)	29.0	218.5	584.5	-	-	-	-	-	-
	(0.11)									
	(3, 0.47, 1)	2.99	3.73	31.3	-0.88	-0.98	-0.85	-0.05	-	-
	(0.27)									
dlGDPC	(2, 0.09, 3)	0.09'	9.55	42.1	-0.00	-1.00	-	0.42	-0.67	0.29
	(0.29)									
	(3, -1.12, 2)	56.6	202.1	437.4	0.96	-1.01	0.95	0.17	-0.67	-
	(0.15)									
$GDPC_{d11}$	(0, 1.07, 3)	218.8	0.82'	168.4	-	-	-	0.08	0.02	-0.0
	(0.07)									
	--	--	--	--	--	--	--	--	--	--

(continued)

$GDPC_{d11log}$	(0, 1.08, 3) (0.07)	223.9	0.97'	168.7	--	--	--	0.08	0.01	0.00
	--	--	--	--	--	--	--	--	--	--
$GDPE_t$	(0, 0.67, 0) (0.10)	40.8	11.3	172.1	-	-	-	-	-	-
	--	--	--	--	--	--	--	--	--	--
dGDPE	(0, -0.35, 0) (0.09)	12.08	182.2	553.2	-	-	-	-	-	-
	(3, 0.68, 1) (0.30)	4.99	1.05'	18.3	-0.89	-0.97	-0.82	-0.14	-	-
dlGDP	(3, 0.14, 3) (0.18)	0.57'	21.1	99.0	-0.75	-1.01	-0.74	-0.51	-0.87	-0.49
	(3, 0.72, 1) (0.31)	5.14	0.81'	16.5	-0.88	-0.96	-0.80	-0.11	-	-
$GDPE_{d11}$	(0, 1.19, 3) (0.51)	5.42	0.15'	2.41	-	-	-	0.17	0.00	-0.09
	(2, 0.94, 3) (0.67)	1.96	0.00'	2.49	0.74	0.00	-	0.68	-0.03	-0.12
$GDPE_{d11log}$	(0, 1.16, 3) (0.52)	4.93	0.09'	2.57	-	-	-	0.11	-0.02	-0.10
	(2, 1.29, 2) (0.23)	31.2	1.56'	9.53	-0.58	-0.12	-	-0.33	0.07	-

Source: Author calculations

Tables (5,6,7,8,9,10,11,12 see appendix) summarize selected models for level and seasonally adjusted (X-12 ARIMA) aggregate output series according to both selections criteria used. Tables show that for level and seasonally adjusted series order of integration varies.

For seasonally adjusted real GDP order of integration ranges from 0.99 - 1.81 while for real GDP in levels 0.57 - 1.81. Resulting model from the established model selection criterion based on residual diagnostics and LR tests is an ARFIMA(0,0.75,0).Identified model implies nonstationarity but mean reversion. This result is in contradiction with a large body of empirical studies in Croatia identifying real GDP series in levels as I(1).

This study however shows that a fractional model with d smaller then one (d = 0.75) better describes series behavior. For the same series, AIC, SIC and LC model selection procedure chooses an ARFIMA(3,1.51,2) model rejecting both I(1) and I(2) hypothesis are rejected. Once again, results of this study contradict various other study for Croatia. Correct model specification for real GDP per capita series in levels appears to be ARFIMA(0,1.14,3) supporting other studies finding this series to be an I(1) variable. For the real GDP per employed person series identified correct model is an ARFIMA(0,0.67,0) implying nonstationarity, mean reversion and rejection of I(1) assumption. For the X-12 ARIMA adjusted GDP per capita series best identified model follows ARFIMA(0,1.29,3) thus not rejecting the I(1) hypothesis. Therefore, X-12 ARIMA adjusted real GDP series in Croatia is best modeled as I(1) process. Same holds for X-12 ARIMA real GDP per capita modeled as ARFIMA(0,1.07,3) clearly not rejecting I(1) hypothesis. For X-12 ARIMA real GDP per employed person series a identified plausible model follows ARFIMA(0,1.19,3) confirming once again the null of I(1). Tests results are confirmed by the LR tests except for X-12 ARIMA real GDP series.

To describe general characteristics of fluctuation in aggregate output series in Croatia impulse response functions for all series are identified (see figures 3,4 and 5).

Figures (3,4 and 5) show real GDP series have long memory in levels and that the hypothesis of $d = 1$ is strongly rejected. Thus, using this series as unit root process in modeling is inappropriate. Series clearly show long memory or long range dependence as a mean reverting process with corresponding impulse responses convergent to zero. We observe that the effect of a shock on real GDP die out slowly in the long run (30 periods later). The same is valid for real GDP per employed person series while real GDP per capita series show the effects of a shock are divergent hyperbolically ($d > 1$). For first differenced series of real GDP/GDP per capita/GDP per employed person effects of a shock die out quickly. Right side graphs display impulse response function for model selected under information criteria. Anti-persistence and $d < 0$ is clearly visible with effect of a shock in aggregate output shifting from positive to negative period after period. A shock in output is followed by an increase in output in the following period after which another decline appear with series tending to revert to the mean. Anti-persistence is quite strong still present after 30 periods showing that differenced and log differenced aggregate output series are highly anti-persistent characterized by short memory and IR coefficients that die out fast. However, memory characteristics for the anti-persistent series varies from a standard short memory process so differenced and log differenced aggregate output series in Croatia should be modeled as intermediate memory process and not as I(0) contradicting other studies for Croatia implicitly assuming that differenced and log differenced real output is an I(0) process. Seasonally adjusted series for real output (GDP, GDP per capita, GDP per employed persons) clearly show impulse response coefficients diverge hyperbolically with $d > 1$. Thus the effects of a shock on real output seasonally adjusted series tend to be permanent. Series are nonstationary and non mean reverting. Not only, effect of shocks in real output permanent component in the series intensify over time as showed by the impulse response function graphs.

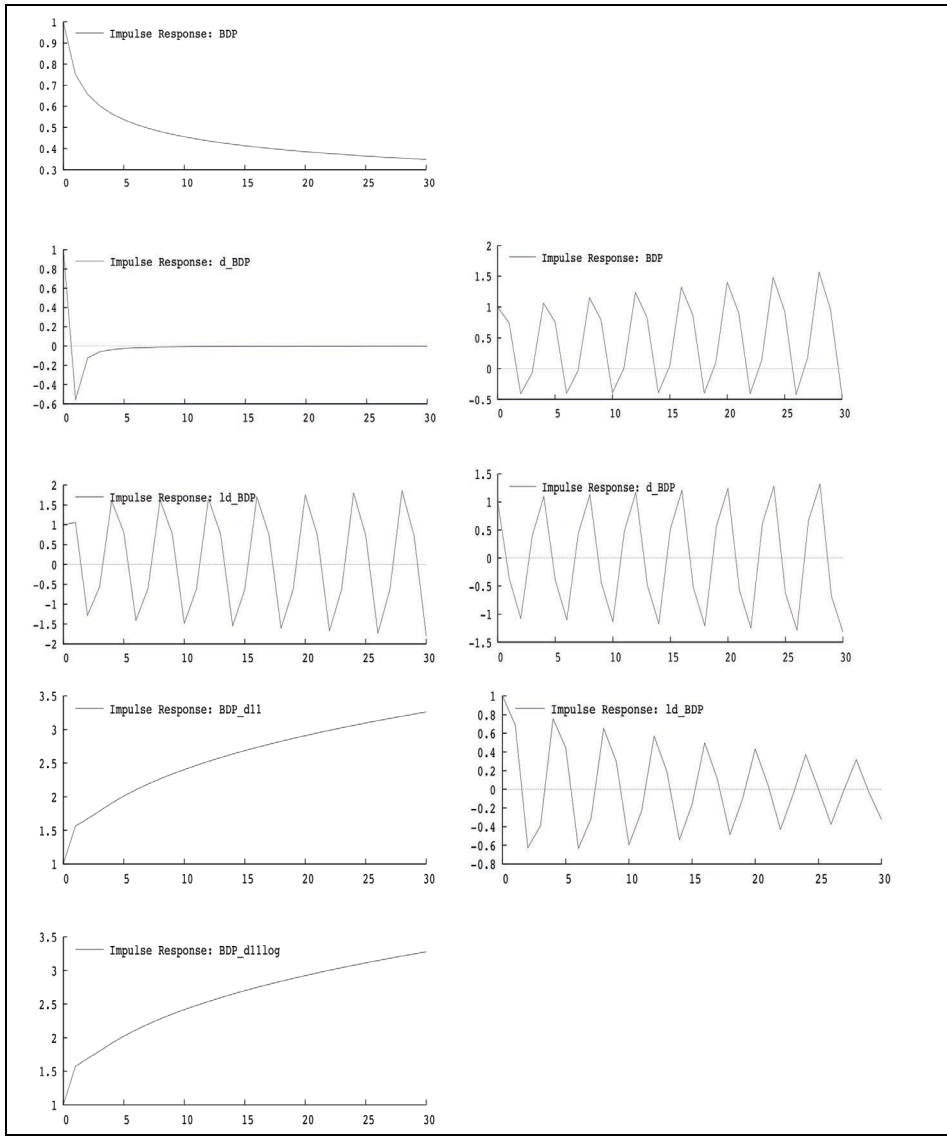

FIGURE 3 IMPULSE RESPONSE FUNCTION FOR REAL GDP

Source: Author calculations

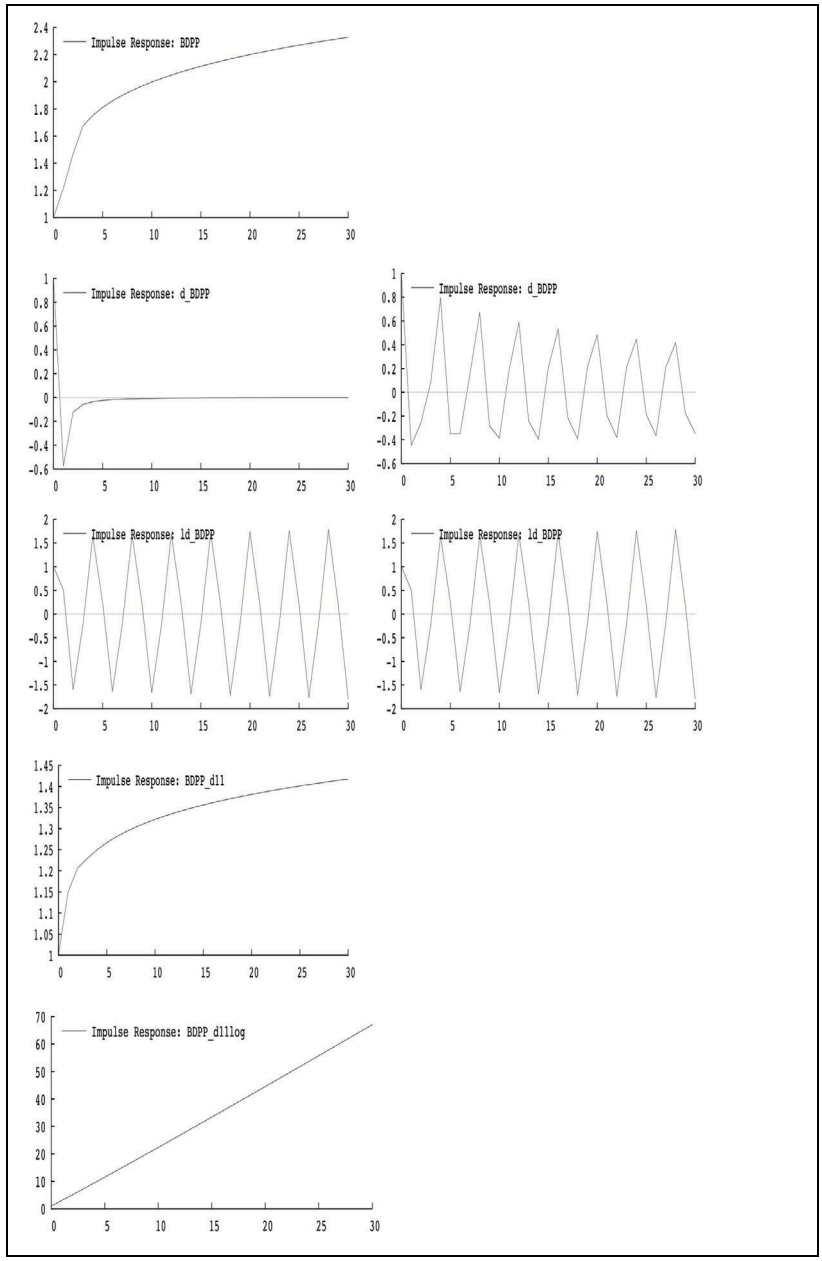

FIGURE 4 IMPULSE RESPONSE FUNCTION FOR REAL GDP PER CAPITA

Source: Author calculation

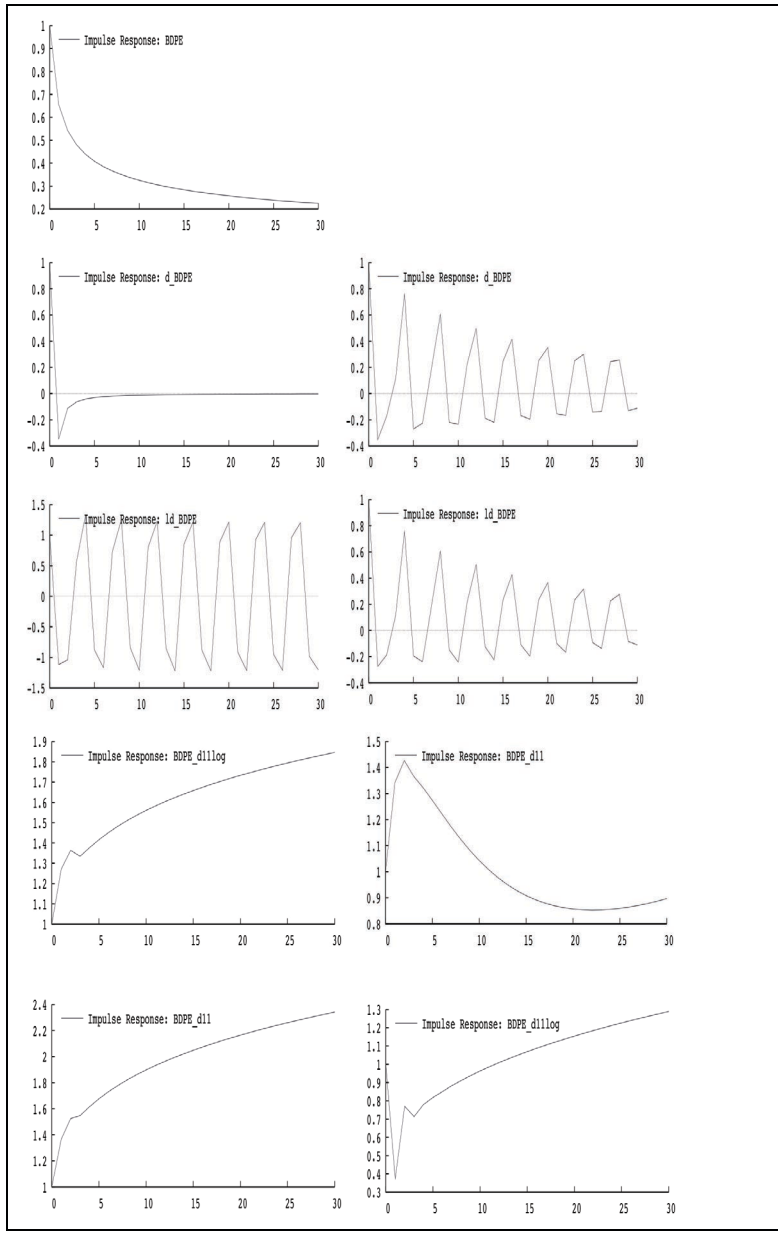

FIGURE 5: IMPULSE RESPONSE FUNCTION FOR REAL GDP PER EMPLOYED PERSON

Source: Author calculation

IV. CONCLUSION

The quarterly structure of real GDP, real GDP per capita and real GDP per employed person in Croatia has been examined using fractional integration methods. Using a battery of non-parametric, semi-parametric and parametric tests order of integration of aggregate output series was investigated. The tests statistics clearly reject the null of trend stationary process I(0) in favor of near-integration (intermediate memory) or long memory processes. This study results clearly contradict other studies results for aggregate output in Croatia implicitly assuming different GDP series as I(0) or I(1) variables. Using fractional integration techniques evidence of both anti-persistence (intermediate memory) and persistence (long memory) is found. ARFIMA models turn out to best the best model for describing real output dynamics in Croatia over 1996-2012. Presented test results indicate real output in Croatia is a highly persistent process. Differenced series show anti-persistence or long range dependence demanding correct order of integration estimation rather than constraining the order of integration to zero or one. For the real output seasonally adjusted series (except for real GDP and real GDP per capita log differenced/differenced series) the null of unit root cannot be rejected.

This paper describe in details the general characteristics of real output fluctuations in Croatia. Evidence succinctly and clearly shows ARFIMA models best capture short and long memory characteristics in real output series. Fractionally integrated models for Croatian GDP series obviously show that real output series behave distinctly from stationary or integrated processes most often assumed in studies related to output dynamics in Croatia. This fact has two important implications for further study and policy implementation. Further research on real output dynamics for Croatia should focus on estimating the correct order of integration rather then assuming stationary, unit root behavior or cointegration. Second, even more important, shocks affecting real output in Croatia have long lasting and even increasing effects over time. Thus, fluctuations in real output in Croatia are largely permanent. Consequently, this implies that appropriate policy actions are required to reestablish output equilibrium. However, consequences of a miss-specified economic policy can be even more devastating than no policy action. Effects of shocks in Croatian real output can last up to 8 years but outcomes of using badly designed economic policy can last almost infinitely. Only a small part of output fluctuations in Croatia are of transitory nature. This indicates cycles have minor effects on economy in relation to devastating consequence of wrong policy implementation that appears to be a case in Croatia.

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APPENDIX

TABLE 5 MAXIMUM LIKELIHOOD ESTIMATES OF D IN ARFIMA(P,D,Q) MODELS FOR THE CROATIAN GDP

ARMA (p,q)	GDP_t	*dGDP*	*dlGDP*	$GDPC_t$	*dGDPC*	*dlGDPC*	$GDPE_t$	*dGDPE*	*dlGDPE*
(0,0)	0.75	-0.55	-0.51	0.99	-0.57	-0.55	0.65	-0.35	-0.33
(1,0)	0.62	-0.67	-0.61	0.90	-0.66	-0.64	0.56	-0.42	-0.41
(0,1)	0.63	-0.79	-0.73	0.93	-0.77	-0.75	0.46	-0.53	-0.52
(1,1)	0.57	-0.80	-0.72	0.94	-0.73	-0.72	0.50	-0.48	-0.47
(2,0)	1.13	0.01	0.04	1.06	-0.19	-0.15	1.08	0.05	0.08
(0,2)	1.05	-0.30	-0.24	1.13	-0.34	-0.31	0.89	-0.12	-0.11
(2,1)	1.45	0.33	0.37	1.14	0.15	0.19	1.35	0.37	0.39
(1,2)	1.10	-0.33	-0.27	1.15	-0.33	-1.26	0.97	-1.07	-0.11
(2,2)	-	0.02	0.07	-	-0.17	-1.25	-	0.02	0.04
(3,0)	1.81	0.84	0.74	1.20	0.50	-1.13	-0.02	0.78	0.79
(0,3)	0.99	-0.22	-0.17	1.13	-0.20	-0.66	0.59	-0.40	0.09
(3,1)	1.71	0.75	0.63	1.18	0.47	-0.76	0.38	0.68	0.71
(3,2)	1.51	0.44	-	-	0.22	-1.12	-	-	-
(1,3)	-	-0.42	-0.24	1.15	-0.83	-0.72	0.69	-0.49	-0.23
(2,3)	-	0.34	0.44	1.07	0.07	0.09	-0.86	0.35	0.31
(3,3)	-	-	-	-	-0.02	-0.80	-0.98	-	0.14

Source: Author calculations

TABLE 6 MAXIMUM LIKELIHOOD ESTIMATES OF D IN ARFIMA(P,D,Q) MODELS FOR THE CROATIAN GDP (SEASONALLY ADJUSTED X-12 ARIMA)

ARMA(p,q)	GDP_{d11}	GDP_{d11log}	$GDPC_{d11}$	$GDPC_{d11log}$	$GDPE_{d11}$	$GDPE_{d11log}$
(0,0)	1.18	-0.55	0.99	-0.57	0.65	-0.35
(1,0)	1.35	-0.67	0.90	-0.66	0.56	-0.42
(0,1)	1.40	-0.79	0.93	-0.77	0.46	-0.53
(1,1)	1.33	-0.80	0.94	-0.73	0.50	-0.48
(2,0)	1.13	0.01	1.06	-0.19	1.08	0.05
(0,2)	1.05	-0.30	1.13	-0.34	0.89	-0.12
(2,1)	1.45	0.33	1.14	0.15	1.35	0.37
(1,2)	1.10	-0.33	1.15	-0.33	0.97	-1.07
(2,2)	-	0.02	-	-0.17	-	0.02
(3,0)	1.81	0.84	1.20	0.50	-0.02	0.78
(0,3)	0.99	-0.22	1.13	-0.20	0.59	-0.40
(3,1)	1.71	0.75	1.18	0.47	0.38	0.68
(3,2)	1.51	0.44	-	0.22	-	-
(1,3)	-	-0.42	1.15	-0.83	0.69	-0.49
(2,3)	-	0.34	1.07	0.07	-0.86	0.35
(3,3)	-	-	-	-0.02	-0.98	-

Source: Author calculations

TABLE 7 PARAMETER ESTIMATES OF ARFIMA MODELS FOR GDP_T

	Long memory	*AR parameters*			*MA parameters*			*Log-likelihood*	*Lik. criterions*	
ARMA	*d*	$\phi 1$	$\phi 2$	$\phi 3$	$\theta 1$	$\theta 2$	$\theta 3$		AIC	SIC
(0,0)	0.75	-	-	-	-	-	-	618.5	621.5	624.7
	(0.09)									
(1,0)	0.62	0.15	-	-	-	-	-	607.5	611.5	615.9
	(0.08)	(0.12)								
(0,1)	0.63	-	-	-	-0.61	-	-	612.5	618.2	620.8
	(0.09)				(0.05)					
(1,1)	0.57	-0.02	-	-	-0.62	-	-	602.2	607.1	612.5
	(0.10)	(0.18)			(0.07)					
(2,0)	1.13	-0.08	-0.91	-	-	-	-	557.2	562.2	567.5
	(0.06)	(0.07)	(0.06)							
(0,2)	1.05	-	-	-	0.09	0.51	-	605.9	610.8	616.3
	(0.13)				(0.06)	(0.05)				
(2,1)	1.45	-0.05	-0.93	-	0.48	-	-	552.0	558.0	564.5
	(0.14)	(0.06)	(0.06)		(0.11)					
(1,2)	1.09	-0.07	-	-	0.13	0.56	-	595.3	601.3	607.8
	(0.04)	(0.05)			(0.07)	(0.05)				
(2,2)	--	--	--	--	--	--	--	--	--	--
(3,0)	1.81	-0.93	-1.02	-0.92	-	-	-	523.6	529.6	536.0
	(0.20)	(0.09)	(0.03)	(0.09)						
(0,3)	0.99	-	-	-	0.61	0.26	-0.68	596.8	602.8	609.3
	(0.11)				(0.09)	(0.08)	(0.09)			
(3,1)	1.71	-0.95	-1.02	-0.93	-0.13	-	-	523.4	530.4	537.8
	(0.22)	(0.10)	(0.03)	(0.09)	(0.13)					
(3,2)	1.51	-0.74	-1.03	-0.74	-0.03	-0.68	-	517.9	525.9	534.4
	(0.25)	(0.29)	(0.01)	(0.29)	(0.25)	(0.32)				
(1,3)	--	--	--	--	--	--	--	--	--	--
(2,3)	--	--	--	--	--	--	--	--	--	--
(3,3)	--	--	--	--	--	--	--	--	--	--

*Source: Author calculations. Notes: Standard errors in parenthesis, *model pass diagnostic tests on the residuals (no serial correlation, functional form, normality and homoscedasticity) at the 5% significance level.*

TABLE 8 PARAMETER ESTIMATES OF ARFIMA MODELS FOR $GDPC_T$

	Long memory	*AR parameters*			*MA parameters*			*Log-likelihood*	*Lik. criterions*	
ARMA	*d*	$\phi 1$	$\phi 2$	$\phi 3$	$\theta 1$	$\theta 2$	$\theta 3$		AIC	SIC
(0,0)	0.99	-	-	-	-	-	-	564.6	567.6	570.8
	(0.06)									
(1,0)	0.90	0.11	-	-	-	-	-	556.0	560.0	564.3
	(0.10)	(0.11)								
(0,1)	0.93	-	-	-	-0.13	-	-	564.4	568.4	572.7
	(0.08)				(0.09)					
(1,1)	0.94	-0.22	-	-	-0.33	-	-	556.1	561.1	566.5
	(0.09)	(0.26)			(0.25)					
(2,0)	1.06	-0.01	-0.18	-	-	-	-	547.3	552.3	557.7
	(0.10)	(0.10)	(0.17)							
(0,2)	1.13	-	-	-	0.11	0.17	-	563.9	568.9	574.3
	(0.20)				(0.22)	(0.17)				
(2,1)	1.14	0.23	-0.20	-	0.33	-	-	547.1	553.1	559.6
	(0.13)	(0.22)	(0.26)		(0.26)					
(1,2)	1.15	0.18	-	-	0.30	0.17	-	555.6	561.6	568.1
	(0.19)	(0.25)			(0.30)	(0.14)				
(2,2)	--	--	--	--	--	--	--	--	--	--
(3,0)	1.20	-0.17	-0.26	-0.18	-	-	-	538.5	544.5	550.0
	(0.24)	(0.24)	(0.17)	(0.15)						
(0,3)	1.14	-	-	-	0.08	0.17	0.12	563.6	569.6	576.1
	(0.16)				(0.16)	(0.13)	(0.09)			
(3,1)	1.18	-0.38	-0.27	-0.23	-0.24	-	-	538.3	545.3	552.8
	(0.20)	(0.34)	(0.20)	(0.17)	(0.22)					
(3,2)	--	--	--	--	--	--	--	--	--	--
(1,3)	1.15	--	--	--	-0.09	0.19	0.17	555.2	562.2	569.7
	(0.16)				(0.18)	(0.15)	(0.11)			
(2,3)	1.07	0.00	-1.01	-	0.01	-1.06	0.16	538.9	546.9	555.4
	(0.04)	(0.02)	(0.02)		(0.09)	(0.01)	(0.10)			
(3,3)	--	--	--	--	--	--	--	--	--	--

*Source: Author calculations. Notes: Standard errors in parenthesis, *model pass diagnostic tests on the residuals (no serial correlation, functional form, normality and homoscedasticity) at the 5% significance level.*

TABLE 9 PARAMETER ESTIMATES OF ARFIMA MODELS FOR GDPET

	Long memory	*AR parameters*			*MA parameters*			*Log-likelihood*	*Lik. criterions*	
ARMA	*d*	$\phi 1$	$\phi 2$	$\phi 3$	$\theta 1$	$\theta 2$	$\theta 3$		AIC	SIC
(0,0)	0.65	-	-	-	-	-	-	587.5	591.8	593.8
	(0.10)									
(1,0)	0.56	0.17	-	-	-	-	-	578.5	582.5	586.8
	(0.11)	(0.13)								
(0,1)	0.46	-	-	-	-0.51	-	-	583.7	587.6	592.0
	(0.10)				(0.08)					
(1,1)	0.50	-0.11	-	-	-0.55	-	-	575.0	580.0	585.4
	(0.11)	(0.17)			(0.08)					
(2,0)	1.08	-0.14	-0.74	-	-	-	-	550.8	555.8	561.2
	(0.09)	(0.10)	(0.09)							
(0,2)	0.89	-	-	-	0.04	0.35	-	581.5	586.5	591.9
	(0.18)				(0.12)	(0.05)				
(2,1)	1.37	-0.09	-0.77	-	0.39	-	-	548.2	554.2	560.6
	(0.16)	(0.09)	(0.10)		(0.13)					
(1,2)	0.97	-0.07	-	-	0.06	0.38	-	573.0	579.0	585.6
	(0.10)	(0.15)			(0.12)	(0.08)				
(2,2)	--	--	--	--	--	--	--	--	--	--
(3,0)	-0.01	0.90	-0.62	0.72	-	-	-	541.3	547.3	553.7
	(0.02)	(0.09)	(0.15)	(0.10)						
(0,3)	0.59	-	-	-	-0.66	0.08	0.42	577.3	583.4	589.9
	(0.12)				(0.14)	(0.09)	(0.06)			
(3,1)	0.38	0.88	-0.69	0.74	-	-	-	538.7	545.7	553.2
	(0.14)	(0.09)	(0.14)	(0.09)						
(3,2)	--	--	--	--	--	--	--	--	--	--
(1,3)	0.69	0.52	--	--	0.72	0.16	-0.54	566.3	573.3	580.8
	(0.35)	(0.51)			(0.30)	(0.09)	(0.07)			
(2,3)	-0.86	1.87	-0.86	-	0.59	0.23	-0.50	557.1	565.1	**573.7**
	(0.18)	(0.07)	(0.07)		(0.15)	(0.09)	(0.12)			
(3,3)	-0.98	2.18	-1.43	0.26	0.66	0.22	-0.42	549.3	558.3	567.9
	(1.12)	(0.49)	(0.90)	(0.41)	(0.37)	(0.29)	(0.30)			

Source: Author calculations

TABLE 10 PARAMETER ESTIMATES OF ARFIMA MODELS FOR GDPD11

	Long memory	*AR parameters*			*MA parameters*			*Log-likelihood*	*Lik. criterions*	
ARMA	*d*	ϕ1	ϕ2	ϕ3	θ1	θ2	θ3		AIC	SIC
(0,0)	1.18	-	-	-	-	-	-	528.3	531.3	534.6
	(0.12)									
(1,0)	1.35	0.35	-	-	-	-	-	518.4	522.4	526.7
	(0.17)	(0.15)								
(0,1)	1.40	-	-	-	0.34	-	-	526.8	530.8	535.2
	(0.18)				(0.19)					
(1,1)	1.33	-0.37	-	-	-0.05	-	-	518.3	523.3	528.7
	(0.14)	(0.15)			(0.22)					
(2,0)	1.38	-0.38	-0.07	-	-	-	-	510.5	515.5	520.9
	(0.17)	(0.22)	(0.22)							
(0,2)	1.32	-	-	-	0.30	-0.16	-	526.1	531.1	536.5
	(0.21)				(0.27)	(0.14)				
(2,1)	1.39	-0.00	0.01	-	0.36	-	-	510.5	516.5	522.8
	(0.28)	(1.60)	(0.27)		(1.05)					
(1,2)	1.29	-0.32	-	-	-0.02	-0.06	-	518.3	524.3	530.8
	(0.24)	(0.22)			(0.22)	(0.24)				
(2,2)	0.88	0.96	-0.04	0.83	-0.21	--	--	510.0	517.0	524.5
	(0.18)	(0.10)	(0.08)	(0.22)	(0.18)					
(3,0)	1.13	-0.13	0.17	0.00	-	-	-	501.5	507.5	513.9
	(2.01)	(2.03)	(1.37)	(0.09)						
(0,3)	1.29	-	-	-	0.27	-0.16	-0.03	526.0	532.0	538.6
	(0.20)				(0.29)	(0.14)	(0.14)			
(3,1)	1.16	0.03	0.17	0.01	0.21	-	-	501.5	508.4	515.8
	(0.40)	(0.65)	(0.25)	(0.02)	(0.22)					
(3,2)	1.11	1.16	-0.58	-0.04	1.30	-0.85	-	499.5	507.6	516.0
	(0.51)	(0.45)	(0.28)	(0.21)	(0.42)	(0.27)				
(1,3)	1.24	-0.29	-	-	-0.05	-0.09	-0.07	518.2	525.2	532.7
	(0.26)	(0.27)			(0.21)	(0.26)	(0.12)			
(2,3)	--	--	--	--	--	--	--	--	--	--
(3,3)	--	--	--	--	--	--	--	--	--	--

*Source: Author calculations. Notes: Standard errors in parenthesis, *model pass diagnostic tests on the residuals (no serial correlation, functional form, normality and homoscedasticity) at the 5% significance level.*

TABLE 11 PARAMETER ESTIMATES OF ARFIMA MODELS FOR $GDPC_{D11}$

	Long memory	*AR parameters*			*MA parameters*			*Log-likelihood*	*Lik. criterions*	
ARMA	*d*	$\phi 1$	$\phi 2$	$\phi 3$	$\theta 1$	$\theta 2$	$\theta 3$		AIC	SIC
(0,0)	1.01	-	-	-	-	-	-	559.8	562.8	566.0
	(0.02)									
(1,0)	1.03	-0.03	-	-	-	-	-	551.5	555.5	559.8
	(0.07)	(0.08)								
(0,1)	1.06	-	-	-	0.08	-	-	559.7	563.7	568.1
	(0.04)				(0.03)					
(1,1)	1.02	-0.02	-	-	0.02	-	-	551.5	556.5	561.9
	(0.06)	(0.06)			(0.01)					
(2,0)	1.03	-0.06	-0.02	-	-	-	-	543.3	548.3	550.0
	(0.02)	(0.02)	(0.01)							
(0,2)	1.07	-	-	-	0.09	0.02	-	559.7	564.7	570.1
	(0.05)				(0.05)	(0.02)				
(2,1)	1.07	-0.95	-0.10	-	-0.86	-	-	543.4	549.4	555.8
	(0.02)	(0.03)	(0.03)		(0.02)					
(1,2)			--	--			--	--	--	--
	--	--			--	--				
(2,2)	--	--	--	--	--	--	--	--	--	--
(3,0)	--	--	--	--	--	--	--	--	--	--
(0,3)	1.07	-	-	-	0.08	0.02	-0.00	559.7	565.7	572.2
	(0.07)				(0.08)	(0.03)	(0.03)			
(3,1)	1.05	-0.90	-0.07	0.02	-	-	-	535.3	542.2	549.7
	(0.03)	(0.06)	(0.05)	(0.03)						
(3,2)	--	--	--	--	--	--	--	--	--	--
(1,3)	1.00	-0.00	--	--	0.02	-0.00	-0.02	551.5	558.5	566.0
	(0.12)	(0.12)			(0.01)	(0.06)	(0.03)			
(2,3)	--	--	--	--	--	--	--	--	--	--
(3,3)	--	--	--	--	--	--	--	--	--	--

*Source: Author calculations. Notes: Standard errors in parenthesis, *model pass diagnostic tests on the residuals (no serial correlation, functional form, normality and homoscedasticity) at the 5% significance level.*

TABLE 12 PARAMETER ESTIMATES OF ARFIMA MODELS FOR $GDPE_{D11}$

	Long memory	*AR parameters*			*MA parameters*			*Log-likelihood*	*Lik. criterions*	
ARMA	*d*	ϕ_1	ϕ_2	ϕ_3	θ_1	θ_2	θ_3		AIC	SIC
(0,0)	1.10	-	-	-	-	-	-	535.7	542.0	535.7
	(0.10)									
(1,0)	1.09	-0.01	-	-	-	-	-	527.1	531.1	527.1
	(0.11)	(0.13)								
(0,1)	1.28	-	-	-	0.25	-	-	535.3	539.3	543.7
	(0.34)				(0.40)					
(1,1)	1.23	0.06	-	-	0.26	-	-	526.8	531.8	537.2
	(0.31)	(0.16)			(0.33)					
(2,0)	1.29	-0.27	-0.12	-	-	-	-	518.8	523.8	529.1
	(0.23)	(0.25)	(0.18)							
(0,2)	1.30	-	-	-	0.26	0.01	-	535.3	542.5	545.7
	(0.39)				(0.41)	(0.15)				
(2,1)	1.27	-0.40	-0.14	-	0.16	-	-	518.8	524.8	531.2
	(0.24)	(0.35)	(0.15)		(0.49)					
(1,2)	1.23	0.11	-	-	0.31	-0.03	-	526.8	532.8	539.2
	(0.33)	(0.50)			(0.58)	(0.27)				
(2,2)	1.27	-0.27	-0.18	--	-0.03	-0.07	--	518.7	525.7	533.2
	(0.21)	(0.40)	(0.20)		(0.52)	(0.26)				
(3,0)	1.19	-0.16	-0.04	0.07	-	-	-	511.0	517.0	523.4
	(0.65)	(0.70)	(0.49)	(0.30)						
(0,3)	1.20	-	-	-	0.17	0.00	-0.09	535.1	541.1	547.6
	(0.52)				(0.53)	(0.22)	(0.14)			
(3,1)	0.32	0.67	0.17	0.12	-	-	-	510.3	517.3	524.7
	(0.41)	(0.83)	(0.47)	(0.33)						
(3,2)	--	--	--	--	--	--	--	--	--	--
(1,3)	0.98	-0.05	--	--	-0.04	-0.06	-0.13	526.8	533.8	541.3
	(0.02)	(0.03)			(0.18)	(0.14)	(0.09)			
(2,3)	0.94	0.74	-0.00	-	0.67	-0.02	-0.12	518.4	526.4	**535.0**
	(0.67)	(0.41)	(0.03)		(0.28)	(0.21)	(0.18)			
(3,3)	--	--	--	--	--	--	--	--	--	--

*Source: Author calculations. Notes: Standard errors in parenthesis, *model pass diagnostic tests on the residuals (no serial correlation, functional form, normality and homoscedasticity) at the 5% significance level*

FRAKCIONIRANO INTEGRIRANI MODEL ZA NIZ HRVATSKOG UKUPNOG OUTPUTA (BDP)

SAŽETAK

Opće karakteristike fluktuacije outputa u Hrvatskoj proučene su u okviru frakcionarne integracije. Ovaj rad procjenjuje postojanje dugoročne memorije u fluktuacijama realne dekompozicije outputa prema tranzitornim i stalnim komponentama. Rezultati upućuju na to da je ponašanje niza hrvatskog realnog outputa najlakše identificirati s ARFIMA modelom s redom integracije $0.5 < d < 1.5$. To ukazuje na činjenicu da su makroekonomski šokovi u realnom outputu visoko prisutni. Za razliku od drugih studija u Hrvatskoj po kojima je realni output I(0) ili I(1) varijabla, rezultati ispitivanja koji proizlaze iz ove studije ukazuju na to da realni output pokazuje karakteristike dugoročne memorije sa srednjom reverzijom (frakcionarnom integracijom).

Ključne riječi: frakcionarna integracija, ARFIMA, odgovor na impuls, realni BDP Hrvatska, dugoročna memorija


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POLITICAL RISK AND ECONOMIC DEVELOPMENT: A CASE STUDY OF CHINA

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ABSTRACT

The political instability affects the investment especially the foreign investment which has a close relationship with economic development. This paper investigates the mechanism of the economic influence of political risk through a case of China. The synthetic control methodwill be used to deal with the problem caused by the counterfactual analysis in the case study. The intense situation of the cross-Taiwan Strait relation has great influence on the economic development of Fujian province because of the closely geographic features and economic links. The empirical result reveals that there is an economic loss measured by GDP per capitain Fujian province as political risk increases. Furthermore, the mechanism is investigated. The result shows that FDI in Fujian province receives adverse impact correspondingly.

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I. INTRODUCTION

Political risk is important in the economic development because the investment will be repressed under an unstable political situation. The political risk will lower down the actual investment return. Hence, the economic performance will be worse in this case. On the contrary, a stable political situation will encourage the investment, and thus facilitate the economic growth. However, the cost of increase in political risk is difficult to measure because of the problem caused by the counterfactual analysis. For example, we cannot observe the economic performance in the case of political instability if the actual political situation is stable, and vice versa.

Abadie and Gardeazabal (2003) propose a synthetic control method to deal with such problem. In the case study, it is difficult to find a suitable control group. But we could use several groups to synthesize one control group that may perform better. In this paper, we will use the synthetic control method (SCM) to estimate the cost of political instability, and more importantly the mechanism behind such influence. The event of the tension of cross-Taiwan Strait relation is studied.

We choose the beginning year 2001 of governing period by Taiwan's Democratic Progressive Party (DPP) as a beginning point of the event study and 2008 that Kuomintang (KMT) elected to be the ruling party as an ending point. The major difference between DPP and KMT is that KMT supports one-China policy a fundamental principle for China. But DPP advocates the independence of Taiwan. One of the DPP's goals is to struggle for the independence of Taiwan. As a result, the political risk increases during the period when DPP is in power. Correspondingly, the perceived level of investment risk is aggrandized, which will exert a negative impact on economic development.

Moreover, Fujian province is chosen to be a treatment group. Fujian province has the closest relationship with Taiwan not only in geographical features but also in economic links. For example, Xiamen city of Fujian province has been established as special economic zone (SEZ) by central government in 1980. This special economic zone aims at attracting the investment from Taiwan, as well as the rest of the world The other three cities, Shenzhen, Shantou and Zhuhai, are also set up as special economic zones at the same time.

Shenzhen and Shantou have the purpose of attracting the investment from Hong Kong and Zhuhai has the purpose of attracting the investment from Macao. Figure 1 shows that Fujian province has a closer relationship with Taiwan. The ratio of Taiwanese direct investment to FDI in Fujian is significantly greater than that in the nationwide since 1990s, even there are some fluctuations. The tension of cross-Taiwan Strait relations will affect Fujian province most directly rather than others. Therefore, Fujian province is a treatment group and the other provinces are control groups which could be used to synthesize a new control group.

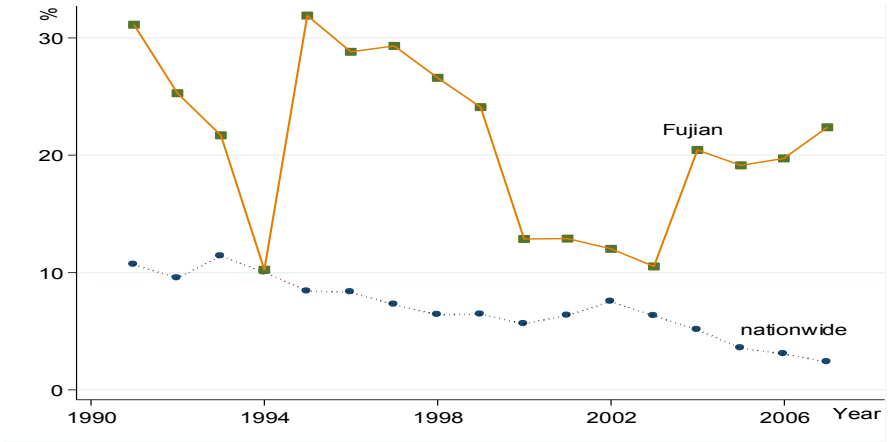

Figure 1. Ratio of Taiwanese Direct Investment to FDI

Data Source: "China's Economy and Trade Yearbook" and "China Business Yearbook"

Admittedly, in the middle period of 1990s, Denghui Li, president of KMT also renounced the one-China policy, which leads to the tension of cross-Taiwan Strait relation. For example, the Chinese people's liberation army held a military maneuver near Taiwan Strait in 1995 and 1996 respectively. When we move the beginning point of the event study backward to 1996, we find a negative gap between FDI of Fujian and FDI of synthetic Fujian, but a similar trend between GDP per capita of Fujian and GDP per capita of synthetic Fujian. It is reasonable because FDI is relatively trivial in the middle period of 1990s. However, it reveals a fact that FDI is affected by the political instability more directly, through which the economy will be influenced by the rising of political risk.

II. LITERATURE REVIEW

There are a lot of literatures on the politico-eonomic links. Alesina and Perotte (1996) find that the worsening of politico-economic environment will reduce investment because of the huge investment risk. The investment is a primary engine of growth, and thus the political risk has an intimate relationship with economic growth. Svensson (1998) and Devereux and Wen (1998)

investigate the multinational differences in investment rate and establish a theoretical model explaining the mechanism of the influence of political instability on investment rate. Jong-A-Pin (2009) also examines the impact of multidimensionality of political instability on the economic growth. The indicators are divided into four categories: politically motivated violence, mass civil protest, instability within the political regime and instability of the political regime. The generalized method of moments (GMM) model is used to deal with the endogenous problem.

Even though, it is quite difficult to estimate the economic cost of political factor because of the counterfactual essence in this case. Specifically, we cannot observe the case of favorable political situation when the de-facto adverse political situation turns up, and vice verse. Moreover, the exclusive assumption is hard to satisfy in IV method. Finally, there is no index of political risk in provincial level of China.

The synthetic control method emerged recently in the comparative case study can overcome this difficulty[1]. The data-driven property of synthetic control method guarantees that the synthesized control group can represent the treatment group had it not been treated. Abadie and Gardeazabal (2003) and Abadie et al. (2010) come up with this new method, named synthetic control method to infer the causal effect in case study. Abadie and Gardeazabal (2003) study the economic cost of terrorism led by Euskadi Ta Askatasuna (ETA), one terrorist organization in Basque of Spain. The synthetic control method is used here. Specifically, the new method is applied to find the weights for the other two areas in Spain.

These areas can be synthesized to a new control group for Basque by the obtained weights. This could overcome the identification problem. The estimated result illustrates that in the later period of 1960s, the GDP in Basque has been dropped by 10 percentage points due to the terrorist attack. Moreover, once ETA stops terrorist attack, the stock prices of enterprises located in Basque performs better than before, which confirms the economic costs generated by the conflicts. Abadie et al. (2010) also use the synthetic control method to research on the effect of California's Proposition 99 implemented in 1988 on the tobacco consumption habits of residents in California. They find that by the year 2000, annual per capita cigarette sales in California are 26 packs lower than what California would have in the absence of Proposition 99. In this case, all the other states are synthesized as a control group for California. In this case, Fujian province, the neighborhood of Taiwan is affected mostly by the impact of cross-Taiwan Strait Tension and thus regarded as a treatment group. The other provinces are synthetized to be a control group for Fujian.

On that account, this paper uses SCM to investigate the impact of cross-Taiwan Strait tension in China on regional economy. As far as we know, DPP has elected to be the ruling party of Taiwan in 2000, which has a significantly negative influence on the cross-Taiwan Strait relation, because DPP is willing to make Taiwan an independent country. In many circumstances, DPP advocates that Taiwan is an independent sovereign country and declares that it is necessary for referendum legislation to determine the future and the fate of Taiwan. This definitely breaks through the bottom line of China. During this period, the cross-Taiwan Strait relation comes to a deadlock.

This paper uses a quantitative method to provide a Chinese case about the connection between political risk and economic development. This research is similar with Chan and

1The details about comparative case study can be found in Card (1990), Card and Krueger (1994). Card (1990) investigates Mariel Boatlift in Cuba and its influence on Miami's economy. Card and Krueger (1994) study the case of minimum wage increase in New Jersey.

Wei(1996) and Sun et al.(2002). The difference is that this paper exploits a natural experiment and uses a latest method of empirical study to carry on the research.

In addition, Enders and Sandler (1996) use the basic analysis method in time series Vector-Autoregression Model (VAM) and Impulse Response Function (IRF) to calculate the cost of terrorist activities on foreign direct investment in Spain and Greece. Abadie and Dermisi (2008) use the building-level data to investigate the vacancy rates in Chicago after "9/11".

The 9/11 attacks induce a large increase in the perception of terrorism risk in Chicago Central Business District. Their results reveal that the economic activity in Central Business Districts is affected greatly by the increase of terrorism risk. However, there is little evidence about Chinese case.

The paper is organized as follows. Section 3 introduces the synthetic control method. Section 4 uses the provincial data of China to analyze the influence of political instability on economy and carry on the robustness check. Section 5 investigates the influence channel of political instability on economic development. Section 6 concludes

III. INTRODUCTION OF SCM

The essential feature of synthetic control method is that the choice of control group depends on the existing data completely. A precondition of a perfect control group is the fitness between the treatment group and the control group before the treatment. It is verifiable because both the treatment group and the control group can be observed without intervention. Hence, the potential control groups and the treatment group before the treatment should be compared to find the weights of these potential control groups for the best fitness. This implies the potential control groups could represent the treatment group by using these weights before the treatment. Moreover, if the potential groups are not been affected by the treatment, these weights could be used to synthesize a new control group that can predict the treatment group after the treatment in the case that it does not accept the treatment. In the following, more details about the synthetic control method will be discussed.

Suppose Y_{it}^N be the outcome that would be observed for region i at time t without treatment and Y_{it}^I be the outcome that would be observed for region i at time t with treatment, where $i = 1,2,\ldots,J+1, t = 1,2,\ldots,T$. Region 1 receives the treatment at time T_0 and ends at time T, where $1 < T_0 < T$. The model can be specified as the following:

$$T_{it} = Y_{it}^N + \alpha_{it} D_{it} + \varepsilon_{it} \quad (1)$$

$$D_{it} = \begin{cases} 1 \text{ if } i = 1 \text{ and } t > T_0 \\ 0 \text{ otherwise} \end{cases}$$

Where δ_t is an unknown common factor with constant factor loading across unit. When D_{it} equals 1, region i receives the treatment at time t. When D_{it} equals 0, region i does not

receive the treatment at time t. Because only region 1 receives treatment, our purpose is to estimate the value of α_{1t} when $t > T_0$. However, we cannot observe the value of Y_{it}^N for $t > T_0$, because we only observe the value of Y_{it}^I, and thus Y_{it}^N is a counterfactual variable here. Hence, the key point of comparative case study is to construct the counterfactual variable and estimate it..

Let's suppose that Y_{it}^N is given by the factor model:

$$Y_{it}^N = \delta_t + \theta_t Z_i + \lambda_t \mu_i + \varepsilon_{it} \tag{2}$$

Where Z_i is a vector of control variables that are seldom affected by the treatment, θ_t is a vector of parameters needed to be estimated, λ_t is common factor with varying factor loadings, μ_i across units standing for the individual effect, and ε_{it} is the error term that standing for the unobserved transitory shocks at the region level with 0 mean for all i.

The purpose here is to estimate a vector of weights $W = (w_2, \ldots, w_{J+1})'$ that $w_j \geq 0$ for $i = 2, \ldots, J+1$ and $\sum_{j>1} w_j = 1$. In fact, each value of vector $W = (w_2, \ldots, w_{J+1})'$ can synthesize to a potential control group, that is, a particular weighted average of control regions.

The value of the outcome variable for each synthetic control indexed by $W = (w_2, \ldots, w_{J+1})'$ is as follows:

$$\sum_{j=2}^{J+1} w_j Y_{jt} = \delta_t + \theta_t \sum_{j=2}^{J+1} w_j Z_j + \lambda_t \sum_{j=2}^{J+1} w_j \mu_j + \sum_{j=2}^{J+1} w_j \varepsilon_{jt} \tag{3}$$

Suppose there is a vector of $(w_2^*, \ldots, w_{J+1}^*)$such that [2]:

$$\sum_{j=2}^{J+1} w_j^* Y_{j1} = Y_{11}, \ldots, \sum_{j=2}^{J+1} w_j^* Y_{jT_0} = Y_{1T_0} \tag{4}$$

$$\sum_{j=2}^{J+1} w_j^* Z_j = Z_1 \tag{5}$$

If $\sum_{t=1}^{T_0} \lambda_t' \lambda_t$ is nonsingular, then the following equation

[2] $(w_2^*, \ldots, w_{J+1}^*)$ can be obtained from minimization of $\| X_1 - X_0 W \|_V = \sqrt{(X_1 - X_0 W)' V (X_1 - X_0 W)}$, where X represents the predicted variables and V is the symmetric positive semi-definite matrix. The detail is discussed in the appendix B of Abadie and Gardeazabal(2003).

holds. $Y_{1t}^N - \sum_{j=2}^{J+1} w_j^* Y_{jt} = \sum_{j=2}^{J+1} w_j^* \sum_{s=1}^{T_0} \lambda_t (\sum_{n=1}^{T_0} \lambda_n' \lambda_n) \lambda_s' (\varepsilon_{js} - \varepsilon_{1s}) - \sum_{j=2}^{J+1} w_j^* (\varepsilon_{js} - \varepsilon_{1s})$ (6)

Abadie et al. (2010) has proven that under the general condition [3], the right hand side of equation (6) will approach to zero. As a result, $\sum_{j=2}^{J+1} w_j^* Y_{jt}^N$ is the unbiased estimator of Y_{1t}^N. When $t > T_0$, Y_{1t}^N cannot be observed, $\sum_{j=2}^{J+1} w_j^* Y_{jt}^N$ could be used to estimate Y_{1t}^N. The treatment effect in the time t can be estimated, where $t \in \{T_0 + 1, \ldots, T\}$ [4]:

$$\alpha_{1t} = Y_{1t} - \sum_{j=2}^{J+1} w_j^* Y_{jt} \quad (7)$$

Equation (7) implies that in fact synthesized control method is similar with weighted difference-in-difference estimation strategy.

IV. EMPIRICAL STUDIES

A. Data

This paper uses the provincial data in China from "Comprehensive Statistical Data and Materials on 60 Years of New China" except Chongqing which becomes a new municipality after 1997. The dependent variable using to describe the economic development is GDP per capita adjusted by the price of 1978. The predicted/independent variables include the ratio of fixed investment to GDP, the ratio of industrial output to GDP, the ratio of construction output to GDP, the ratio of farming forestry, animal husbandry and fishery output to GDP and the ratio of labor force to total population(Abadie and Gardeazabal, 2003). These predicted variables are closely related with regional economic development. Because of the uncertainty of the economic reform, we choose the data from 1990 to 2008. Deng Xiaoping's southern tour happened in 1992 opened the prelude of the market-oriented reform. The data before 2000 will be used to predict the dependent variable Y_{it}^N in equation (2).

3See more detail in the appendix B of Abadie et al (2010).

4 The technical detail about the synthetic control method is discussed in the appendix B of Abadie et al (2010).

TABLE 1. MEAN VALUE OF PREDICTED VARIABLES

	Fujian (1)	China (2)	Synthetic Fujian (3)
Fixed Investment/GDP (%)	0.299	0.219	0.321
Farming forestry, animal husbandry and fishery /GDP(%)	0.347	0.416	0.315
Industry/GDP (%)	0.351	0.403	0.353
Building Industy/GDP (%)	0.059	0.046	0.053
Labor/Population (%)	0.482	0.465	0.492
GDP per capita in 1992 (Yuan)	1027.209	969.281	1078.097
GDP per capita in 1994 (Yuan)	1487.753	1191.786	1558.553
GDP per capita in 1997 (Yuan)	2055.405	1451.068	1964.331

Data Source: "Comprehensive Statistical Data and Materials on 60 Years of New China"

Table 1 illustrates that the differences between the predicted variables of Fujian and that of synthetic Fujian are all smaller than the difference between the predicted variables of the Fujian province and that of the nationwide. This means the weights from synthetic control method can match the characteristic of Fujian province much well, and thus can used to predict the economic development of Fujian province in the period of post cross-Taiwan Strait tension.

B. Empirical Results

In this study, the potential control groups include 29 provinces in China. The estimated result of synthetic control method shows that Jiangsu has the largest weight that is 0.708. Shandong has the weight of 0.231 and Tianjin has the weight of 0.061. The others are 0. The weighted average of Jiangsu, Tianjin and Shandong can well fit the economic development of Fujian province. Such combination can be used as a control group for Fujian without the change in political situation.

Figure 2 shows that before 2001, the synthetic data fits the actual data quite well. After 2001, the gap between GDP per capita of Fujian and that of the synthetic Fujian emerges, which shows a deviation from the synthetic data. In 2008, this gap becomes -1364.19 Yuan and the average loss of GDP per capita is -682.54 Yuan. In other word, the loss of GDP per capita in Fujian province has accumulated to 711 US Dollar from 2001 to 2008.Summarily, the cross-Taiwan Straittension increases the investment risk in Fujian province and lowers down the predicted investment return, and thus goes against the economic development of Fujian.

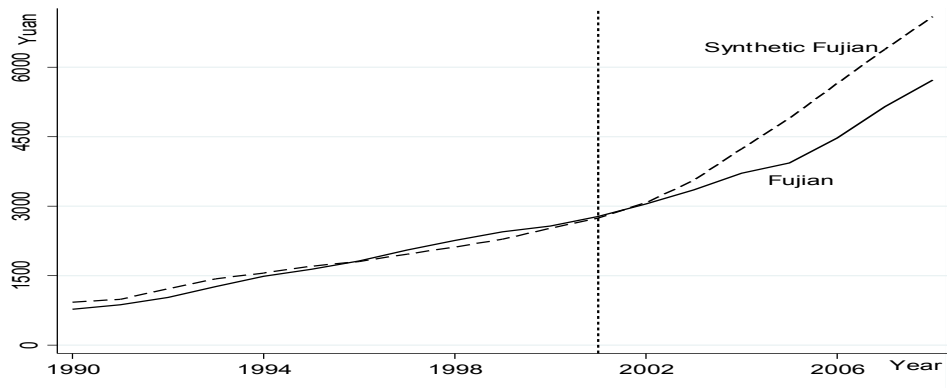

FIGURE 2. GDP PER CAPITA: FUJIAN VS SYNTHETIC FUJIAN

Source: Author calculation

C. Robustness test

The previously empirical result reveals a gap between the GDP per capita of Fujian and that of synthetic Fujian. Is this gap really caused by the tension of cross-Taiwan Strait relations in China or just by chance? The robustness check will give an answer to this question.

The robustness check in this context is permutation test which is similar to rank test in statistics. The purpose is to test the statistical significance of our results.

For example, are there any other provinces shows a gap between GDP per capital and synthetic GDP per capita when these provinces are viewed as treatment group respectively? In other words, what is the probability of appearing the same large gap as Fujian province does? To answer these questions, we iteratively apply the synthetic control method to estimate the impact of cross-Taiwan Strait tension on every other province. Before doing this test, we need exclude the provinces that do not fit the original data before 2001 well. The gap after the treatment may not be caused by the treatment, but by the bad fitness before the treatment. Therefore, we exclude the provinces whose MSPE before 2011 are larger than 100. Finally, we obtain 22 provinces as potential control groups here[5].

Figure 3 shows the results of permutation test. Each province is viewed as treatment group each time and the gap between GDP per capita and synthetic GDP per capita is drawn respectively. We find that the largest negative gap is Fujian province, which means the probability of estimating a gap of the magnitude of the gap for Fujian under a random permutation of the treatment in our data is 1/22. In other words, the previous result is statistically significant at 4.5% or so.

[5]The dropped provinces include Tianjin, InnerMongolia, Heilongjiang, Shanghai, Hainan, Guizhou, Ningxia and Tibet.

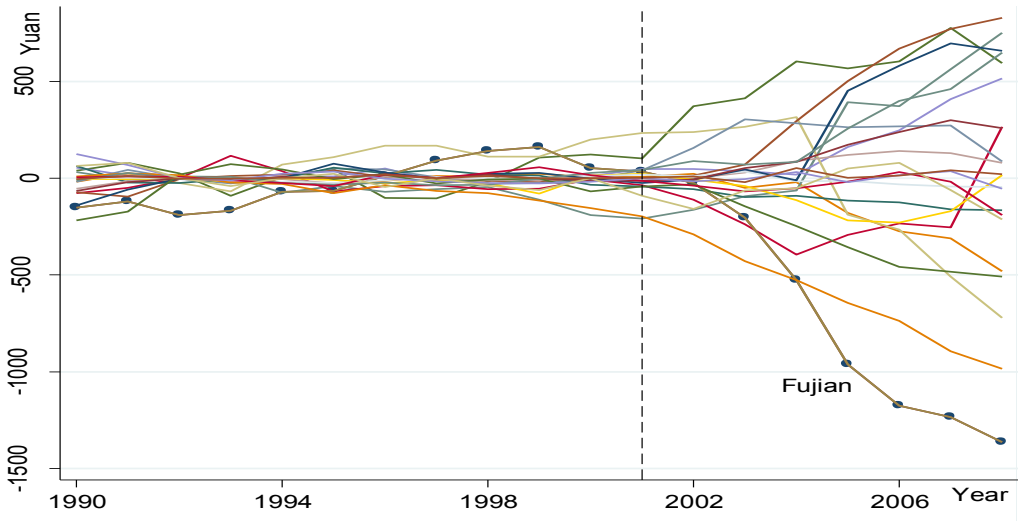

FIGURE 3. GAP BETWEEN GDP PER CAPITA AND SYNTHETIC GDP PER CAPITA (MPSE<100)

Source: Author calcuation

Furthermore, we calculate the ratio of MSPE after 2001 to MSPE before 2001. The main advantage here is that it avoids the subjective choice of cutoff for the exclusion of ill-fitting provinces. If the final result is convincing, then the MSPE before 2001 should be small and the MSPE after 2001 should be large, which means the ratio will be larger. Figure 4 shows the result of permutation test. The ratio of MSPE after 2001 to MSPE before 2001 of Fujian stands out in the figure. The MSPE of post cross-Taiwan Straittension period is about 16 times the MSPE of the pre cross-Taiwan Straittension period.

No control province achieves such a large ratio. If the treatment is assigned at random in the data, the probability of obtaining a ratio of MSPE after 2001 to MSPE before 2001 as large as Fujian is 1/30. In other word, the null hypothesis that political instability has no influence on economic development can be rejected and the result does not change its magnitude 96.7% of the time in 100 random resampling.

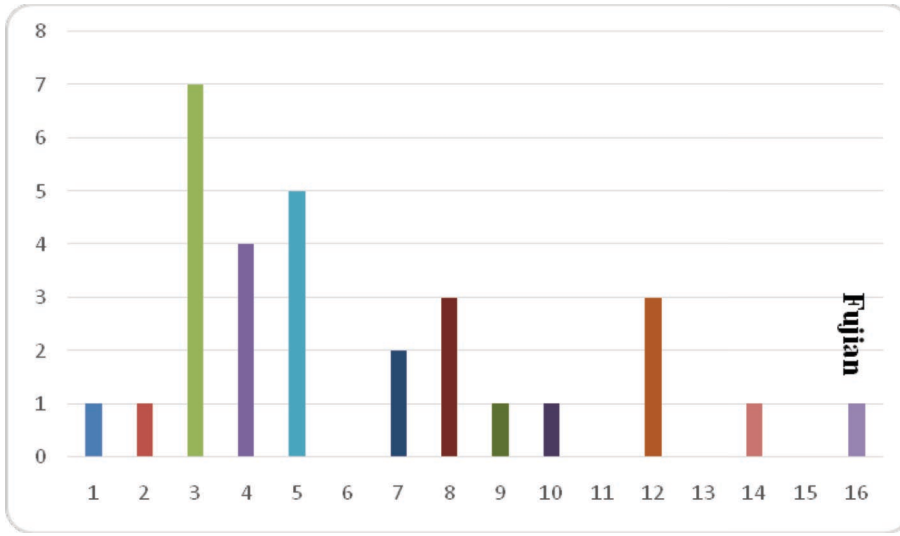

FIGURE 4. DISTRIBUTION OF MPSE(AFTER 2001)/MPSE(BEFORE 2001)

Source: Author calculation

V. FURTHER DISCUSSION

It is stated in the introduction that when the turning point is set to be 1996, we find that the gap between FDI of Fujian and FDI of synthetic Fujian. Actually, the political instability has a direct impact on the investment especially foreign investment. Through this channel the political instability affects the economic development. In this section, the channel of the influence of political instability on economic development is investigated. The model specification is similar with the above except the dependent variable becomes FDI.

Considering that Chinese people's liberation army held a military maneuver near Taiwan Strait in 1995 and 1996 respectively, 1996 is set to be a turning point. Fujian province is a treatment group once again. The estimation result is shown in figure 5.

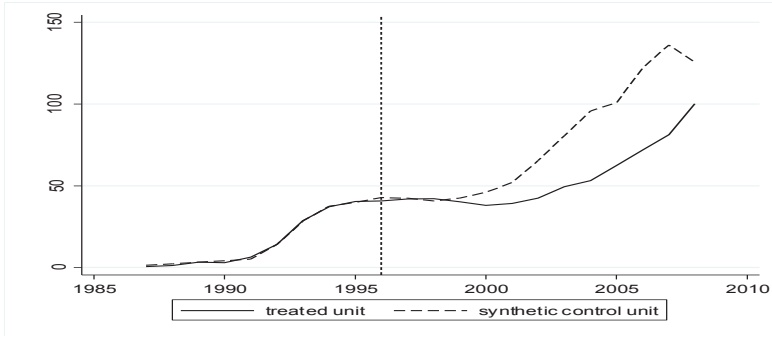

FIGURE 5. FDI: FUJIAN VS SYNTHETIC FUJIAN

Source: Author calculation

Figure 5 displays the empirical result obtained bysynthetic control method. The potential control groups include 26 provinces in China[6]. Table 2 shows the estimated weights by synthetic control method. Shandong has the largest weight 0.463. Guangdong, Hainan, Jiangsu and Inner Mongolia have the weights of 0.194, 0.117, 0.14 and 0.086 respectively. The others are 0s. Before 1996, the synthetic data fits the actual data quite well. This implies that the combination of Shandong, Guangdong, Hainan, Jiangsu and Inner Mongolia could be used as a control group for Fujianif there is no change in political situation.

TABLE 2. WEIGHTS IN SYNTHETIC FUJIAN

Region	Weight	Region	Weight	Region	Weight
Beijing	0	Zhejiang	0	Chongqing	—
Tianjin	0	Anhui	0	Sichuan	0
Hebei	0	Jiangxi	0	Guizhou	0
Shanxi	0	Shandong	0.463	Yunnan	0
Inner Mongolia	0.086	Henan	0	Tibet	—
Liaoning	0	Hubei	0	Shaanxi	0
Jilin	0	Hunan	0	Gansu	0
Heilongjiang	0	Guangdong	0.194	Qinghai	—
Shanghai	0	Guangxi	0	Ningxia	0
Jiangsu	0.14	Hainan	0.117	Xinjiang	—

Source: Author calculation

However, the gap between actual FDI in Fujian and synthetic FDI emerges after 1996. The synthetic FDI is much smaller. This means that the tension of cross-Strait Taiwan after 1996 has an adverse effect on FDI in Fujian. The result reveals the loss of FDI in Fujian is about 2.48 billion dollars from 1996 to 2008.

[6] Because of the data missing problem, Qinghai, Ningxia and Tibet are dropped in the analysis.

Moreover, we calculate the ratio of MSPE after 1996 to MSPE before 1996. Figure 6 shows the result. We find that the ratio of MSPE after 1996 to MSPE before 1996 of Fujian stands out in the figure. The MSPE after 1996 is about 43 times the MSPE before 1996. No other province achieves such a large ratio. If the treatment is assigned at random in the data, the probability of obtaining this ratio as large as Fujian is 1/27. This implies that we can refuse the null hypothesis that cross-strait tension has no effect on FDI in Fujian at 3.7% statistical significance.

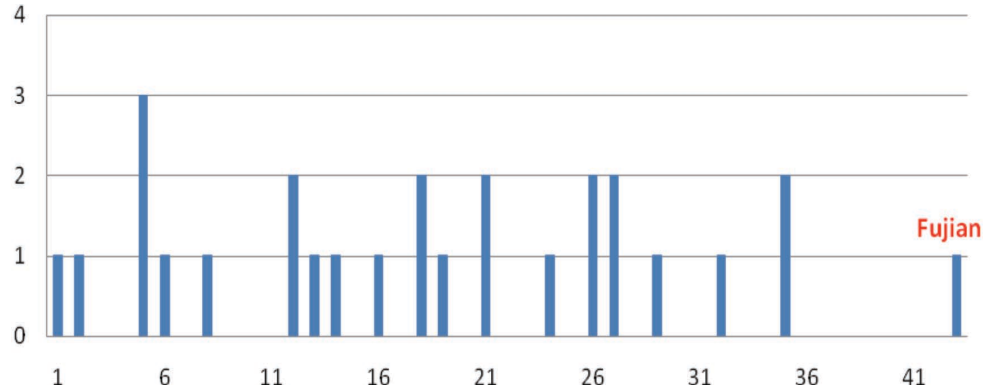

FIGURE 6. DISTRIBUTION OF MPSE(AFTER1996)/MPSE(BEFORE 1996)

Source: Author calculation

VI. CONCLUSION

Comparative case study is widely used in social science. However, there is a difficult about how to choose a suitable control group and how to catch the causal effect. We cannot find an identical individual standing for the treatment group. The pool of potential control groups provides a change to find a suitable representative even if each control group predicts the treatment group badly. The synthetic control method utilizes the pool of potential control groups, and thus calculates the weights of each potential control group under certain rules. By using these weights, an applicable control group is generated. It is a kind of completely data driven method utilizing the information of the existing data.

This paper uses the synthetic control method to study the influence of political risk on economy through a case of China, and more importantly the mechanism behind such influence. Taiwanese independence activists try to divide the country, and thus make the political situation deteriorative, which will increase the investment risk in Fujian province. As a result, if Taiwanese independence activists becomes a ruling party, then the political instability emerges, which will raise the perceived level of investment risk in both mainland China and Taiwan. Especially, Fujian the closest province near Taiwan is affected mostly. This provides a natural experiment to conduct our research.

We find that even if there are lots of preferential policies, there is indeed an economic loss measured by GDP per capita in Fujian province after 2000. This implies that an increase of

political risk has a negative impact on economy. The accumulated loss of GDP per capita of Fujian province is estimated to be 711US Dollar from 2001 to 2008. Even more importantly, the influence mechanism of political instability on economy is investigated. The foreign direct investment in Fujian province also gets loss due to the tension of cross-Taiwan Strait relation. The loss of FDI in Fujian is about 2.48 billion dollars from 1996 to 2008, which is the key reason for the loss in GDP per capita compared with the case of no change in political risk. In sum, the paper provides a case of China to illustrate the influence of political risk on economic development and the mechanism of political risk on economy.

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POLITIČKI RIZIK I EKONOMSKI RAZVOJ – STUDIJA SLUČAJA KINE

SAŽETAK

Nesigurnost uzrokovana političkom nestabilnošću utječe na rizik ulaganja te tako utječe i na ulaganja, posebice strana, koja su u uskoj vezi s ekonomskim razvojem. Ovaj rad istražuje cijenu političke nestabilnosti na primjeru tenzija na dvije strane tajvanskog tjesnaca u Kini. Koristi se sintetička metoda kontrole za analizu problema uzrokovanog kontrafaktičkom analizom u studiji slučaja. Napeta situacija na dvije strane tajvanskog tjesnaca snažno utječe na ekonomski razvoj provincije Fujian radi geografskih karakteristika i ekonomskih veza. Empirijski rezultati otkrivaju da je gubitak BDP-a po glavi stanovnika u provinciji Fujian dosegao 711 USD od 2001. do 2008. Nadalje, izravna strana ulaganja u provinciju Fujian također podliježu negativnom utjecaju.

Ključne riječi: politički rizik; ekonomski razvoj; sintetička metoda kontrole; odnosi dvije strane tajvanskog tjesnaca


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DOES EXTERNAL DEBT CONTRIBUTE TO MALAYSIA ECONOMIC GROWTH?

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ABSTRACT

This paper analyzes the contribution of external debt to Malaysia's economic growth. To investigate whether the external debt has contributed to the economic growth in the long run, the growth model is tested by applying the Autoregressive Distributed Lag (ARDL) bound test. In addition, the existence of the threshold effect is examined to estimate the optimal level of external debt. The empirical results reveal that the accumulation of external debt is associated with an increase in Malaysia's economic growth up to an optimal level, and an additional increase of external indebtedness beyond the level has inversely contributed to the Malaysian economy.

Reference to this paper should be made as follows: Mohd Daud, N.; Halim Ahmad, A; Azman-Saini, W.N.W. 2013. Does External Debt Contribute to Malaysia Economic Growth?: *Ekonomska istraživanja – Economic Research 26(2): 346-363.*

I. INTRODUCTION

In recent decades, literature on economic growth and its determinants has attracted considerable attention. However, studies conducted to examine the impact of external debt on economic growth are still lagging behind, leading to ambiguous answers.[1] The increasing level of the stock of external debt has raised concerns about whether the external borrowing could help to boost economic growth or whether it could become a burden that future generation would have to pay for. In addition, the role of external debt in economic growthof developing countrieshas been questioned since there has been a high incidence of default, low economic growth and high levels of poverty, all of which are associated with high stocks of external debt. Furthermore, the uncertainties about country external debt sustainability position as well as whether countries are already trapped in the debt-overhang situation have underlined the importance of analyzing this issue.

Due to scarce resources in domestic economies, external debt has become one of the important sources of domestic capital. In particular, the dual-gap theory, that explains the savings gap and foreign exchange gap, has highlighted the motivation behind the introduction of external debt to a growth model. The savings gap and foreign exchange gap indicate that there are inadequate and insufficient resources to support the expected level of growth in the economy, revealing the role of external borrowings. Thus, the role of external borrowing in economic growth has been discovered even though it depends on the two gaps of either savings-investment or import-export. The foreign borrowing will increase until the gaps are narrowed and the expected marginal product of capital is equivalent to the marginal cost of funds.

Malaysia, as a small open economy that formulates and implements a prudent debt management policy, has shown an increasing pattern of total outstanding external debt. The tremendous increment has reached around 406.5 percent within 20 years, which highlighted issue on the usability of external debt to boost domestic economy. Furthermore, with high level of external debt, country would possibly increase the probability of being default. Does this development provide a good overview to attract investors from abroad to invest in the Malaysian economy? The answer would depend on the contribution of external debt to the economy, or the sustainability of the external position. If external debt has been efficiently allocated to domestic investment it could, in return, generate economic growth in the long run, implying that Malaysia's external debt position is sustainable. Furthermore, having the benefit of economic growth could also improve the capability of servicing the debt without crowding out the country's investment. On the other hand, if a country were to experience an adverse impact from its external borrowing, it would affect the investor's confidence since the debt would not have been productively channeled into investment or economic growth (Clements, Bhattacharya and Nguyen, 2003; Chowdhury, 2001; Mohamed, 2005; Wijeweera, Dollery and Pathberiya, 2005; Sen, Kasibhatla and Steward, 2007). As a result, with high levels of indebtedness, countries would not be able to generate more economic growth and would fail to repay their debts.

[1] Total external debt is defined as, at any given time, the outstanding amount of those actual current and non-contingent liabilities that require payments of principal and/ or interest by the debtor at some point in the future and that are owed to non-residents by residents of an economy (International Monetary Fund, 2003).

At the other end of the spectrum, debt repayment has been used as a signaling device to reveal the competence of the government and can display the fundamentals of the country's economy (Sandleris, 2008). Moreover, the ability to repay debt is closely related to Malaysia's sovereign debt rating (probability of default) as well as the future borrowing opportunities. Risk of default, rescheduling and arrears are likely to increase the volatility of future inflows and additional lending, while access to capital markets depends on the perceived sustainability (Gunning and Mash, 1998). As such, any negative and uncertain elements in Malaysia's external position would possibly delay any foreign investment into the country.

As has been explained by the capital market imperfection, there is no effective mechanism to prevent borrowers from being in default to the lenders. Even with a high level of indebtedness where debt service could "crowd out" investment or, to a lesser extent, cause stagnant or declining economic growth, most of the developing countries such as Malaysia have tried their best not to default.[2] Being either in default or in a debt-overhang situation is not the best solution for a country to maintain a sustainable position. Thus, an analysis of the relationship between external debt and economic growth could give us some intuition as to whether Malaysia has been benefiting from external borrowing over the past 20 years. This could also give a signal about the effectiveness of debt management policies in Malaysia. In other words, by considering the findings of this paper, governments could formulate policies that could prevent countries from being default or in a debt-overhang situation.

The objective of this paper is to analyze the debt-growth nexus, particularly for Malaysia. This paper provides evidence on the "disincentive effects" of high debts, due to the debt-overhang and macroeconomic instability, as well as liquidity constraint that could be referred to adverse effect of debt service on investment and growth. Furthermore, this paper is also concerned with the importance of the optimal level of external debt holding. This analysis is profound since any results found from the linkages between the external borrowing and economic growth would be useful for policy formulation. Regardless of whether there is a positive or negative relationship between external debt and economic growth, the non-linear relationship of debt and growth is important for providing an optimal level or threshold for a country to manage its debt position. Moreover, this paper could give an indirect signal to creditors on a country's ability to service its debt in the future.

This paper is distinct from other research in several aspects. This paper contributes to the small but growing body of empirical literature on the debt-growth nexus. To the best of our knowledge, only a few and inconclusive empirical studies have been carried out to determine whether external debt matters for Malaysia's economic growth. Moreover, this paper also investigates the potential of the non-linear relationship between external debt and economic growth (Laffer curve relationship). Thus, this study attempts to fill this gap in the literature. The paper is structured as follows.

[2]According to Borensztein and Panizza (2008), exclusion from the international capital market for future borrowing, international trade exclusion costs, costs to the domestic economy through the financial system and political costs to the authorities are among the cost that country potentially incur in the event of default.

An overview of external debt and economic growth in Malaysia is presented in section II. The next section reviews the theoretical and empirical literature on the debt-growth model. Section IV outlines the data and methodology while the empirical results are presented in section V, and section VI concludes the paper.

II. EXTERNAL DEBT AND ECONOMIC GROWTH IN MALAYSIA

Figure 1 shows the Malaysia's total outstanding of external debt since the early 1990s. The total outstanding of external debt has shown an increasing and tremendous upward pattern since the year 1990. As at the end of 2009, Malaysia's total outstanding external debt was recorded at RM233,136 million (or USD67.7 million), which is equivalent to 35.3 percent of Gross National Income (GNI) (Central Bank of Malaysia, 2009).[3] The drastic increase in the external debt accumulation is during the first quarter of 1997 with 11.3 percent growth and 15.2 percent growth in second quarter of 2008. In addition, as at end of Q4 2009, the debt service amounted at 6.8 percent which indicates that Malaysia has used 6.8 times of its revenue to service its external debt.

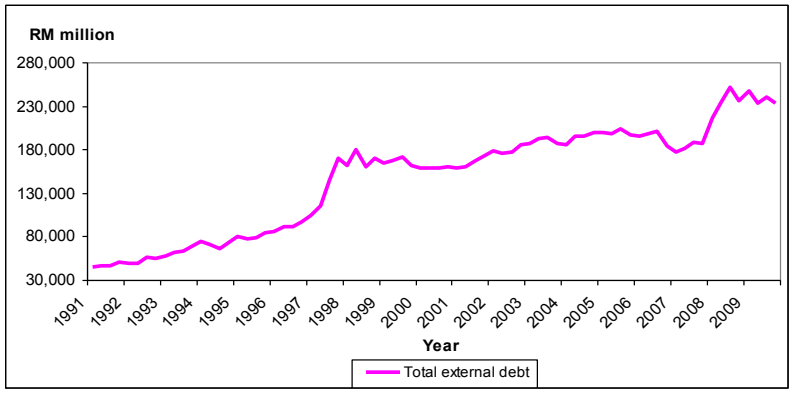

FIGURE 1. TOTAL OUTSTANDING EXTERNAL DEBT OF MALAYSIA

Source: *Central Bank of Malaysia, Monthly Bulletin*

In addition, Table 1 provides details on the compositions of Malaysia's total outstanding external debt for the period 1991 to 2009. The composition of Malaysia's external debt position shows a stable pattern over the period. Malaysia's external debt profile continued to be skewed towards a longer maturity structure with medium- and long-term debt accounting for 76.96 percent of total external debt over the period from 1991 to 2009.

[3] Malaysia has revised its external debt position in 2005 to be in line with the Balance of Payment manual (BPM5) by the International Monetary Fund (IMF) which classifies offshore entities (Labuan International Financial Offshore Financial Centre) in an economy as residents for compilation of external data, including external debt data.

The external borrowing held by the Non-Financial Public Enterprises (NFPE thereafter) and private sector accounted for the largest portion of Malaysia's external debt, while the federal government debt remains low at an average of 19 percent.

TABLE 1 - THE COMPOSITIONS OF EXTERNAL DEBT

	In million (Ringgit Malaysia)		
	1991Q1-2009Q4	1991Q1-1999Q4	2000Q1-2009Q4
Total external debt	148,357	97,402	194,217
Long-term debt[1]	114,171	76,207	148,339
Federal government	21,743	16,805	26,187
NFPE	44,595	27,679	59,820
Private sector	47,833	31,723	62,332
Short-term debt	34,186	21,195	45,878
	As percentage of total external debt		
	1991Q1-2009Q4	1991Q1-1999Q4	2000Q1-2009Q4
Long-term external debt	76.96	78.24	76.38
Federal government	19.04	22.05	17.65
NFPE	39.06	36.32	40.33
Private sector	41.90	41.63	42.02
Short-term debt	23.04	21.76	23.62

Source: Monthly Bulletin Statistics, Central Bank of Malaysia

On the other hand, the Malaysian economy has recorded constant growth over the past three decades with several fluctuations in the economy as depicted in Figure 2. As a small open economy, Malaysia is sensitive to any fluctuation in international market and suffered a contraction in GDP growth due to the contagion and spillover effect from the external factors.

Descriptively, it shows that the growth in accumulation of external debt is higher than the growth in country economic growth. Furthermore, the information on the increasing trend and stable compositions of the external debt hold by all sectors has led to the question of whether Malaysia has benefited from the decision to borrow from abroad.

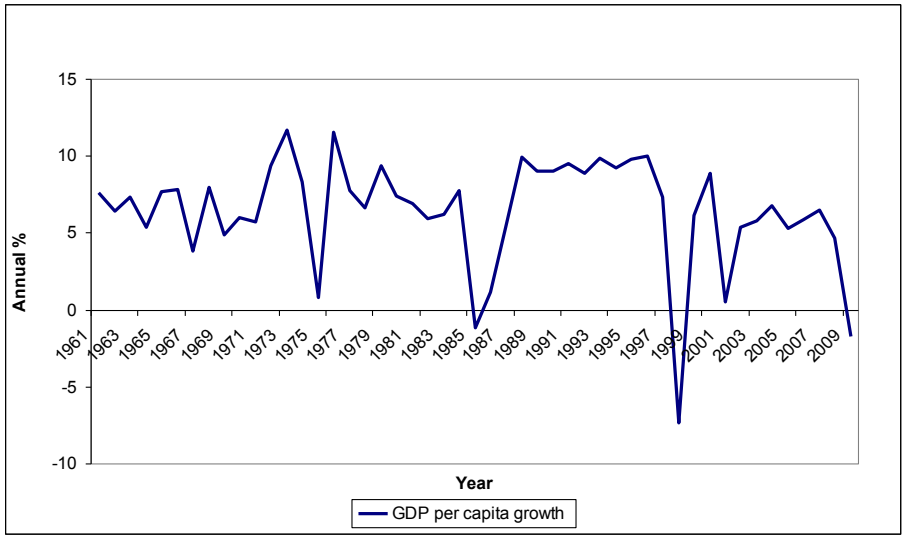

FIGURE 2. MALAYSIA ECONOMIC GROWTH, 1960-2009

Source: WDI, World Bank

III. LITERATURE REVIEW

In the neoclassical growth theory developed by Solow-Swan (1956), the domestic saving financing the aggregate investment with labour-augmenting technological change is exogenous in determining the equilibrium growth of per capita output. However, the growth model is feasible in the closed economy where there is no interaction with the rest of the world. In addition, Mankiw, Romer and Weil (1992) extend the Solow-Swan model to include human capital in the growth model by retaining the assumption of constant returns to scale in all inputs (diminishing returns to physical and human capital). Relatively speaking, small changes in resources devoted to physical and human capital may lead to large changes in output per worker. In the era of globalization, the interdependence among countries in the world through trade and capital flow has inspired Otani and Villanueva (1989), Agenor (2000), Villanueva (2003), and Villanueva and Mariano (2007) to develop a growth model for the open economy that incorporates a global capital market role. Krugman (1988) defines debt-overhang as a situation in which the expected repayment of external debt falls short of the contractual value of the debt. In addition, with the high level of debts having adverse effects on economic growth, a country would be faced with the high probability of experiencing the debt-overhang problem. Moreover, if there is some likelihood that, in the future, debt will be larger than the country's repayment ability the expected debt-service cost will discourage further domestic and foreign investment (Pattilio, Poirson and Ricci, 2002). In other words, large debt burdens squeeze investments because returns are discounted through debt service payment by foreign creditors. Furthermore, high debts have a negative impact on the rate of investment and economic growth because of disincentive, cash flow and moral hazard effects (Claessens, Detagiache, Kanbur and Wickham, 1997).

However, at a reasonable level of foreign borrowing, external debt could have a positive impact on investment and growth. The "Laffer Curve" describes the relationship between the face value of debt and investment. If the outstanding debt increases beyond a threshold level, the expected repayment begins to fall as a consequence of adverse effect. In other words, on the

upward-sloping curve or 'good' section the implication is that an increase in the face value of debt is associated with an increase in expected repayment up to a threshold level. Along the 'bad' section of the "Laffer Curve", an increase in the face value of debt reduces expected payment.

A high-level stock of indebtedness and low level of investment in the 1980s by several Latin America countries has inspired Cohen (1995) to analyze whether the high debt stock could be the best predictor of the low level of investment rate. However, large debtors do not expect to service their debt, thus investment should not be crowded out. Surprisingly, the impact of debt flows (debt service) could affect economic growth by crowding out private investment or altering the composition of public spending. Higher debt service can raise the government budget deficit, thus reducing the public savings. This in turn may either raise interest rates or crowd out credit available for private investment, dampening economic growth (Clements, Bhattacharya and Nguyen, 2003). Higher debt service payments can also have adverse effects on the composition of public spending by shrinking the amount of resources available for infrastructure and human capital, with a negative effect on growth.

Over the past decades, academics and policy-makers have shown consistent interest in and have made efforts to investigate and develop the theory on the link between debt and economic growth. Previous empirical evidence has found mixed results to support the debt-overhang hypothesis. Chowdhury (2001), Clements, Bhattacharya and Nguyen (2003), Mohamed (2005), Wijeweera, Dollery and Pathberiya (2005) and Sen, Kasibhatla and Stewart (2007) found evidence to support the negative effect of external debt on a country's economic growth. In other words, an increase in the stock of debt has a negative impact on economic growth. Previous empirical works done by Choong, Lau, Liew and Puah (2010) suggest that external debt have a negative effect on Malaysia long-run economic growth. Furthermore, the Granger causality test also reveals the existence of short-run causality linkages between external debt and economic growth. Meanwhile, Pattilio, Poirson and Ricci (2004), Cordella, Ricci and Ruiz-Arranz (2005), and Imbs and Ranciere (2005) found non-linearity in the debt-growth relationship. Furthermore, Patillio, Poirson and Ricci (2004) report that the average impact of debt on per capita growth appears to become negative for debt levels above 160 to 170 percent of exports and 35 to 40 percent of GDP. Clements, Bhattacharya and Nguyen (2003) found that, above the threshold of 20-25 percent of GDP and 101-105 percent of exports, external debt is associated with lower rates of growth for 55 low income countries. However, the study by Schclarek (2004) stands in contrast to the others since there it finds no evidence of non-linearity (inverted–U shape relationship) for selected developing countries.

Meanwhile, the flow of debt, and the debt service of external debt in particular, could affect growth by crowding out private investment or public spending. Iyoha (1999) provides evidence of the crowding-out effect in the sub-Saharan African countries, implying that heavy external debt stock and debt service payment could reduce foreign investment into the country. Clements, Bhattacharya and Nguyen (2003) support the crowding-out effect for 55 low-income countries. On the other hand, Pattillio, Poirson and Ricci (2004) found that one third of the effect of debt on growth occurs via physical capital accumulation and two thirds via total factor productivity growth. As such, by extending the analysis to investigate the potential of the non-linear relationship between external debt and economic growth as well as providing the optimal level of external debt that Malaysia should hold will fill the gap in the literature.

IV. DATA AND ECONOMETRICS MODEL

Inspired by the dual-gap theory, Otani and Villanueva (1989), Agenor (2000), Villanueva (2003), and Villanueva and Mariano (2007) developed a theory on the relationship between external debt and economic growth through several mechanisms such as fiscal policy adjustment. This has revealed the role of external debt in contributing to a country's economic growth. On the other hand, Villanueva (2003) has extended the standard neoclassical growth model that incorporates endogenous technical change and global capital market. In addition, Villanueva (2003) defines the aggregate capital stock as the accumulated sum of domestic saving and net external borrowing. As has been explained in the neoclassical growth model, a country that intends to increase its economic growth could increase its saving, which would lead to an increase in investment and, to a lesser extent, economic growth. In addition, Villanueva (2003) claims that economic growth will not increase until capital stock has risen to a certain level. As such, a rise in capital through debt accumulation will result in an increase in saving rate, investment rate and economic growth. Thus, to investigate whether the external debt has contributed to the economic growth, the growth model to be estimated is

$$y_t = \beta + \beta_1 GROSSF_t + \beta_2 POP_t + \beta_3 GREV_t + \beta_4 OPENN_t + \beta_5 ED_t + \beta_6 DSERV_t + \varepsilon_t \quad (1)$$

where (at time *t*), y is real of Gross Domestic Product (GDP), GROSSF is gross investment, POP is population, GREV is government revenue, OPENNis trade openness, EDis external debt, DSERV is debt service payment and ε_t represent the error term. The basic growth model to be estimated include y (dependent variable) as a proxy of economic growth while the independent variable includes GROSSF, POP, GREV, OPENN, ED and DSERV. The GROSSF and POP represent the rates of growth of factor inputs (capital and labor force) in the production function. Meanwhile, GREV, OPENN and DSERV account for country-specific government policies particularly on the fiscal, trade and debt management policy.

All data are collected from the Monthly Bulletin Statistics issued by Central Bank of Malaysia from the period 1991Q1 to 2009Q4. Since the observations are on a quarterly basis, for maximum order of the lags in the ARDL model, a lag order of 4 is chosen. The Autoregressive Distributed Lag (ARDL) bound test developed by Pesaran, Shin and Smith (2001) is being employed for cointegration analysis. One of the advantages of the Pesaran, Shin and Smith (2001) approach is that this method is robust to small sample sizes (Pattichis, 1999; Mah, 2000; Tang and Nair, 2002). Basically, the bound test developed by Pesaran Shin and Smith (2001) is the Wald test (F-statistic version of the bound testing approaches) for the lagged level variables in the right-hand side of an Unrestricted Error Correction Model (UECM). The asymptotic distribution of the F-statistic is non-standard under the null hypothesis of no cointegrating relationship between the examined variables, irrespective of whether the explanatory variables are purely I(0) or I(1).

If the statistic from a Wald test falls outside the critical bounds value (lower and upper values), a conclusive inference can be made without considering the order of integration of the explanatory variables. In addition, if the F-statistic exceeds the upper critical bound, the null hypothesis of no cointegrating relationship can be rejected. However, if the test statistic (F-statistic) falls below the lower critical bound, then the null of non-cointegration cannot be rejected. If the F-statistic falls between the upper and lower bounds, a conclusive inference cannot be made.

The second stage of the ARDL approach is to estimate the coefficients of the long-run cointegrating relationship and the corresponding error correction model. Below is the error correction version of the ARDL (*p,q,q,q,q*) model in the variables GDP, GROSSF, POP, OPENN, GREV, ED, DSERV;

$$\Delta Ln(GDP)_t = \alpha_0 + \sum_{i=1}^{p} a_i \Delta Ln(GDP)_{t-i} + \sum_{i=0}^{q} b_i \Delta Ln(GROSSF)_{t-i} + \sum_{i=0}^{q} c_i \Delta Ln(POP)_{t-i} + \sum_{i=0}^{q} d_i \Delta Ln(OPENN)_{t-i} + \sum_{i=0}^{q} e_i \Delta Ln(GREV)_{t-i} + \sum_{i=0}^{q} f_i \Delta Ln(DSERV)_{t-i} + \sum_{i=0}^{q} g_i \Delta Ln(ED)_{t-i} + \delta_1 Ln(GDP)_{t-1} + \delta_2 Ln(GROSSF)_{t-1} + \delta_3 Ln(POP)_{t-1} + \delta_4 Ln(OPENN)_{t-1} + \delta_5 Ln(GREV)_{t-1} + \delta_6 Ln(DSERV)_{t-1} + \delta_7 Ln(ED)_{t-1} + e_t \quad (2)$$

The lagged error correction term (e_{t-1}) derived from the error correction model is an important element in the dynamics of the cointegrated system as it allows for adjustment back to the long-term equilibrium relationship given a deviation from the last year.

In addition, this paper also tries to examine the existence of the threshold effect which made it possible to estimate the optimal amount of external debt holding. Thus, the test proposed by Hansen (2000) to assess the null hypothesis of a linear regression against a threshold regression analysis has been employed. In the form of the thresholds model,

$$y_t = \beta_1^{'} x_t + \mu_t \; q_t \leq \gamma \quad (3)$$

$$y_t = \beta_2^{'} x_t + \mu_t \; q_t > \gamma \quad (4)$$

where q_t is the threshold variable, which is external debt ED.The threshold variable could be part of the regressors and it is used to split the sample into two regimes. Meanwhile y_t is economic growth measured by real gross domestic product (GDP). x_t is $p \times 1$ vector of independent variables and μ_t is a regression error. Models (3) and (4) can be written in a single equation form as

$$y_t = \beta' x_t + \theta x_t(\gamma) + \mu_t \quad (5)$$

where $d_t = I(q_t \leq \gamma)$where $I(.)$ denotes the indicator function and sets the variable $x_t(\gamma) = x_t d_t(\gamma)$. Furthermore, the null hypothesis of linearity against a threshold specification can be expressed as:

$$H_0 : \beta_1 = \beta_2 \quad (6)$$

Hansen (2000) has developed a threshold model estimator which considered the least squares estimations. In addition, by providing an asymptotic simulation test of the null of linearity against the alternative of a threshold, this method also computed a confidence interval by inverting the likelihood ratio statistics. Hansen (2000) also proposes an F-test bootstrap (heteroskedasticity-consistent) procedure to test the null of linearity. Since the threshold value

γ is not identified under the null, the p-values are computed by a fixed bootstrap method. The independent variables are supposed to be fixed and the dependent variable is generated by a bootstrap from distribution $N(0,\hat{\mu})_i$, where $\hat{\mu}_i$ is the OLS residual from the estimated thresholds model. In other words, it is estimated by fixing the regressors at the right-hand side and generating the bootstrap dependent variable from the dependent variable. Hansen (2000) shows that this procedure yields asymptotically correct p-values. If the null hypothesis of linearity is rejected, one can split up the original sample according to the estimated thresholds value and perform the same analysis on each subsample. The distribution of the threshold estimator is non-standard while it only allows one threshold relationship and one threshold variable. The method is employed for this analysis to examine the optimal level of external debt that a country should hold. In addition, with continuous variables such as GDP and ED used in this analysis, this method developed by Hansen (2000) is the most relevant for use in this study.

V. RESULTS AND DISCUSSION

Table 2 presents the result of the F-statistic for testing the long-run relationship between external debt and economic growth.[4] To provide additional insight into the debt-growth relationship, this paper also estimates the model for the periods 1991Q1 to 1997Q3 and 1998Q3 to 2009Q4.[5] The computed F-statistic's value of 3.8774 exceeds the critical bound (2.476 to 3.646) at the 5 percent significance level when the maximum lag order of 4 is imposed for the overall period. This implies that the null hypothesis of no cointegrating long-run relationship can be rejected. The evidence of a long-run relationship rules out the possibility of any spurious relationship existing between the variables. In other words, there is a theoretical relationship existing between the variables. Furthermore, the estimated F-statistics of 24.8089 and 3.6000 for the periods of 1991Q1 to 1997Q3 and 1998Q3 to 2009Q4 respectively exceed the critical bound (at 5 percent significance leveland 10 percent significance level respectively), indicating the existence of a long-run cointegration relationship of the debt-growth model. Thus, these results confirmthe robustness of evidence on the existence of a long-run relationship between GDP and external debt in Malaysia.

[4] Unit root test has been conducted to confirm the non-existence of I(2) variables. The results found that all variables are non stationary variables, I(1) variables.

[5] It has been noted that Malaysia experienced the Asian financial crises in 1997. The economy started to recover after the pegged exchange rate (with United States dollar) policy was announced by the Central Bank of Malaysia in September 1998.

TABLE 2 - F-STATISTICS FOR TESTING THE EXISTENCE OF LONG-RUN RELATIONSHIP

	Overall period	1991Q1-1997Q3	1998Q3-2009Q4
Test statistics	3.8774*	24.8089*	3.6000**
Critical value at 5 percent			
Lower bound, Upper bound	2.476, 3.646	2.476, 3.646	2.476, 3.646
Critical value at 10 percent			
Lower bound, Upper bound	2.141, 3.250	2.141, 3.250	2.141, 3.250

Source: Author research

Notes:*and ** denotes significant at 5 and 10 percent significance level respectively. The critical values are provided by Pesaran, Shin and Smith (2001), unrestricted intercept and no trend. All models include intercept in the estimation.

Once a long-run cointegration relationship has been established, the estimates of the ARDL long-run coefficient for the estimated model are presented in Table 3. The external debt variables are found to have a positive and significant (at 5 percent significance level) effect on Malaysia's economic growth. For the overall period from 1991Q1 to 2009Q4, the estimated coefficient of the long-run relationship shows that an increase in external debt contributed to Malaysia's economic growth.

A 1 percent increase in external debt is associated with an increase in economic growth of 0.78 percent. The result also shows a positive relationship between external debt and Malaysia's economic growth for the sub-period analysis of 1998Q3 to 2009Q4.[6] In other words, the external borrowings are found to improve the country's investment rate and, to a lesser extent, economic growth. Other control variables, such as gross investment, government revenue and population growth, are found to have a positive and significant (at 5 percent significance level) effect in explaining the real GDP level. The result implies that any fluctuation and movement in the gross investment, population, government revenue and external debt are found to be cointegrated with the changes in real GDP. On the other hand, the debt service variable and the trade openness variable are found to have negative and significant (at 5 percent significance level and 10 percent significance level respectively) effect on the economic growth. This indicates that the debt service payments are crowdingout the investment opportunity and economic growth.

The error correction model representation for the ARDL model is based on the Schwarz Bayesian criterion. For the overall period, the error correction term coefficient is estimated at -0.3648, is statistically significant, and has the correct sign, ensuring that the long-run equilibrium is attainable. This suggests that economic growth is adjusting moderately at 36.48 percent to changes in the explanatory variables before reaching its equilibrium.

[6] There is no evidence of the relationship between external debt and economic growth for the sub-period of 1991Q1 to 1997Q3.

TABLE 3 - RESULTS OF ESTIMATED LONG-RUN COEFFICIENT USING THE ARDL APPROACH

GDP	ARDL (3,0,0,0,1,0,0)	ARDL (2,2,2,0,0,2,2)	ARDL (1,1,0,0,1,0,0)
	Overall period	**Sub-period**	
	1991Q1-2009Q3	1991Q1-1997Q3	1998Q3-2009Q4
GROSSF	0.3153	-0.1715	0.3985
	(0.0693)*	(0.1074)	(0.1519)*
POP	1.6900	5.2901	0.6647
	(0.3256)*	(0.6147)*	(0.5618)
GREV	0.1154	-0.0711	0.0283
	(0.0411)*	(0.0358)**	(0.0439)
OPENN	-0.5552	0.2038	0.4630
	(0.3286)**	(0.0570)*	(0.0964)*
ED	0.7810	-0.0735	0.2726
	(0.2914)*	(0.0542)	(0.1234)*
DSERV	-0.0573	0.0213	-0.0258
	(0.0255)*	(0.0105)*	(0.0309)
C	-11.9512	-40.763	-8.3784
	(2.4828)*	(4.9844)*	(3.5595)*
ECT_{t-1}	-0.3648	-0.937	-0.4360
	(0.0735)*	(0.1380)*	(0.1312)*
	ARDL-VECM diagnostic test		
Adjusted R-squared	0.998	0.982	0.8256
Serial Correlation $\chi^2(4)$	0.9266[0.921]	23.608[0.00]*	1.9430[0.746]
Functional Form $\chi^2(1)$	2.1124[0.146]	1.1020[0.294]	1.1648[0.280]
Heteroskedasticity $\chi^2(1)$	0.0837[0.772]	0.1827[0.669]	1.8542[0.173]

Source: Author research

Notes: *and ** denotes significant at 5 and 10 percent significance level respectively. GDP is the real gross domestic product, GROSSF is gross investment, POP is population, GREV is government revenue, OPENN is trade openness, ED is external debt, DSERV is debt service payment. The ARDL model is selected based on Schwarz Bayesian Criterion (SBC). The serial correlation test is based on Lagrange multiplier test of residual serial correlation, the functional form test is based the Ramsey's test, and the heteroskedasticity test is based on the regression of squared residuals on squared fitted value. Numbers in parenthesis represents the *p*-value.

Table 3 also provides diagnostic results from the estimated model. Based on the LM test statistics, none of the test statistics could reject the null of no serial correlation, functional form and heteroskedasticity in the model. As such, the models have conceded all the diagnostic tests against functional form misspecification, serial correlation, and heteroskedasticity for the overall (1991Q1 to 2009Q4) and 1998Q3 to 2009Q4 period of analysis. Thus suggest that the estimation for the overall and 1998Q3 to 2009Q4 period of analysis is unbiased and efficient. However, the analysis over the sub-period of 1991Q1 to 1997Q3 rejects the null of no serial correlation (significant chi-square value at 5 percent). Hence, careful interpretation is needed since it suffers from the serial correlation problem.

To provide additional insight that attempts to tease out more detail on the relation between external debts and Malaysia's economic growth, it is useful for policy formulation to analyze the optimal stock of external indebtedness. By employing the threshold method of Hansen (2000), this paper also explores any potential threshold effect in the debt-growth model. By using 10,000 bootstrap replications, the results for F-statistics and the p-value for the threshold model are reported in Table 4.The F-statistics and the bootstrap p-value suggest a

rejection of the null of no thresholds effect at 5 percent significance level of external debt on economic growth over the period 1991 to 2009.

TABLE 4 - RESULTS OF THRESHOLD REGRESSION

	Overall period	1991Q1-1997Q3	1998Q3-2009Q4
F-test statistics	58.207	34.809	74.9258
Bootstrap p-value	0.000*	0.404	0.000*
	$q_i \leq 170{,}757.02$	$q_i \leq 170{,}757.02$ $q_i \leq 73{,}635$	$q_i \leq 175{,}874.64$
	Coefficient		
GROSSF	0.1402	0.5419	-0.0001
	(0.0216)*	(0.1019)*	(0.06444)
POP	0.1362	-0.2942	0.5650
	(0.1449)	(0.5702)	(0.2829)*
GREV	0.1157	0.0645	0.1140
	(0.0321)*	(0.0808)	(0.0326)*
OPENN	0.2929	0.05486	0.3472
	(0.0379)*	(0.1023)	(0.0711)*
ED	0.1069	0.0830	0.1666
	(0.0258)*	(0.1164)	(0.1377)
DSERV	0.0237	0.0611	-0.0066
	(0.0201	(0.0366)	(0.0402)
C	-0.5424	3.1256	-4.7590
	(1.1317)	(4.617)	(3.1172)
No of observations	73	27	46
R-Squared	0.988	0.94	0.930
	$q_i > 170{,}757.02$	$q_i > 73{,}635$	$q_i > 175{,}874.64$
	Coefficient		
GROSSF	0.0878	0.0530	0.1050
	(0.0387)*	(0.03714)*	(0.0386)*
POP	0.2628	1.4052	0.1552
	(0.1511)	(0.4096)*	(0.1522)
GREV	0.0413	0.2834	0.0407
	(0.0089)*	(0.0803)*	(0.0085)*
OPENN	0.1659	0.3614	0.1846
	(0.0219)*	(0.0615)*	(0.0258)*
ED	-0.0401	-0.0523	-0.0129
	(0.0249)*	(0.0455)	(0.0209)*
DSERV	-0.0042	-0.0165	0.0031
	(0.0077)	(0.0236)	(0.0085)
C	2.6998	-12.7828	3.1721
	(1.1063)*	(3.5795)*	(1.0863)*
No of observations	73	27	46
R-Squared	0.971	0.96	0.971

Source: Author research

Notes: *and ** denotes significant at 5 and 10 percent significance level respectively. GROSSF is gross investment, POP is population, GREV is government revenue, OPENN is trade openness, ED is external debt, DSERV is debt service payment. The null hypothesis is no threshold relationship. Number in brackets represents the standard error.

This indicates the evidence of a threshold effect for the debt-growth model (Pattillo, Poirson and Ricci, 2004; Cordella, Ricci and Ruiz-Arranz, 2005;Imbs and Ranciere, 2005). Intuitively, it shows the existence of an inverted-U shape relationship between the debt stock and growth. The inverted-U relationship explains that an increase in debt stock has a positive effect on economic growth until it achieves the optimal level (up to a certain level). Beyond the threshold level, an increase in stock of indebtedness is associated with negative effects on economic growth. The negative effect could be related to the fact that it has not been efficiently allocated to investment; furthermore, too much debt holding might squeeze the investment through debt repayment. In addition, for the sub-period of 1991Q1 to 1997Q3 the F-statistics could not reject the null of no threshold effect, which implies that, during the period, the relationship between external debt and economic growth is linear. Meanwhile, the null of no threshold effect of external debt and economic growth is rejected for the period 1998Q3 to 2009Q4, suggesting the existence of an inverted-U shape relationship between the debt stock and growth in Malaysia.

In addition, the results show that the threshold estimate of external debt is at RM170,757 million for the overall period estimation. The results also reveal that an increase of external debt below RM170,757 million is associated with an increase in Malaysia's economic growth. This result is slightly lower than the threshold estimates found for the period 1998Q3 to 2009Q4. As the stock of external indebtedness increases, it is associated with a negative effect of external debt on the economy. The empirical results obtained in this study would suggest Malaysia hold external debt within the limit of RM170,757 million and RM175,875 million. Intuitively, with the current stock of external indebtedness of RM233,917 (as at the end of Q4 2009), Malaysia is positioned in the 'bad' section of the "Laffer Curve", which implies that accumulating more borrowings would raise the risk of being trapped in the debt-overhang situation.

VI. CONCLUSION

This article analyzes whether external debt contributes to Malaysia's economic growth in the long run. By employing the Autoregressive Distributed Lag (ARDL) for the period 1991 to 2009, the study demonstrates the existence of a long-run relationship between GDP and external debt in Malaysia. In addition, the results also show a consistent positive relationship between external debt and Malaysia's economic growth for the subperiod analysis. The main contribution of this study is in proving the optimal stock of external indebtedness by employing the threshold method of Hansen (2000). The results substantiate the notion that the accumulation of external debt is associated with an improvement in Malaysia's economic growth up to a certain optimal point; above that level, an additional rise in external indebtedness contributes inversely to the Malaysian economy. Malaysian policy-makers should play an effective role in monitoring Malaysia's external debt position, and close attention should be given to avoiding the risk of being trapped in the debt overhang situation. In particular, policy-makers should reformulate the external debt management strategy to minimize sovereign risk through diversification of the external borrowing. This could potentially be achieved by reducing the dependency on one specific debt instrument or currency. Hence, the strategy will be effective if it is carried out in parallel with a comprehensive surveillance and debt-monitoring system.

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UTJEČE LI VANJSKI DUG NA EKONOMSKI RAST MALEZIJE?

SAŽETAK

Uloga vanjskog duga u ekonomskom rastu je ispitana s obzirom na visoki broj neizvršenih novčanih obaveza, smanjeni ekonomski rast i visoku razinu siromaštva. Stoga, ovaj rad analizira utjecaj vanjskog duga na ekonomski rast Malezije. Kako bi se istražilo je li vanjski dug utjecao na ekonomski rast dugoročno gledano, model rasta je testiran primjenom ARDL graničnog testa. Pored toga, postojanje efekta praga je ispitano kako bi se procijenila optimalna razina vanjskog duga. Empirijski rezultati otkrivaju da je akumulacija vanjskog duga povezana s povećanjem malezijskog ekonomskog rasta na optimalnu razinu dok je dodatno povećanje vanjske zaduženosti preko tog nivoa inverzno pridonijelo malezijskoj ekonomiji.

Ključne riječi: ekonomski rast, međunarodna ekonomija, vanjski dug, Malezija


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OPTIMAL ECONOMIC POLICY AND OIL PRICES SHOCKS IN RUSSIA

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ABSTRACT

The goal of the paper is to explain and analyze whether the Central Bank of Russia should include commodity prices into the lists of variables they try to respond. We augmented New Keynesian DSGE small open economy model of Dib (2008) with the oil stabilization fund and new Taylor-type monetary policy rule and estimated the model using Bayesian econometrics. The results show that Central Bank's mild response to the oil price changes may be desired in terms of minimizing fluctuations of inflation and output only in the case when stabilization fund would be absent, while this response is redundant when "excess" oil revenues can be saved in the fund.

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I. INTRODUCTION

Russian economy is located on a natural resources-rich area. This reality significantly influences economic development and policy of the country. In such a situation the economy is vulnerable to the large extent to commodities demand fluctuations on external market, especially, to the price (quotes) behavior.

Commodity prices in the countries, which are significantly dependent on the raw materials-intensive sectors, have implication not only to the GDP and export/import growth but also to the budget deficit and other related issues like social policy and inequality. For example, negative commodity prices shocks during recent financial crises can be considered as the key factors that led to significant welfare losses and poverty increase in Russia, while positive shocks have counter effects during before the crises period (World Bank, 2008; Cerami, 2009).

Commodity pricing modeling is an active area of modern economic research. Significant commodity prices fluctuations is an important factor influencing real economic variables, especially in the countries with large dependency on export/import of natural resources. Russia definitely belongs to this group: crude oil revenues account for approximately one third of total export. Additional significant source of export incomes (more than one tenth) in Russia is generated by natural gas. In term of import, Russia does not have significant shares of commodities in its import bundle.

In such conditions it is natural to consider the possibility of economic policy to fine tune the real economy, achieve inflation stability and to weaken the negative influence of commodity prices shocks. In terms of monetary policy, authorities realize the existence of many channels though which asset (commodity) market is related to the real sectors and inflation. Central Banks should analyze the necessity to react to commodity prices and to change the effect of them on the real economic variables. The identification of economy drivers from the position of commodity market can be very useful for the economy stabilization during the periods of significant up- and downturns.

On the way from fixed to floating exchange rate regimes in Russia still play fiscal policy an important role in comparison to the monetary one and carry it significant burden of macroeconomic adjustment. In terms of fiscal policy regulators can manage such fiscal variables as revenues and expenditure to mitigate the influence of commodity prices shocks. The relations between government policy and natural resources prices pass through different channels, including fiscal spending, savings and other. An important element in this mechanism is the oil reserve fund. At the beginning of 2004 Stabilization fund was established in the Russian Federation. The goal of it was to balance federal budget when the oil prices fall below some cup-off point. In 2008 the fund was split into two parts: a Reserve Fund (invest in low-yield securities and is used when oil prices fall) and National Welfare Fund (invest in riskier assets). In the booming period the Funds absorb the excess liquidity and, as a result, reduce inflationary pressure and overheating of the economy.

Regardless of the existence of many channels through which economic policy can soften negative effects of commodity prices fluctuations, policy management often (in contradiction to the recommendations of the standard theory to be countercyclical) leads to the increasing business cycle expansions and contractions caused by changing prices of natural resources or at least is not effective in mitigating real variables deviations from their long-term values, that is, it is acyclical. The procyclicality of economic policy is especially acute in commodity-rich countries like Russia.

In the light of the importance of commodity markets modeling within coherent macroeconomic models, we investigate the question whether Central Bank of Russian should react to the fluctuations of the oil prices. We use production-intensive DSGE small open economy model with oil producing sector of Dib (2008) and introduce stabilization fund assuming that oil revenues taxed by the export duty may be used as government expenditures or savings in the fund. Central Bank is represented by monetary policy rule, which may include oil price. The model is calibrated and estimated on the Russian data using Bayesian techniques. For the purpose of economic policy optimization we test standard and augmented with oil prices policy rules for their ability to macroeconomic adjustments. The rule that is the most efficient in terms of fluctuations minimization would be treated as the most optimal.

The results shows that Central Bank may consider mild respond to the oil price, however, the economic gain in terms of fluctuations minimization is very small when there is stabilization fund in the country. The effect is more significant if the fund would be absent implying that either Central Bank or stabilization fund should stabilize the economy when oil prices deviate from the steady-state level and there is no significant necessity in using both of them.

The rest of the paper is organized as follow. In the next section a discussion on New Keynesian macroeconomic model augmented with oil prices elements is discussed. Then, methodology and short data analysis are presented. Finally, we report the results. At the end some conclusions are offered.

II. NEW KEYNESIAN DSGE MODEL

There are different ways of incorporating commodities into the model. We selected a standard NK DSGE small open economy model of Dib (2008). This model is a good candidate to describe the Russian economy, which is small and open and heavily depends on oil export.

In general, the DSGE model describes the behavior of households, which consume, save and work, intermediate firms in oil, tradable (also called manufacturing) and non-tradable sectors, which rent capital, labor and use oil to produce intermediate goods and services; final producer, which aggregates intermediate production and import; government; Central Bank; mechanisms of market imperfections, that is, elements of monopolistic competition, wage and price stickiness; shocks and equilibrium relations. We present here only the part of the model which differs from Dib (2008).

At the beginning we transform the model of the Central Bank to take into account the possibility of reaction to the oil prices. At the second stage the model is augmented with reserve fund and in this case the fiscal policy plays a greater role.

III. CENTRAL BANK MODEL MODIFICATION

Central bank monetary policy rule is assumed to have the following form

$$\log\left(\frac{R_t}{R}\right) = \rho o_R \log\left(\frac{R_{t-1}}{R}\right) + \left(1-\rho o_R\right)*\ldots$$

$$\ldots*\left(\rho o_\pi \log\left(\frac{\pi_t}{\pi}\right) + \rho o_Z \log\left(\frac{Z_t}{Z}\right) + \rho o_{\mu u} \log\left(\frac{\mu u_t}{\mu u}\right) + \rho o_e \log\left(\frac{e_t}{e}\right) + \rho o_{P_X} \log\left(\frac{P^*_{X,t}}{P^*_X}\right)\right) + e_{R,t},$$

(1)

which implies that interest rate is set based on the previous interest rate, R_{t-1}, inflation level, π_t, real output, Z_t, money growth rate, μu_t, nominal exchange rate, e_t, and oil price, $P^*_{X,t}$; $e_{R,t}$ denotes monetary policy shock; R, π, Z, μu, e, P^*_X are steady-states values of the corresponding variables. We have added to the classical Taylor rule the term oil price. Basically the goal of this study is to find optimal value of the parameter $\rho o_{P^*_X}$ such that it minimizes economic fluctuations.

In addition, we assumed (as in Sosunov and Zamulin, 2007) that some share, w^{rs}, of foreign revenues from oil export, $S_t p^*_{X,t} Y^{ex}_{X,t}$, forms additional amount of Central Bank's reserves:

$$Rs_t = w^{rs} S_t p^*_{X,t} Y^{ex}_{X,t} \tag{2}$$

and this purchase is financed by issuing necessary amount of money, M_t/P_t, such that total money growth rate is:

$$\mu u_t = \frac{M_t/P_t + \sum_{i=1}^{t} Rs_i}{M_{t-1}/P_{t-1} \sum_{i=1}^{t-1} Rs_i}. \tag{3}$$

Finally, reserves are introduced to international position of the country and its current account balance is given by

$$\frac{b^*_t}{\kappa_t R^*_t} = \frac{b^*_{t-1}}{\pi^*_t} + p^*_{X,t} Y^{ex}_{X,t} + \frac{p_{M,t}}{S_t} Y^{ex}_{M,t} - Y_{F,t} - \frac{Rs_t}{S_t} \tag{4}$$

where $b_t^* = B_t^* / P_t^*$ is a real foreign borrowing, $Y_{F,t}$ denotes import volume, $p_{M,t}$ is an import price in domestic currency, S_t is a real exchange rate, $Y_{X,t}^{ex}$ is an oil export volume, $p_{X,t}^*$ denotes oil prices in foreign currency, R_t^* is a foreign interest rate, and κ_t is an international risk-premium.

IV. EXTENSION: STABILIZATION FUND

So far oil prices have impact mainly on the oil-producing sector (see Dib, 2008) and to some extent on the Central Bank reserves. However, oil revenues are also using in fiscal policy making. In particular, in Russia there is a special export tax (duty) on oil and petroleum products. Proceeds from this duty till 2004 were included into the central budget as government expenditures. In fact, it brought a lot of instability into government sector and this effect so far was not captured in the model since government expenditures in Dib (2008) were assumed to be a simple AR(1) process. To soften potential vulnerability of the Russian economy to the oil price movements, stabilization fund was formed so that "excess" oil revenues from the oil export were not spent in total but some part may be saved in the fund. To keep government expenditures stable in case of oil revenues decrease, accumulated in the fund resources may be used.

We assume that government expenditures in the current period are related to the previous expenditures. In addition, oil revenues (received share from the export duty[1]), interest rate revenues on funds assets, and change in the fund assets may be used by the government:

$$g_t = \rho_G g_{t-1} + 0.1*\left(s_t + p_{X,t}^* + y_{X,t}^{ex}\right) + \left(r_t - 1\right)*swf_{t-1} - \left(swf_t - swf_{t-1}\right) + e_{G,t}, \quad (5)$$

where small letters denote log-deviations from the steady-state of corresponding variables denoted by capital letters, that is, g_t is government expenditures, r_t is domestic interest rate, swf_t is stabilization fund, and $e_{G,t}$ is government expenditures shock. We assume that on average 10% of oil revenues are taxed by the government.

If the oil revenues are used by the government and cannot be accumulated in the fund (the case before 2004), then as in Dagher, Gottschalk and Portillo (2012) we assume that

$$SWF_t = SWF_{t+1} = 0, \quad (6)$$

otherwise, we assume that government expenditures are constant share of GDP (forward looking government rule):

[1] It should be noted that the revenue of oil companies should be reduced by export duty.

$$\frac{G_t}{Z_t} = \frac{G_{t+1}}{Z_{t+1}} \tag{7}$$

so that excess oil revenues will be accumulated in the stabilization fund.

We define optimal policy as the monetary rule that minimizes fluctuations of inflation and GDP providing the two times larger weight to the former in the quadratic loss functions.

V. METHODOLOGY AND DATA

The model is log-linearized around its steady-state and estimated using the instruments of Bayesian econometrics in Dynare package on quarterly data covering the period from 2003Q1 to 2012Q2.

Key variables, which describe the evolution of the proposed economic system, are real per capita government expenditures, oil, tradable and non-tradable production, quarterly interest rate, inflation, real exchange rate, foreign inflation and GDP. The data is seasonally adjusted by X12-ARIMA filter and trend component is extracted with Hodrick-Prescott filter. Government expenditures are measured in 2008 Russian rubles and are calculated as the final expenditures of public sector. Percentage changes in oil production are approximated by the percentage changes in mineral resources extraction. Tradable sector is represented by agriculture, fishing, forestry, and different manufacturing sectors. Non-tradable production is measured by the sum of outputs in production and transportation of electricity, gas and water (utilities), construction, wholesale and retail trade, hotels and restaurants, transportation and communication, finance, insurance and real estate, public governance, education, health and social services and other services. Each types of economic activity is expressed in 2008 rubles per capita. Interest rate is an average quarterly nominal credit rate. Russian inflation is measured as the change in CPI. Price of oil is the 2008 price index of oil export average prices measured in euros per barrel. World economy is represented by EU-27 countries. This approximation is reasonable since trade turnover between Russia and EU-27 countries constitutes around 40% of total Russian turnover. Correspondingly, real exchange rate is the nominal exchange rate of ruble per euro multiplied by EU-27 CPI and divided by Russian CPI. Foreign inflation is measured as the change in EU-27 nominal deflator and foreign output is the nominal EU-27 GDP divided by the deflator.

The model parameters (see Dib (2008) for model parameters description) are calibrated in the following way. Discount factor β which measure impatience of the households is set at 0.9961. It is calculated as a reciprocal of real interest rate and corresponds to the average (steady-state) quarterly inflation level of 2.4% and nominal credit rate of 2.8%. Choosing standard in the RBC literature value for intertemporal elasticity of substitution 0.5, we can define parameter τ – the inverse of the former – at 2. Similarly the inverse ratio of Frisch labor elasticity, χ, is calibrated at standard value of one and labor elasticity of substitution across sectors, ς, can be defined also as a unity. Capital depreciation rate is typically set in the literature at 0.025 level.

Production functions parameters are calculated based on the input-output tables of Russian economy. To model the production process in oil sector we need to assume that share of natural recourse income, η_X, is 0.2 as in Stuber (1998) and Macklemet. al (2000) since this factor of production is not explicitly shown in the data. Then, based on 0.8 return to scale for capital

and labor, their shares, α_X and γ_X, are 0.37 and 0.43, respectively. Shares of capital, labor and oil inputs in manufacturing and non-tradable sectors are set at 0.45, 0.49 and 0.07 (α_M, γ_M and η_M) and 0.55, 0.44 and 0.01 (α_N, γ_N and η_N), respectively (they were calculated using input-output tables).

We assume that average steady-state markup constitutes 25%, which is in line with the findings for Russian economy (Zabolotskiy, 2005). As a result, parameter measuring degree of monopolistic competition, θ, is equal to 5. Elasticity of substitution for different types of labor is set at 6 implying wage markup of 20%. Elasticity of substitution between manufacturing, non-tradable and imported goods, ν, is 0.67 as estimated by Belomestnova (2002) and New Economic School (2005) and used in Zamulin and Sosunov (2007). It means that these goods are complements. On the other hand, Knobel (2011) on the 2000-2010 data estimated import price elasticity at 0.95 – in comparison to 0.67 closer to the substitution region. In addition, Zamulin and Sosunov (2007) tested their DSGE model of Russian economy using two values: estimated 0.67 and hypothetical 1.5, where the letter captures the case of goods substitution.

Parameter w_{ex} is calibrated at 0.24 based on the average share of non-oil export in GDP for 2000-2011 period. Shares of non-tradable, w_N, imported, w_F, and domestically produced and used manufactured good, w_M, are calculated on the 2002-2011 data as 0.69, 0.27 and 0.04, respectively. Risk premium parameter $\aleph$ is the average for 2000-2010 period ratio of net international investment position of country to GDP and is evaluated at 5.2%. The following variables constitutes the next shares of GDP: 50% has consumption, 22% investment, 18% government expenditures, 34% export, 23% manufacturing export, 10% oil export, 22% import, 60% non-tradable goods, 25% manufacturing and 14% oil extraction.

On average 65.6% of people are employed in non-tradable sector, 33.8% in manufacturing and 0.6% in oil sector and households allocate one third of their time for employment (the latter one is a standard assumption). It is assumed that each quarter 15% of oil export revenues forms additional volume of reserves. Values of natural recourse, technology levels in manufacturing and non-tradable sectors are set to unity at steady-state.

VI. OPTIMAL MONETARY POLICY

The results of estimation show that pricing structure in manufacturing sector is more flexible with Calvo pricing parameter equal to 0.51, while in non-tradable one it is 0.73 implying more rigid adjustment (for imported goods it is 0.65). Wage adjustment parameters are close in oil, manufacturing and non-tradable sectors – around 0.5 – implying average period for salary change half a year. Estimated capital adjustment parameters signals that most quickly capital is changing with new investments in manufacturing sector while the adjustment is more rigid in oil and non-tradable sectors.

Autoregressive parameters for technology evolution in manufacturing and non-tradable sectors are 0.07 and 0.26, respectively, and for natural resource it is 0.81 implying that the shock is relatively persistent. Government expenditures are also relatively stable with the AR parameter 0.94, oil price coefficient is 0.74. Foreign GDP evolves as AR process with coefficient equal to 0.68,

coefficient for foreign inflation is 0.36 and for foreign interest rate it is 0.06. Standard deviations of shocks lie in the [0.03, 0.10] range (see Appendix A for more details).

The analysis of impulse response functions shows that negative monetary policy shock leads immediately to the rise of domestic inflation. While output also rises, the magnitude of its increase is significantly lower. Similarly, consumption rises a little bit and converges to the steady-state. By sectors, production in manufacturing industry starts rising and after achieving the pick of growth in 4-6 quarters starts gradually declining. Production in non-tradable and oil sectors also rises but are very close to the steady-state level. Similarly to the production behaves investments in these sectors. Real exchange rate depreciates which correspondingly lead to the increase of reserves.

Positive oil price shock mildly influences the economic system. First of all, production significantly rises in the oil sector itself, while in manufacturing and non-tradable sector it decreases temporally. The cumulative effect on GDP is relatively small. The shock leads to the currency appreciation that finally neglects the effect of rising euros revenues from oil production implying small reduction in reserves formation (oil export decreases, this strange result may be caused by absence of oil price domestic and foreign differential combined with exchange rate appreciation). Employment, compensation level, capital stock (also investments) and price of capital (Tobin's q) in oil production sector rise and gradually converge to their long-term values.

Finally, we consider reserve formation positive shock. This shock has a very small influence on almost all economic variables. As a result, positive increase of reserves immediately disappears in the next quarter. Nevertheless, it should be noted that real exchange rate appreciates and foreign debt slightly rises. Reserve increase is financed by new money issuing, while the demand for real money balances from the households' side decreases.

In Table 1 we present the results monetary policy rule estimation and optimization. It suggests that Central Bank of Russian Federation sets up refinancing rate unsmoothly reacting more to the current and expected future event and poorly relying on the past interest rate trajectory (ρo_r is relatively small).

Response to inflation is accommodative, not too aggressive. The reaction to the changes in output is even smaller since output stabilization is not the primary goal. The most strongly CBR responds to the changes in nominal exchange rate since ruble stability is one of the most important goals of the monetary regulator. It appears that CBR also mildly react to the oil prices: the rise of oil price by 1% will trigger refinancing rate to rise on average by 0.12%. It means that CBR conducts countercyclical monetary policy and take into account oil price quotes.

Then we run three key optimization exercises: (i) keeping all parameters except ρo_{p_X} as estimated and optimizing with respect to the reaction to oil price, (ii) optimizing all parameters except ρo_r keeping it at the estimated value, and (iii) optimizing against all monetary policy rule parameters.

Suggested reaction in the first case is significantly lower that estimated and constitutes only 0.03% of 1% oil price increase. On the other hand, the last two cases suggest that response to oil price shock should be slightly lower that the estimated level at the 0.1 level.

The model suggests also CBR to ignore completely past values of refinancing rate. The estimated response to inflation is close to the optimal. It is suggested to increase the response to the nominal exchange rate from 1.66 to the aggressive level 2.26.

If we compare optimal rule without response to oil price (case 0) with such a response (case 3), suggested parameters of reaction are almost the same for all variables that can be compared.

TABLE 1: OPTIMAL REACTION UNDER DIFFERENT POLICY RULES

Monetary policy rule	ρo_r	ρo_π	ρo_z	ρo_e	ρo_{p_X}
Estimated	0.07	1.06	0.47	1.66	0.12
Optimization 0	0.00	1.12	-0.06	2.27	-
Optimization 1	-	-	-	-	0.03
Optimization 2	-	1.14	-0.04	2.25	0.10
Optimization 3	0.00	1.12	-0.06	2.26	0.10

Source: Author research

Received results are intuitive, except suggested reaction to the output. To research this issue we test the same rule augmented with the response to the output change. Estimated results are close to the previous one. Optimal rules are also close to those without output change (Table 2). Optimal reaction to the output level is suggested to be almost zero while CBR should respond to the change in output: each 1% change in the output change should be followed by corresponding 0.3% change in the refinancing rate.

TABLE 2: OPTIMAL REACTION UNDER POLICY RULES WITH OUTPUT CHANGE VARIABLE

Monetary policy rule	ρo_r	ρo_π	ρo_z	ρo_e	ρo_{p_X}	ρo_{dz}
Estimated	0.07	1.07	0.46	1.64	0.12	0.42
Optimization 1	-	-	-	-	0.02	-
Optimization 2	-	1.14	-0.04	2.25	0.10	0.3
Optimization 3	0.01	1.13	-0.05	2.25	0.10	0.3

Source: Author research

Robustness tests were ran for three alternative types of models: model with flexible wages but sticky prices, model with sticky wages but flexible prices and model with flexible wages and prices. Results suggest that optimal response to the oil price shock is close to zero as in the first optimization cases.

In addition, we consider the influence of different monetary policy regimes on the optimization results. Since 1999 Central Bank of Russia has introduced managed floating regime continuously decreasing interventions on the exchange market. This regime with some modifications exists till the current moment. The most significant reform was conducted in 2005, when monetary regulator made a step to floating exchange rate, having officially introduced the band for the ruble. Central Bank sell or buy foreign currency only when the exchange rate is at the interval border. It should imply that the coefficient at exchange rate in the monetary policy rule should decrease with the passage of time (fixed regime would imply infinite coefficient and floating zero value). For this reason, the model is reestimated on the 2005-2012 data set. However, Central Bank reaction to the exchange rate did not change significantly (coefficient

changed by less than 3%). The recommendation for the optimal rule also changed not too much: suggested response to the oil price is negligible and to the exchange rate it decreased a little bit.

There is a necessity to consider the potential influence of Dutch Disease on received results. Since 2007 oil price started rising very rapidly. We also reestimated and analyzed optimal monetary policy for the 2003-2006 period to eliminate the case of potential Dutch Disease. Estimated reaction to the exchange rate is higher now and constitutes 1.92. Other parameters do not changed significantly. In contrast to the previous cases, response to the exchange rate appears to be close to the optimal without necessity to raise it above 2.25 level.

Taking into account the presence of rigidities in the economic system, we may suggest to respond mildly ($\rho o_{p_X} \approx 0.1$) to the oil price movements. Such positive response may mean that increasing oil prices leads to general economy increase overheating the economy and correspondingly lower refinancing rate will stabilize it at acceptable inflation level, keep under the control exchange rate movements and other variables on lesser importance. However, the improvement in the value of the loss function when the Central Bank starts reacting to the oil prices (from 0.0 to 0.1) is not significant (less than 1%) implying that monetary policy should not react to oil prices and this reaction cannot generate economically significant results.

With introduction of oil revenues into government expenditures in both cases of stabilization fund presence and absence economic fluctuations significantly rise. Recommended response to oil quotes without stabilization fund (equation (6) is active) is slightly higher than recommended response when the fund is active (equation (7) is used instead of (6)). It means that the necessity in monetary policy rule reaction to the oil prices is higher when there are no stabilization fund, however, it is still of the 0.1 magnitude. It should be noted that in both cases Central Bank might form part of its reserves from the oil revenues as well.

Mitigating effect of the fund on the Russian economy was also found by Merlevede et al. (2007). They simply introduced fund presence dummies, which captures the drop of oil price elasticity of government expenditures. Monetary policy was modeled in a standard way and its influence on the oil revenue management is secondary.

Konorav (2011) model also showed that introduction of stabilization fund into the model did not change significantly ranking of alternative monetary policy rules/ regimes with respect to inflation and exchange rate (oil prices were not considered). Welfare improvement was proportional across all rules.

The recommendation to the monetary authority not to react to the oil prices (at least when the fund is present) is also in line with the dominating general recommendation to oil-importing countries (see, for example, Bernanke, Gertler& Watson, 1997 and 2004).

VII. CONCLUSIONS

To conclude, despite of the wide literature on constructing and estimating DSGE models, there are no models for Russian economy which took into account the influence of exporting oil prices on the macroeconomic variables and answer the question on optimal monetary policy reaction on prices fluctuations. This paper should fill this gap, which ultimately can positively influence the effectiveness of policy management in Russia and other countries with similar economic structures. It should be also noted that these results are obtained within the model where reserve forming mechanism is introduced. It means that fluctuations of macroeconomic variables may be

smoothed both with the help of stabilization fund and Central Bank policy in the form of Taylor-rule.

Suggested optimal monetary policy implies positive mild direct response to the oil price shocks: 1% of oil price increase should trigger CBR to raise refinancing rate by 0.1% but only in the case of stabilization fund absence; otherwise, the gain of response is not significant. It highlights the importance of policy coordination with respect to the commodity shocks softening. Similar suggestion was made by Dagher, Gottschalk and Portillo (2012). Fiscal smoothing (stabilization fund) can help to stabilize the economy and improve welfare; however, pure Central Bank reserves accumulation without fiscal backing cannot guarantee macroeconomic stability. Our paper also shows that this stability can be improved if monetary policy reacts to oil prices (when fiscal fund is absent).

Collier et al. (2009) argue that there are more effective than stabilization fund instruments absorbing "excess" oil revenue. They propose to invest money to deepen capitalization of the economy through public spending. To mitigate potential crowding out and Dutch Disease, public spending should be designed in such a way that they will increase the competitiveness of private investments. On the other hand, monetary policy is not considered for consumption smoothing.

This and other alternative views on the reaction to the oil windfalls may form a good ground for future research.

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APPENDICES

Appendix A. Priors and posteriors

TABLE A1: SPECIFIED PRIOR DISTRIBUTIONS AND ESTIMATED POSTERIOR MODES

Parameter	Description	Domain	Prior			Posterior mode
			Density	Mean	St.d.	
ϕ_M	Calvo pricing parameter in manufacturing sector	$[0,1]$	Beta	0.5	0.05	0.51
ϕ_N	Calvo pricing parameter in non-trading sector	$[0,1]$	Beta	0.5	0.05	0.73
ϕ_F	Calvo pricing parameter for importing goods	$[0,1]$	Beta	0.5	0.05	0.65
φ_M	Calvo wage parameter in manufacturing sector	$[0,1]$	Beta	0.5	0.05	0.50
φ_N	Calvo wage parameter in non-trading sector	$[0,1]$	Beta	0.5	0.05	0.53
φ_X	Calvo wage parameter for oil	$[0,1]$	Beta	0.5	0.05	0.45
ψ_X	Capital adjustment parameters in oil sector	R	Normal	11.0	4.0	9.44
ψ_M	Capital adjustment parameters in manufacturing sector	R	Normal	2.0	0.5	2.11
ψ_N	Capital adjustment parameters in non-trading sector	R	Normal	7.0	1.0	7.69
ρo_R	Interest rate smoothing parameter of monetary policy	R	Normal	0.1	0.05	0.07
ρo_π	Monetary policy reaction parameter on inflation	R	Normal	1.5	0.5	1.06
ρo_Z	Monetary policy reaction parameter on final good	R	Normal	0.5	0.2	0.47

(continued)

$\rho o_{\mu u}$	Monetary policy reaction parameter on money growth	R	Normal	0.5	0.2	1.01
ρo_{e}	Monetary policy reaction parameter on exchange rate	R	Normal	2.0	0.2	1.66
ρo_{P_X}	Monetary policy reaction parameter on oil price	R	Normal	0.1	0.05	0.12
σ_R	St.d. of monetary policy shock	R^+	Inverse Gamma	0.2	∞	0.09
ρ_{AM}	AR parameter for technology evolution in manufacturing sector	R	Normal	0.5	0.25	0.07
σ_{AM}	St.d. of technology shock in manufacturing sector	R^+	Inverse Gamma	0.2	∞	0.07
ρ_{AN}	AR parameter for technology evolution in non-trading sector	R	Normal	0.5	0.25	0.26
σ_{AN}	St.d. of technology shock in non-trading sector	R^+	Inverse Gamma	0.2	∞	0.04
ρ_{P_X}	AR parameter for price of oil evolution	R	Normal	0.5	0.25	0.74
σ_{P^X}	St.d. of price of oil shock	R^+	Inverse Gamma	0.2	∞	0.04
ρ_L	AR parameter for natural recourse evolution	R	Normal	0.5	0.25	0.81
σ_L	St.d. of natural recourse shock	R^+	Inverse Gamma	0.2	∞	0.10
ρ_G	AR parameter for government expenditures evolution	R	Normal	0.5	0.25	0.94
σ_G	St.d. of government expenditures shock	R^+	Inverse Gamma	0.2	∞	0.10
ρ_{R^*}	AR parameter for foreign interest rate evolution	R	Normal	0.5	0.25	0.06
σ_{R^*}	St.d. of foreign interest rate shock	R^+	Inverse Gamma	0.2	∞	0.04
ρ_{π^*}	AR parameter for foreign inflation evolution	R	Normal	0.5	0.25	0.36
σ_{π^*}	St.d. of foreign inflation shock	R^+	Inverse Gamma	0.2	∞	0.03
ρ_{Y^*}	AR parameter for foreign GDP evolution	R	Normal	0.5	0.25	0.68
σ_{Y^*}	St.d. of foreign GDP shock	R^+	Inverse Gamma	0.2	∞	0.03
σ_{Rs}	St.d. of reserves shock	R^+	Inverse Gamma	0.2	∞	0.09

Source: Author research

Note: for Inverse Gamma distribution mode and degrees of freedom are presented

OPTIMALNA EKONOMSKA POLITIKA I NAFTNI ŠOKOVI U RUSIJI

SAŽETAK

Cilj ovog rada je objasniti i analizirati treba li Centralna banka Rusije uključiti cijene robe na liste varijabli na koje pokušavaju odgovoriti. Proširili smo Dibov Novi Keynesianski DSGE model male otvorene ekonomije (2008) s fondom naftne stabilizacije i novo pravilo monetarne politike Taylorovog tipa te smo procijenili model koristeći Bayesovu ekonometriju. Rezultati pokazuju da je blagi odgovor Centralne banke na promjene cijena nafte možda i poželjan u smislu minimiziranja fluktuacije inflacije i outputa samo u slučaju u kojem ne bi postojao fond za stabilizaciju, dok je takav odgovor suvišan kad se „višak" zarade od nafte može uštedjeti u navedenom fondu..

Ključne riječi: optimalna monetarna politika, cijena nafte, stabilizacija, stabilizacijski fond

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CYCLICAL RELATIONSHIP BETWEEN EXCHANGE RATES AND MACRO-FUNDAMENTALS IN CENTRAL AND EASTERN EUROPE

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ABSTRACT

We present empirical evidence on the business cycle relationship between nominal and real effective exchange rate, real GDP, consumption, investment, export, import and general government debt for a group of ten countries from the Central and Eastern Europe. We apply cross-correlation on cyclically filtered and seasonally adjusted quarterly time series over the period 1998-2010. The results are mixed in intensity, direction and cyclicality but show generally weak correlation between exchange rates and fundamentals. Sufficiently high coefficients are found only for government debt and import. We also apply simple regressions to relate the correlation to openness and welfare of the economy. The correlation between exchange rates and macroeconomic aggregates tends to be more pronounced in less open and relatively poorer countries.

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I. INTRODUCTION

The relationship between exchange rates and macroeconomic variables is one of the most important and extensively examined questions in financial and monetary economics. Since the collapse of the Bretton Woods system in the 1970s and introduction of floating exchange rate arrangements quite many theories and models trying to explain exchange rate development have been proposed and empirically tested (see e.g. Cheung et al., 2005). Many of them assume that exchange rates are closely linked to macroeconomic aggregates such as output, trade balance, investment or money supply. We can illustrate this on example of monetary class of models. From the Frenkel (1976) flexible-price monetary models to the subsequent Dornbusch (1976) fixed-price and overshooting model to the recent open-economy general equilibrium models based on Lucas (1982) they tend to focus on shocks to money supply and show how such shocks can explain fluctuations in macroeconomic fundamentals and exchange rates over business cycles.

However, existence of this relationship is weakly supported by data and, as documented by e.g. De Grauwe and Grimaldi (2006) the respective models often fail empirically. Obstfeld and Rogoff (2001) provide an overview of the six major puzzles in international economics and label the missing relationship between nominal exchange rates and other macroeconomic aggregates "exchange rate disconnect puzzle". They also point to extreme (excessive) volatility of exchange rates with respect to other macroeconomic fundamentals (see more in e.g. Dedola and Leduc, 2001) Moreover, business cycle properties of macroeconomic aggregates are only slightly affected by the exchange rate regime applied. This finding, in combination with evidence of considerably higher exchange rate volatility under a flexible regime that in a fixed arrangement, imply a weak and fragile connection between exchange rates and other macroeconomic variables. Flood and Rose (1995) summarize and extend the findings and come to the conclusion that exchange rate appears to have a life of its own.

The aim of the paper is to provide direct empirical evidence on relationship between exchange rates and selected macroeconomic variables for a group of ten European Union (EU) new member states from the Central and Eastern Europe (Bulgaria, Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Romania, Slovakia, Slovenia). In order to maximise reliability of results the empirical estimation is done with respect to business cycles and cyclical properties of the used macroeconomic variables. It is also important to clarify what we do not attempt in this paper. Our focus is on identification of the exchange rate-fundamental relationship, and not on relevance and ability of macroeconomic fundamentals to predict exchange rates or estimation and validation of exchange rate determination models.

This kind of research is motivated by several factors. First, no similar study has been published for the EU new member states. Second, we aim to expand the current knowledge on the topic by using effective exchange rates instead of bilateral to reflect better a real economic environment in which countries interact with many other countries. Third, we connect the obtained correlations with a country's openness and relative wealth to reveal whether these factors are significant in explanation of intensity of the exchange rate-fundamentals relationship.

The remainder of the paper is structured as follows. In Section Two, we describe the dataset and empirical methods used in the paper. In Section Three, the results of cross correlation between exchange rates and macroeconomic aggregates are reported and discussed. In Section Four, we calculate indicators of a country's openness and relative wealth and evaluate

their effect on correlation. In Section Five, we conclude the paper with summary of main findings and implications.

II. DATA AND METHODOLOGY

The dataset consists of quarterly data on gross domestic product (GDP), private consumption, investment, exports, import, general government debt, nominal and real effective exchange rates (NEER and REER) over the period 1998:1 – 2010:4. Although even earlier data are available for some of the countries we prefer to work with a consistent dataset that excludes observations from the turbulent part of 1990s.

We work with a group of 10 countries from the Central and Eastern Europe. The group consists of Bulgaria (BG), Czech Republic (CZ), Estonia (EE), Hungary (HU), Latvia (LV), Lithuania (LT), Poland (PL), Romania (RO), Slovakia (SK), and Slovenia (SI). All the countries are members of the European Union (EU). Most of them joined the EU in May 2004, Bulgaria and Romania became the EU member states on January 2007.

All the data are collected from the Eurostat database on economy and finance. The series for all macroeconomic fundamentals are obtained in local currencies at constant prices and seasonally adjusted. The series for investment is gross capital formation. The series for effective exchange rates are constructed for 27 main trading partners. An increase of the exchange rate represents an appreciation of the currency. Effective exchange rate is the exchange rate of the domestic currency vis-à-vis other currencies weighted by their share in the country's international trade. We choose effective rather than bilateral exchange rates because the former measure a country's international competitiveness against all important trading partners and capture the role exchange rates in economy more reliably (Stavárek, 2009).

We convert all series into logs and use the Hodrick-Prescott filter (HP filter) to obtain a cyclical component of each time series. Next, we apply cross correlation to all combinations of changes in cyclical component of NEER resp. REER and macroeconomic variable.

The HP filter estimates an unobservable time trend for time series variables.It is used to obtain a smoothed-curve representation of a time series, one that is more sensitive to long-term than to short-term fluctuations. The procedure was first introduced by Hodrick and Prescott in 1980 in the context of estimating business cycles; notably their paper (Hodrick and Prescott, 1997) was published 17 years later after the filter has already been widely used in macroeconomics. Let y_t denote an observable macroeconomic time series. The HP filter decomposes into y_t a nonstationary trend g_t and a stationary residual cyclical component c_t that is:

$$y_t = g_t + c_t \tag{1}$$

Note that g_t and c_t are unobservables. Since c_t is a stationary process we can think of y_t as a noisy signal for the nonstationary trend g_t. Hence, the problem boils down to how extract an estimate for g_t from data on y_t.

The HP filter solves this problem by allocating some weight to a linear trend against the signal y_t. Let λ represent that weight. If there is no noise then the signal is fully informative and λ is set to zero. As λ increases more weight is allocated to the linear trend, and for $\lambda \to \infty$, g_t approaches the ordinary least squares estimate of y_t against a linear time trend. Hodrick and Prescott find that if c_t and the second difference of g_t, $\Delta\Delta g_t$, are identically and independently distributed normal variables with mean zero and variances $\sigma^2_{c_t}$ and $\sigma^2_{\Delta\Delta g_t}$, then the best choice of λ is $\frac{\sigma^2_{c_t}}{\sigma^2_{\Delta\Delta g_t}}$. Generally, data in high frequency is noisier relative to low frequency data series and, therefore, high frequency data require a higher value of λ. Hodrick and Prescott advise that, for quarterly data, a value of = 1600 is reasonable.

Given an adequately chosen, positive value of , there is a trend component that will minimize:

$$\min_{\{g_t\}_{t=1}^{T}} \sum_{t=1}^{T} (y_t - g_t)^2 + \lambda \sum_{t=2}^{T-1} \left[(g_{t+1} - g_t) - (g_t - g_{t-1}) \right]^2 \qquad (2)$$

The first term of the equation is the sum of the squared deviations which penalizes the variance of cyclical component. The second term is a multiple λ of the sum of the squares of the trend component's second differences. This second term penalizes variations in the growth rate (lack of smoothness) of the trend component. The larger the value of λ, the higher is the penalty. In other words, the HP filter identifies the cyclical component c_t from y_t by the trade-off to the extent to which the trend component keeps track of the original series y_t (good fit) against the prescribed smoothness in the trend component g_t.

Cross correlation is a standard method of estimating the degree to which two series are correlated. It assesses how one reference time series correlates with another time series as a function of time shift (lag). Cross correlation does not yield a single correlation coefficient but rather a whole series of correlation values.

This series of correlation coefficients is achieved by shifting one of the series forward and backward in time. Cross correlation is important in studying the relationship between time series for two reasons. First, one series may have a delayed response to the other series, or perhaps a delayed response to a common stimulus that affects both series. Second, the response of one series to the other series or an outside stimulus may be "smeared" in time, such that a stimulus restricted to one observation elicits a response at multiple observations. Like all correlations, cross correlation only shows statistical associations not causation. Hence, we cannot say that changes in one time series cause changes in the other, but the two series behave as if this were happening.

Consider two financial series x_t and y_t, then the cross-correlation at lag (lead)*k* is defined as follows:

$$\rho(y_{t+k}, x_t) = \frac{\operatorname{cov}(y_{t+k}, x_t)}{\sqrt{V(y_{t+k})}\sqrt{V(x_t)}} = \frac{T\sum_{t=k-1}^{T}(y_{t+k} - m_y)(x_t - m_x)}{(T+k)\sqrt{\sum_{t=k}^{T}(y_{t+k} - m_y)^2}\sqrt{\sum_{t=k}^{T}(x_t - m_x)^2}} \quad (3)$$

where ρ is the correlation coefficient and m_x and m_y are the means of corresponding series. The series can be related in three possible ways: (i) y_t can lead x_t ($\rho(y_{t-k}, x_t) \neq 0$), (ii) y_t can lag x_t ($\rho(y_{t+k}, x_t) \neq 0$), (iii) series can be contemporaneously related ($\rho(y_t, x_t) \neq 0$).

III. CROSS CORRELATION ANALYSIS

We follow Duarte et al. (2007) and run cross correlations for all 12 possible combinations of exchange rates and macroeconomic fundamentals for each country. We apply a time shift up to four lags (leads) on the time series of exchange rate cycle relative to the cycle in macroeconomic fundamental variable. Hence, we say that the exchange rate leads the fundamental (fundamental lags the exchange rate) by *k* quarters if $\left|\rho(y_{t+k}, x_t)\right|$ is a maximum for a negative *k*, the exchange rate is synchronous with the fundamental if $\left|\rho(y_{t+k}, x_t)\right|$ is a maximum for *k* = 0, and the exchange rate lags the fundamental (fundamental leads the exchange rate) if $\left|\rho(y_{t+k}, x_t)\right|$ is a maximum for a positive *k*. The correlation coefficients obtained from analysis are presented in Figure 1. We report cross correlations for all countries as well as the average value.

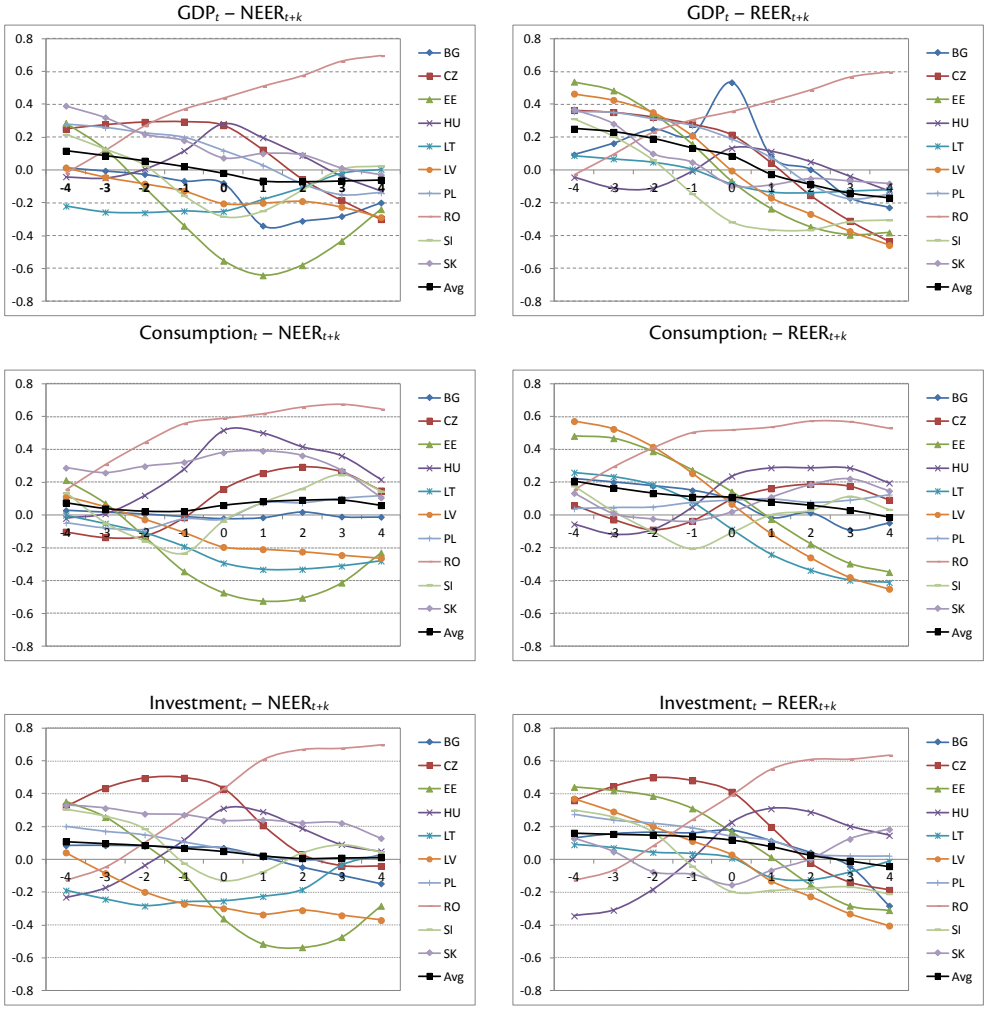
Before we discuss the relations between exchange rates and macro fundamentals it is worth to stress some general findings. Romania seems to be an outlier frequently showing considerably different shape of cross correlation curve than other countries.

One should take this into account mainly when interpreting the average correlation coefficients. The group of ten Central and Eastern European countries is very diverse in terms of exchange rate arrangement applied in economic policy. There are countries with currency board or very similar arrangement (BG, EE, LV, LT) as well as countries with floating regime (CZ, HU) including completely independent floating (PL) or countries with different de jure and de facto regime (SI). Some of the analyzed countries adopted the euro during the estimation period (SK, SI). The effect of exchange rate regime is evident in some of the correlations as well as in differences between correlations with NEER and REER.

In analyzing the cross correlations, we follow Rand and Tarp (2002) and define the exchange rate as procyclical, acyclical, or countercyclical depending on whether the respective correlation coefficient is positive, zero, or negative. Furthermore, we deem the exchange rate to

be strongly correlated if $0.26 \leq |\rho(y_{t+k}, x_t)| \leq 1$, weakly correlated if $0.13 \leq |\rho(y_{t+k}, x_t)| < 0.26$, and uncorrelated if $0 \leq |\rho(y_{t+k}, x_t)| < 0.13$.

If we plot the cross correlation coefficients obtained from using the current value of a macroeconomic aggregate and lagged as well as lead values of the exchange rate, we can often see that the depicted pattern resembles the letter S or reverse letter S. The S-curve is a way that the cross correlation is positive only between the current value of macroeconomic aggregate and future values of the exchange rate and the cross correlation is negative between the current value of the aggregate and past values of the exchange rate. In other words, exchange rates are procyclical if they lag the aggregate but countercyclical if they lead the aggregate. The reverse-S-curve demonstrates the opposite relations pointing to procyclicality of leading exchange rates and countercyclicality of lagging exchange rates.



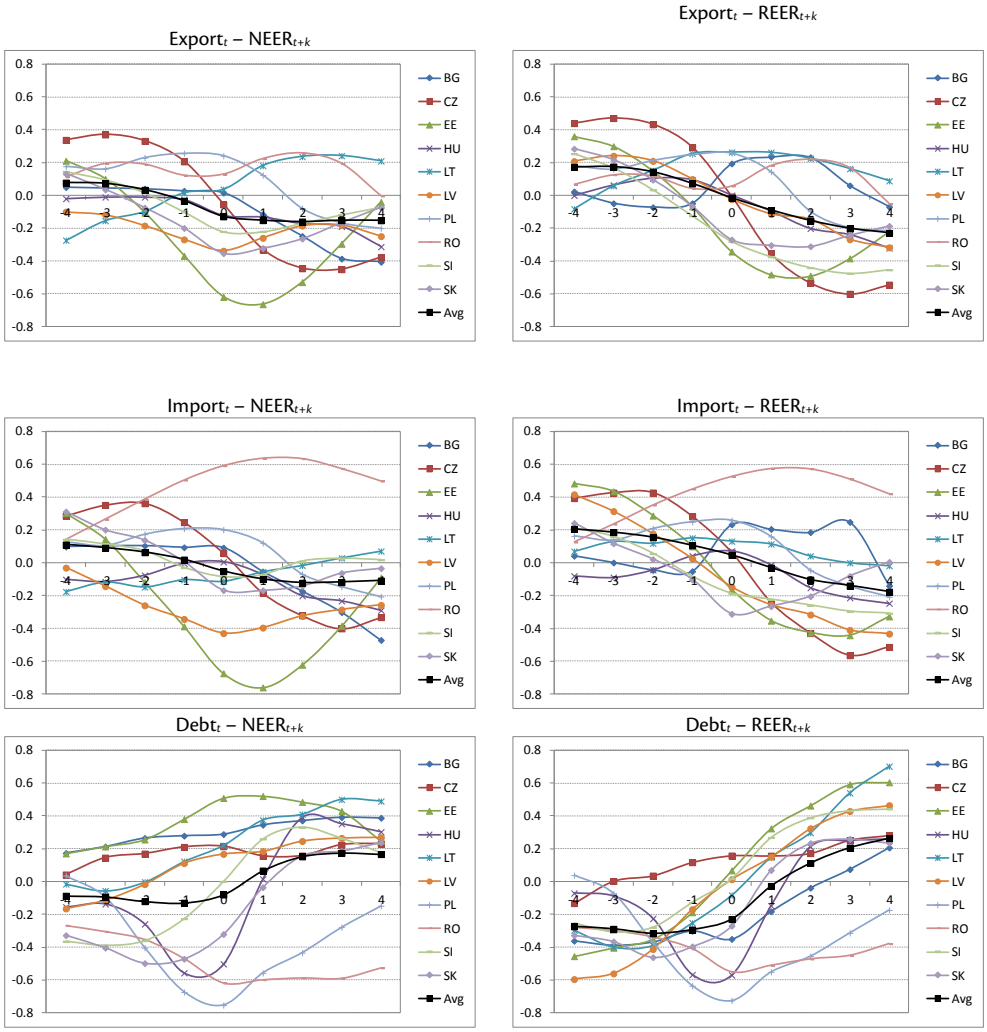


FIGURE 1. CROSS CORRELATION BETWEEN MACROECONOMIC FUNDAMENTALS AND EXCHANGE RATES

Source: Author's calculation
Note: Lags and leads refer to time shift of time series of exchange rate

The relationship between exchange rates and GDP is more evident if REER is used in correlation analysis. The effective exchange rate leads the GDP mostly by four quarters. Correlation coefficients are generally positive and range from 0.08 for Lithuania to 0.54 for Estonia indicating a procyclicality of exchange rates as a leading variable. Similar but negative coefficients are shown if REER lags GDP and indicate and point to countercyclical behaviour. More evidence on relationship between exchange rates and output can be found e.g. in Mirdala (2008).

There is mixed evidence on relationship between detrended consumption and exchange rates. While some countries like Baltic States exhibit rather countercyclical patterns of cross correlation in other countries such as Czech Republic, Slovakia or Hungary a procyclical

relationship prevails. Nevertheless, the correlations usually peak with a lead of 1-3 quarters which means that exchange rate lags the consumption.

Results of cross correlations between investment and exchange rates are also hard to interpret. However, the picture is much clearer if examine REER. The highest correlation coefficients are obtained at the lag of four quarters, which suggests procyclicality and leading position of exchange rates in relation to investments.

It is worth to mention that whereas some countries report similar correlation coefficients for all aggregates (GDP, consumption, investment) the correlation pattern of consumption seems to be opposite to the other aggregates in the Czech Republic, Hungary and Poland.

The cross correlation curves obtained for export and import are almost identical for virtually all countries. However, one can again find considerable differences among countries in terms of pro(counter)cyclicality and intensity of correlation. In average, REER turns out to be more correlated with both sides of international trade as it better reflects international competitiveness of a country. In most of countries, the correlation achieved the highest absolute values at the lead of 1-3 quarters indicating that the exchange rates lag the export and import and have a countercyclical development. Slightly weaker but procyclical relationships were identified at the lag of 3-4 quarters.

Cyclicality of government debt in relation to cyclicality of exchange rates differs remarkably according to the type of exchange rate examined. While the debt and NEER seem to be contemporaneously correlated one can observe a classical S-curve with countercyclicality if REER leads the debt or procyclicality if REER lags the debt. Government spending and debt cyclicality is comprehensively examined e.g. in Szarowská (2012).

A simple arithmetical average of correlation coefficients is showed in graphs in Figure 1. However, it is impossible to use the simple average to draw any conclusion on the lead/lag at which the correlation is the most intensive. Hence, Table 1 reports the highest average of absolute values of national correlation coefficients and respective lead/lag at which this mean value peaks. The relation between government debt and exchange rate is the strongest while the averages for all remaining macro variables are very similar. It is also apparent from Table 1 that exchange rates generally lag the fundamentals. The only exception is investment whose current values are mostly correlated with current or past values of exchange rates.

TABLE 1 - HIGHEST AVERAGE OF ABSOLUTE VALUES OF CORRELATION COEFFICIENTS WITH RESPECTIVE TIME SHIFT

	NEER		*REER*	
	Average	***Lead/lag***	***Average***	***Lead/lag***
GDP	0.2571	1	0.2886	4
Consumption	0.3041	2	0.2622	3
Investment	0.2584	0	0.2563	-4
Export	0.2588	2	0.2902	2
Import	0.2522	1	0.2912	3
Debt	0.3569	0	0.3747	4

Source: Author's calculation

One of the few aspects that can be observed frequently in results graphically presented in Figure 1 is a substantial difference between the correlation coefficient based on NEER and the coefficient computed with REER.Table 2 reports the correlations between NEER and REER. One can notice very high coefficients (above 0.9) for several countries such as Czech Republic, Hungary and Poland. Some more countries exhibit correlations between 0.8 and 0.9 (Latvia, Romania, and Slovakia). The degree of co-movement of NEER and REER in remaining countries was lower. The correlation between (the log of) NEER and REER is related to the ratio of the standard deviation of NEER and REER $\sigma(n)/\sigma(r)$, and the correlation between NEER and the price ratio, $\rho(n,pr)$, and is given by

$$\rho(n,r)=\frac{\sigma(n)}{\rho(r)}+\rho(n,pr)\frac{\sigma(pr)}{\sigma(r)} \tag{4}$$

When the ratio of the standard deviations $\sigma(n)/\sigma(r)$ is larger than the correlation of NEER and REER, changes in REER do not track changes in NEER as well because NEER is negatively correlated with the price ratio across the countries.In particular, in countries with flexible exchange rate regime the nominal depreciations of a country's currency are associated with increases in the price level of that country relative to the price level in other countries. Under a fixed exchange rate regime, the nominal rate is maintained at certain level by a monetary authority (central bank or currency board) and, hence, changes in relative prices are the only channel of changes of real exchange rate.

TABLE 2 – CORRELATIONS BETWEEN NEER AND REER AND RATIO OF STANDARD DEVIATIONS

	BG	*CZ*	*EE*	*LV*	*LT*	*HU*	*PL*	*RO*	*SI*	*SK*
C.C.	-0.581	0.9377	0.5144	0.7949	0.7763	0.9411	0.9801	0.8461	0.6094	0.8498
R.S.D.	5.006	0.8770	0.5532	0.7525	0.8421	0.9773	0.9683	0.9003	1.0482	0.8802

Source: Author's calculation
Note: C.C. is correlation coefficient and R.S.D. is ratio of standard deviations

IV. EFFECT OF COUNTRY'S OPENNESS AND WEALTH

The final step of our empirical analysis is to put the obtained correlations into relation with openness and relative wealth of the analyzed countries. The degree of openness of an economy is measured by the following indicator:

$$open = \frac{|ex| + |im|}{y} \tag{5}$$

where ex denotes volume of exports, im is volume of imports and y denotes GDP. We used not seasonally adjusted, unfiltered time series at current prices for calculation of the indicator. In this formula, the higher the openness indicator $open$ the more open the economy is. For the purpose of further analysis we computed the average value of the $open$ indicator over the sample period. This measure varies from 0.67 in Poland to 1.50 in Estonia. The measure of relative wealth is a ratio of the country's GDP per capita to that of Germany. All the GDP per capita series are constructed on the purchasing-power-parity basis. Similarly with the openness indicator we calculate the average value of the wealth indicator for each country over the entire period of analysis. One can observe substantial differences in relative wealth of the new EU member states. The level of relative wealth varies from 0.28 in Bulgaria and Romania to 0.71 in Slovenia. Average values of both indicators are reported in Table 3.

TABLE 3 – AVERAGE VALUES OF THE OPENNESS AND WEALTH INDICATORS

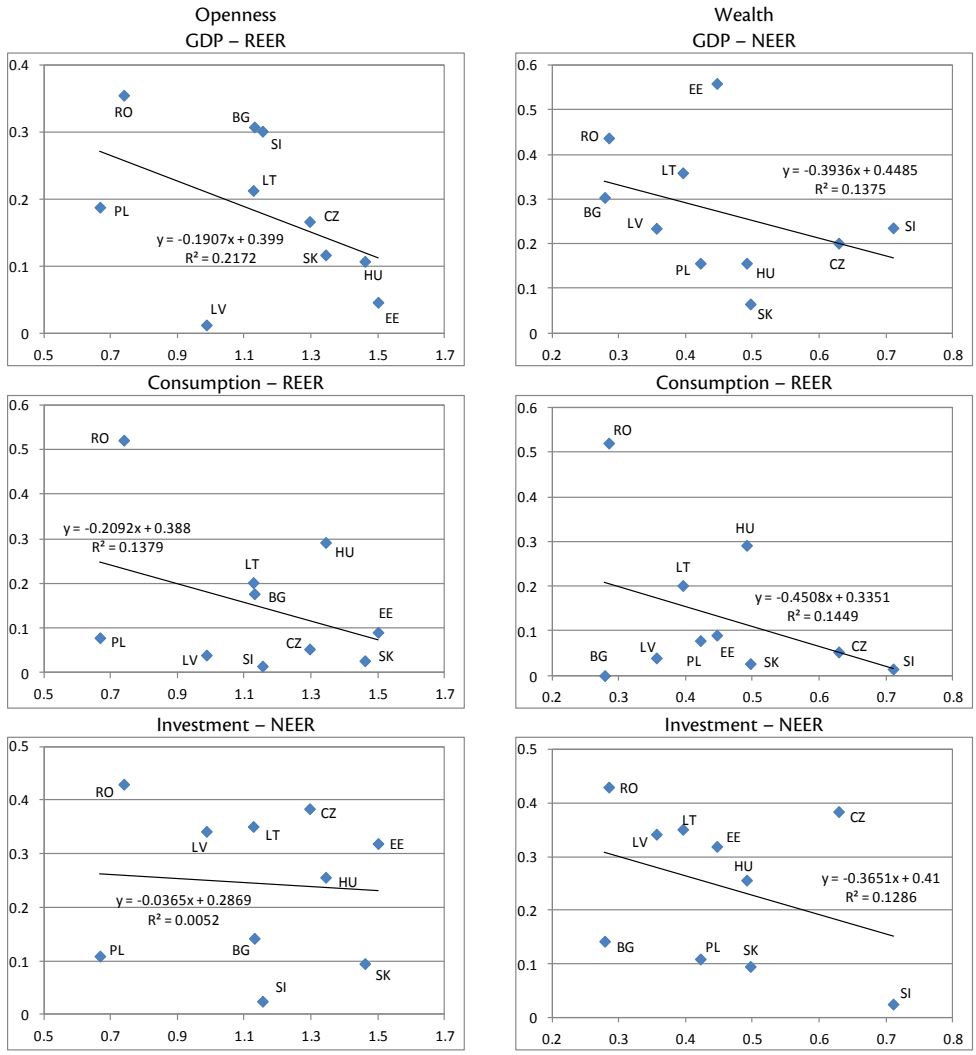
	BG	*CZ*	*EE*	*LV*	*LT*	*HU*	*PL*	*RO*	*SI*	*SK*
Open.	1.130	1.296	1.501	0.987	1.127	1.344	0.668	0.739	1.155	1.462
Wealth	0.279	0.629	0.447	0.356	0.396	0.491	0.422	0.285	0.711	0.497

Source: Author's calculation

We have expectation that the correlation between exchange rates and macroeconomic fundamentals should be stronger in countries with higher degree of openness. In a country where international trade represents larger part of GDP the exchange rates have more room to influence or be influenced by underlying macroeconomic variables. On the other hand, we expect exchange rates and fundamentals to be more correlated in less developed countries with lower relative wealth. This is because less developed countries are usually more fragile in facing economic shocks leading to higher volatility in macroeconomic variables and exchange rates.

Figure 2 portrays scatter plots with simple regressions between the absolute value of correlation coefficient and level of openness or wealth respectively. We use the maximum cross correlation coefficient obtained in the interval of (-4, 4) lags. To conserve the space we present only one graph for each macroeconomic fundamental. It presents only the stronger regression relationship, i.e. with NEER or REER.

While the openness of an economy seems to be more related to correlation of macro aggregates with REER, the level of wealth is more intensively related to correlations that include NEER. However, the regressions shown in Figure 2 confirm rather weak relationship between the country's openness and wealth and correlations. The coefficients of determination are rarely above 0.2.



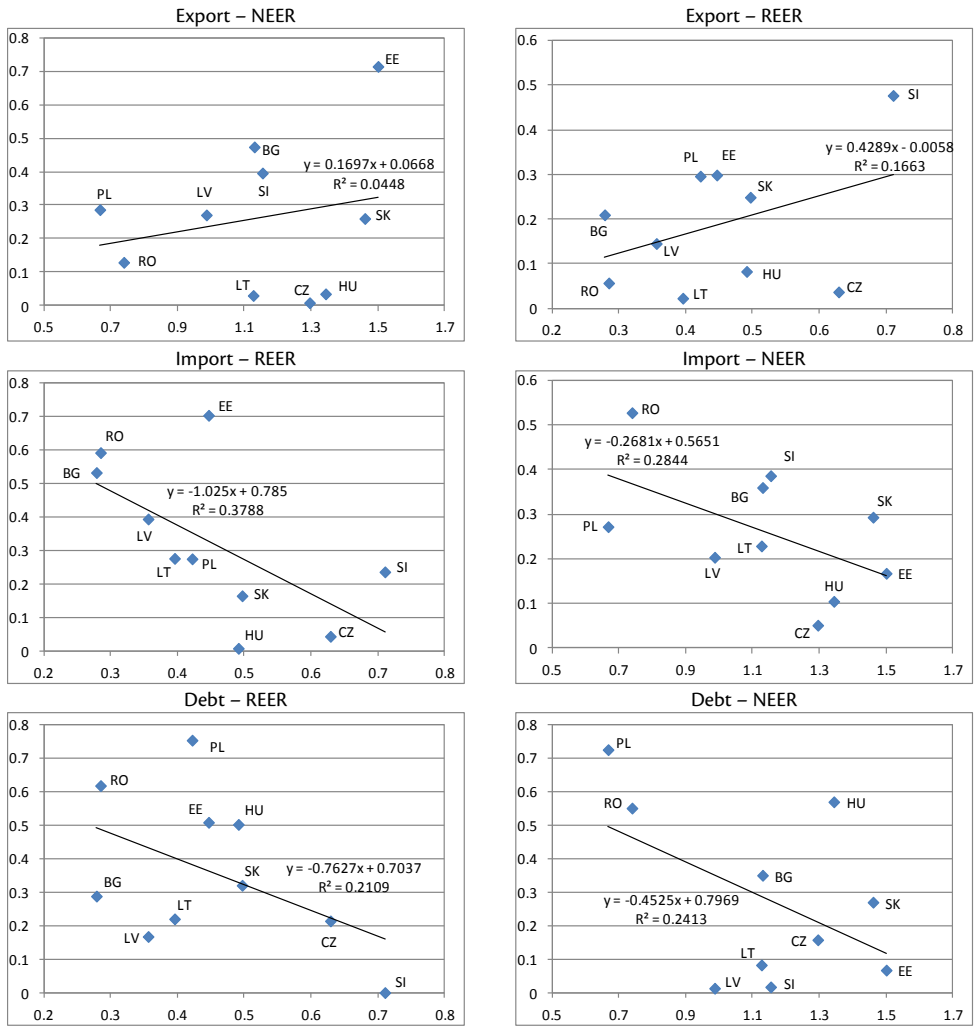


FIGURE 2. REGRESSIONS BETWEEN CORRELATION AND OPENNES OR WEALTH

Source: Author's calculation

Note: We present the stronger relation (NEER or REER) between correlation coefficient and country's openness and wealth. The absolute value of correlation coefficient is on horizontal axis and the openness or wealth indicator on vertical axis.

The strongest relationship exists between country's wealth and import–NEER correlation. There is a solid evidence of decreasing correlation with rising level of wealth. Similar kind of negative and relatively strong relationship can be also revealed between degree of openness and import–REER correlation. Next, significantly lower correlations in more open and wealthier countries are found if we examine the government debt. In other cases, the cross correlation does not vary systematically with wealth and openness in our dataset.

Interestingly, there is just one example of positive relationship between country's wealth and openness measures and cross correlations. It is the case of export for which wealthier and to a lesser degree also more open countries tend to exhibit stronger cross correlations.

V. CONCLUSION

The aim of the paper was to provide direct empirical evidence on relationship between exchange rates and selected macroeconomic variables for ten new EU member states from Central and Eastern Europe. We used cyclical components of the time series and run cross correlations with leads and lags of up to four quarters. Substantial differences in the exchange rates–fundamentals relationships were revealed across the countries. The differences exist in intensity as well as direction and make interpretation of the results complicated. However, few findings are applicable to most of the incorporated countries.

The analysed relationship is usually stronger and more evident if REER is used in the correlation. This suggests that in small open economies the real exchange rate as indicator of a country's international competitiveness is more related to macroeconomic aggregates than nominal exchange rate. Cross correlation pattern for GDP, investment, export and import resembles the reversed letter S. Such a shape illustrates procyclicality of exchange rates at lags and countercyclicality of exchange rates at leads. By contrast, cross correlation function of government debt and consumption (half of countries) seems to be similar in shape to the letter S. This demonstrates procyclicality of leading and countercyclicality of lagging exchange rates. Based on considerable level of cross–country generalization we can conclude that the most significant relationship with exchange rates was discovered for government debt and, to a lesser extent, for import. However, policy analyses related to business cycles should not overemphasize the effects of exchange rates on the economy and crucial fundamentals.

Cross correlations were further related to indicators of country's openness and wealth. We did not find solid evidence that these characteristics have impact on magnitude of cross correlation. In other words, factors other than openness, measured by the weight of international trade in the economy, and relative wealth are associated with the degree of co-movement of exchange rates with macro variables. The only exceptions are again government debt and import for which correlation with exchange rates evidently increases in less open and poorer countries.

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CIKLIČKA VEZA TEČAJNIH STOPA I MAKRO-FUNDAMENATA U CENTRALNOJ I ISTOČNOJ EUROPI

SAŽETAK

Donosimo empirijske dokaze poslovnog ciklusa odnosno veze između nominalnog i stvarnog efektivnog tečaja, realnog BDP-a, potrošnje, investicija, izvoza, uvoza i općeg vladinog duga za grupu od deset zemalja centralne i istočne Europe. Koristili smo poprečnu korelaciju na ciklički filtriranim i sezonski prilagođenim kvartalnim vremenskim serijama u periodu od 1998 do 2010. Rezultati se razlikuju po intenzitetu, smjeru i cikličnosti no pokazuju općenitu slabu vezu između tečajnih stopa i fundamenata. Utvrđeni su dovoljno visoki koeficijenti samo za vladin dug i uvoz. Također smo primijenili jednostavne regresije kako bi korelaciju doveli u vezu s otvorenosti i dobrobiti ekonomije. Korelacija između tečajnih stopa i makroekonomskih agregata stremi jačoj izraženosti u manje otvorenim i relativno siromašnijim zemljama..

Ključne riječi: poslovni ciklus, poprečna korelacija, tečajna stopa, makroekonomski fundamenti, otvorenost, bogatstvo


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THE LINKAGE BETWEEN STOCK PRICE AND ECONOMIC GROWTH IN AUSTRALIA: A CHICKEN-AND-EGG PARADOX?

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ABSTRACT

This study attempts to re-investigate the linkage between stock prices and economic growth in Australia using the cointegration and Granger causality tests. The study covers the quarterly data from 1960:Q1 to 2008:Q4. The cointegration test exhibits that the variables are cointegrated, implying that stock prices and economic growth in Australia are moving together in the long-run. Nevertheless, the TYDL causality test suggests that there is only a unidirectional causality running from stock prices to economic growth. Moreover, the recursive regression-based TYDL causality test affirms that this unidirectional causality is stable over their respective period of analysis. Therefore, the relationship between stock prices and economic growth in Australia is no longer a chicken-and-egg paradox.

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I. INTRODUCTION

The aim of this study is to re-investigate the interaction between stock price and economic growth in Australia within the cointegration and causality framework. The relationship between stock price and economic growth has been an age-old issue in both economics and also finance literatures; nevertheless its causal relationship remains a chicken-and-egg phenomenon. Some empirical evidences showed that stock price is a good indicator to predict future economic growth because a well-developed stock market would effectively mobilize savings to productive investment which in turn lead to economic growth. This is the so-called *supply-leading* relationship highlighted in Patrick (1966). With respect to this the direction of causality presumably running from stock price to economic growth (e.g., Lee, 1992; Kaplan, 2008; Liu and Sinclair, 2008; Shahbaz et al., 2008). On the contrary, other empirical studies defended the views that economic growth induces stock price to change because economic growth would create demand for stock and other financial instruments, then the stock and financial markets would effectively respond to these changes. Patrick (1966) named this as the *demand-leading* relationship. For this reason, the direction of causality is expected to flow from economic growth to stock price (e.g., Know and Shin, 1999; Gjerde and Saettem, 1999).[1] Obviously, the causality direction between stock price and economic growth remains yet an unresolved conundrum. In view of policy implication, Georges (2001) noted that the stock market development played a significant role in policy transmission mechanisms. Therefore, knowledge of the linkage between stock price and economic growth is necessary for investors and also decision makers to formulate a proper investment and economics management strategy.

As far as Australia is concerned, empirical study on the relationship between stock price and economic growth is quite scarce and their finding also failed to reach unanimous consensus. A summary of the earlier studies on the relationship between stock price and economic growth in Australia is delineated in Table 1.As presented in Table 1, Lamberton (1958) found that over half a century the stock price and economic growth in Australia is positively correlated. Next, Tuncer and Alövsat (2000) used the time series data from 1981 to 1998 to assess the causal relationship between stock price and economic growth for 20 economies.[2]In the case of Australia, they found that stock price and economic growth are not Granger-causes each other. In other words, the causal relationship between stock price and economic growth in Australia is neutral. On the contrary, Shan et al. (2001) attempted to re-investigate the causal relationship between stock price and economic growth in Australia using the modified Wald (MWALD) causality test advocated by Toda and Yamamoto (1995). The study covered the quarterly sample from 1976:Q3 to 1998:Q3. Contrary with the finding of Tuncer and Alövsat (2000), they discovered a strong bilateral causality between the stock price and economic growth in Australia.

[1] Extremely, Hu (1993) and Stock and Watson (1998) found that the relationship between stock price and economic growth is neutral.

[2] The 20 economies includes the United States of America, Germany, Australia, Austria, Great Britain, Belgium, France, South Africa, India, Indonesia, Spain, Sweden, Italy, Canada, Japan, Norway, Pakistan, Turkey, New Zealand, and Greece.

TABLE 1: SUMMARY OF SELECTED EMPIRICAL STUDIES ON THE RELATIONSHIP BETWEEN STOCK MARKET AND ECONOMIC GROWTH IN AUSTRALIA

Authors	Research Period	Econometric Methods		Empirical Results		
		Cointegration	Causality	Cointegration	Causality Direction	Stock market-economic growth relation
Lamberton (1958)	1901-1956	–	–	–	–	Positive
Tuncer and Alövsat (2000)	1981-1994	–	Sims (1972) - VAR	–	$SP \not\leftrightarrow Y$	–
Shan et al. (2001)	1976:Q3-1998:Q3	–	Toda and Yamamoto (1995)-MWALD	–	$SP \leftrightarrow Y$	–
Thangavelu and Ang (2004)	1969:Q1-1999:Q4	Johansen-Juselius (1990)	Granger (1969) -VAR	Not Cointegrated	$SP \rightarrow Y$	–
Mao and Wu (2007)	1974-2004:	Johansen-Juselius (1990)	Granger (1988)-VECM			
	Monthly			Cointegrated	$SP \leftrightarrow Y$	0.243
	Quarterly			Cointegrated	$Y \rightarrow SP$	0.613
	1974-1983:	Johansen-Juselius (1990)	Granger (1988)-VECM			
	Monthly			Cointegrated	$SP \not\leftrightarrow Y$	0.057
	Quarterly			Not Cointegrated	$Y \rightarrow SP$	–
	1986-2004:	Johansen-Juselius (1990)	Granger (1988)-VECM			
	Monthly			Cointegrated	$SP \leftrightarrow Y$	0.304
	Quarterly			Cointegrated	$Y \rightarrow SP$	0.690

Note: *SP* and *Y* denotes stock price and economic growth, respectively. $\rightarrow$ represents the unidirectional causality. The $\leftrightarrow$ and $\not\leftrightarrow$ imply bilateral causality, and no causality, respectively.

As a value added to the earlier studies, Thangavelu and Ang (2004) applied both Johansen and Juselius (1990) multivariate cointegration and Granger causality tests to re-examine the linkages between stock price and economic growth in Australia over the period of 1969:Q1 to 1999:Q4. Their empirical evidence suggested that stock price and economic growth in Australia are not cointegrated. Notwithstanding, they found evidence of a unidirectional causality runs from stock price to economic growth in Australia. Recently, Mao and Wu (2007) re-examined the relationship with different sample period and also frequency of data (i.e., monthly and quarterly). In order to achieve the objective of the study, they employed the Johansen-Juselius cointegration and Granger causality tests to assess the relationship between stock price and economic growth in Australia. Remarkably, the Johansen-Juselius cointegration test results show that the variables are cointegrated regardless to which sample period and data frequency is employed. Therefore, they concluded that stock price and economic growth in Australia are moving together in the

long-run. In view of causality direction, the results of Granger causality test showed that economic growth Granger-causes stock price whenever quarterly data is used. Ironically, the Granger causality evidence for monthly data is inconclusive.

Owing to the ambiguous relationship presented by the previous studies and their attendant policy implications, it is pertinent for this study to re-investigate the linkages between stock price and economic growth in Australia. This study differs from the earlier studies in three novel ways. First, we employ the bounds testing approach to cointegration to examine the presence of a long-run equilibrium relationship between stock price and economic growth in Australia. On the basis of Monte Carlo experiment, Pesaran and Shin (1999) and also Panopoulou and Pittis (2004) claimed that this cointegration approach has superior properties over the conventional cointegration tests (e.g., Engle and Granger, 1987; Johansen and Juselius, 1990). Moreover, it could be applied to test for cointegration even when the variables are purely *I*(0), purely *I*(1) or mutually cointegrated.

Second, the earlier studies have utilised asymptotic methods to test for causality which is proven to be low power when the variables are characterized by non-spherical probability distributions and the presence of autoregressive conditional heteroskedasticity (ARCH) problem (see Hacker and Hatemi-J, 2006). Therefore, we use the TYDL causality test (Toda and Yamamoto, 1995; Dolado and Lütkepohl, 1996) and leveraged bootstrap approach to test for causality between stock price and economic growth. As far as our research is concerned, this approach has not been adopted to study the causal relationship between stock price and economic growth. Third, we follow Tang's (2008a) and Tang and Tan's (2013) suggestion to incorporate the recursive procedure into the TYDL causality test to examine the stability of the causal relationship between stock price and economic growth. To the best of our knowledge, no author has hitherto demonstrated the stability or persistency of the stock price-growth relationship. Therefore, our study can provide more reliable results and robust contribution to the literature of causal relationship between stock price and economic growth.

The remainder of this paper is structured as follows. Section 2 provides a brief discussion on model specifications, econometric methods and data used in this study. In Section 3, we report our empirical results. Finally, the conclusion of this study will be presented in Section 4.

II. MODEL SPECIFICATION, ECONOMETRIC METHODS AND DATA

A. Model Specification

The interest of this study is to examine the interaction between stock price and economic growth in Australia, hence we estimate the bivariate framework as expressed in equation (1). On the basis of this bivariate framework, many of the published articles on the relationship between stock price and economic growth have utilized the similar bivariate model. Among them are Binswanger (2000), Padhan (2007), Mao and Wu (2007), Kaplan (2008), and Liu and Sinclair (2008).

$$\ln Y_t = \alpha_0 + \alpha_1 \ln SP_t + \varepsilon_t \quad (1)$$

where ln denotes the natural logarithm. Y is the real gross domestic product (GDP) and SP represent the real stock price. The random error terms ε_t are assumed to be spherically distributed and white noise. The economic theories suggest that the expected sign of α_1 can be either positive or negative.

B. Econometric Methods

As all other studies that utilize time series data, it is of utmost important to recognize and discuss the analytical tools used to achieve the objective of a research work. We begin with describing the Pesaran et al. (2001) bounds testing approach to cointegration. Then, we define the Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996) test statistics and the leverage bootstrap critical values to ascertain the causality direction. Ultimately, we describe the recursive regression-based causality test suggested by Tang (2008a) to investigate the stability of causal relationship between stock price and economic growth in Australia. The following sub-section will briefly explain the testing procedure for each analytical tool.

i. Bounds Testing Approach to Cointegration

This study adopted the bounds testing approach to cointegration developed by Pesaran et al. (2001) to examine the presence of long-run equilibrium relationship between stock price and economic growth. This cointegration test is estimated within the autoregressive distributed lag (ARDL) framework. Although the primary objective of this study was focused on the causality direction between stock price and economic growth in Australia, the existence of co-movement relationship between the variables is of paramount importance in avoiding spurious regression phenomenon. There are several advantages of using the bounds testing approach to cointegration. First, the ARDL approach can be applied irrespective of whether the independent variables are purely *I*(0), purely *I*(1) process or mutually cointegrated. Second, this approach does not push the short run dynamic into the residuals term as in the Engle and Granger (1987) residuals-based cointegration test (see Pattichis, 1999). Hence, it is relatively more reliable than the conventional cointegration tests, in particular for study with a finite sample.

In order to account for the long-run equilibrium relationship through the bounds testing approach to cointegration, we estimate the following ARDL equation:

$$\Delta \ln Y_t = a_0 + a_1 \ln Y_{t-1} + a_2 \ln SP_{t-1} + \sum_{i=1}^{k} b_{1i} \Delta \ln Y_{t-i} + \sum_{i=0}^{k} b_{2i} \Delta \ln SP_{t-i} + e_t \qquad (2)$$

where Δ is the first difference operator and *k* is the maximum lag length. The residuals e_t are assumed to be white noise, normally and identically distributed. Next, we investigate the existence of a long-run relationship by restricting the lagged level variables $\ln Y_{t-1}$ and $\ln SP_{t-1}$ in equation (2). Obviously, this is a joint significance F-test for the null hypothesis of not cointegrated $\left(H_0 : a_1 = a_2 = 0\right)$ versus the alternative hypothesis of cointegrated $\left(H_A : a_1 \neq a_2 \neq 0\right)$. Pesaran et al. (2001) tabulated two sets of asymptotic bounds critical values

– upper bounds critical value, *I*(1) and lower bounds critical value, *I*(0). If the calculated F-statistics for cointegration test is greater than their respective upper bounds critical value, we surmise that the estimated variables are cointegrated. On the contrary, if the calculated F-statistic is less than the lower bounds critical values, then we cannot reject the null hypothesis of no cointegrating relation. Nevertheless, it must be pointed out here that if the calculated F-statistics fall within the upper and lower bounds critical values, the inference would be inconclusive and the degree of integrated must be known before any cointegration conclusion can be drawn (see Pesaran et al., 2001).

ii. Causality Method

Here, we briefly describe the causality method used in this study. We employ the causality method developed by Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996) or more popularly known as TYDL causality test to investigate the causal link between stock price and economic growth within the augmented-VAR system. Zapata and Rambaldi (1997) performed a Monte Carlo experiment and found that both the likelihood ratio test and the Wald test are very sensitive to the specification of the short-run dynamics in error-correction models (ECMs), even in large samples. Prior to ascertain the causal relationship, we have to determine the optimal lags structure (*k*) accommodated into the VAR model and the maximal order of integration $\left(d_{\max} = 1\right)$ for the variables in the system. Therefore, the augmented-VAR system in levels can be written as follows:

$$\begin{bmatrix} \ln Y_t \\ \ln SP_t \end{bmatrix} = \begin{bmatrix} \beta_1 \\ \beta_2 \end{bmatrix} + \begin{bmatrix} B_{11,1} & B_{12,1} \\ B_{21,1} & B_{22,1} \end{bmatrix} \times \begin{bmatrix} \ln Y_{t-1} \\ \ln SP_{t-1} \end{bmatrix} + \mathrm{L} + \begin{bmatrix} B_{11,k} & B_{12,k} \\ B_{21,k} & B_{22,k} \end{bmatrix} \times \begin{bmatrix} \ln Y_{t-k} \\ \ln SP_{t-k} \end{bmatrix}$$
$$+ \begin{bmatrix} B_{11,p} & B_{12,p} \\ B_{21,p} & B_{22,p} \end{bmatrix} \times \begin{bmatrix} \ln Y_{t-p} \\ \ln SP_{t-p} \end{bmatrix} + \begin{bmatrix} \xi_{1t} \\ \xi_{2t} \end{bmatrix} \qquad (3)$$

where ln denotes as natural logarithm. The lags' order of*p* represents the $\left(k+1\right)$ and *k* is the optimal lags' order of the VAR system. The residuals $\left(\xi_{1t}, \xi_{2t}\right)$ are assumed to be white noise, normally and identically distributed. In equation (3), $B_{12,k} \neq 0 \ \forall_k$ implies that $\ln SP$ Granger-causes $\ln Y$, whereas $\ln Y$ Granger-causes $\ln SP$ if $B_{21,k} \neq 0 \ \forall_k$.

Ironically, Shukur and Mantalos (2000) stated that the TYDL causality test may be biased in analysis with small and medium sample size. Hacker and Hatemi-J (2006) conducted a Monte Carlo analysis on size distortion properties. They found that the Wald test performed badly when the residuals are not spherically distributed and the ARCH effect exist in the VAR system. In this respect, the leveraged bootstrap approach suggested by Hacker and Hatemi-J (2006) will be used to compute the bootstrap critical values. If the computed TYDL statistic is greater than the simulated bootstrapped critical values, the null hypothesis of non-Granger causality should be rejected. Otherwise, we cannot reject the null hypothesis of non-Granger causality. Due to the extensive discourses done on the leveraged bootstrap approach, the

interested readers can refer to Hatemi-J and Roca (2004), Hatemi-J and Irandoust (2005), Hacker and Hatemi-J (2006), and Hatemi-J and Irandoust (2006) for details discussion.

iii. Recursive Regression-based Causality Test

Apart from the standard causality test explained in above, this study will also employ the recursive regression-based causality test suggested by Tang (2008a) and Tang and Tan (2013) to examine the stability of the causal relationship between stock price and economic growth in Australia. The recursive regression-based TYDL causality test can be described as follows. Initially, the TYDL causality test is estimated for the beginning subsample of T observations, i.e., with an initial sample size T. After that, a new observation is added into the end of the estimation sample period (i.e. $T+1$). This relationship is then re-estimated with the Ordinary Least Squares (OLS) estimator. For example, if we start at 10 years, that is, T = 40 observations, the first TYDL causality test statistic was obtained by using a subsample period from 1960:Q1 to 1969:Q4 (i.e. T = 40 observations). Then the second test statistic was obtained by using data from 1960:Q1 to 1970:Q1. This recursive regression procedure will continue until the last observation was used to examine the causal relationship. Finally, the generated χ^2 - statistics are normalized by the 5 per cent critical values, meaning that if the normalized TYDL statistic is more than unity then the null hypothesis is rejected.[3]

[3] The normalized TYDL statistic can be calculated by dividing the TYDL statistics with the 5 per cent critical values. Hence, if the normalized TYDL statistic exceeded unity, meaning that the TYDL statistics is greater than the 5 per cent critical values. On the other hand, the normalized TYDL statistics will be less than unity if the TYDL statistic is lower than the 5 per cent critical values.

iv. Data Source

In this study, we used quarterly data from the period 1960:Q1 to 2008:Q4. The quarterly data for Australia were extracted from *International Financial Statistics* (IFS), published by the International Monetary Fund (IMF). The variables employed in this study consist of stock price index (2000 = 100) and Gross Domestic Product (GDP). The GDP deflator (2000 = 100) was used to transform the series into the real term.

III. EMPIRICAL RESULTS

A. Unit Root Test Results

It is well established in the econometric literature that it is essential to determine the degree of integration for each series to avoid the spurious regression problem (Granger and Newbold, 1974; Phillips, 1986) and the validity of bounds test to cointegration. Although the bounds testing approach to cointegration does not require a pre-testing of the degree of integration, it is important to ensure that the variables under consideration are not integrated at an order higher than one and the dependent variable in the ARDL equation is an *I*(1) process variable. This is because the critical values tabulated in Pesaran et al. (2001) are no longer valid if the ARDL equation included the *I*(2) variables. For this reason, we applied the Augmented Dickey-Fuller (ADF, 1979, 1981) and Phillips-Perron (PP, 1988) unit root tests to assess the degree of integration of the variables under investigation $\left[\ln Y_t,\ \ln SP_t\right]$.

TABLE 2: THE RESULTS OF UNIT ROOT TESTS

Variables	ADF	PP
$\ln Y_t$	−2.941 (9)	−2.218 (6)
$\Delta \ln Y_t$	−4.423 (8)***	−14.580 (4)***
$\ln SP_t$	−2.215 (3)	−1.785 (5)
$\Delta \ln SP_t$	−11.265 (0)***	−11.352 (3)***

Note: The asterisk *** denotes the significance level at the 1 per cent. ADF and PP refer to Augmented Dickey-Fuller and Phillips-Perron unit root tests. The optimal lag length of ADF test is selected using the AIC while the bandwidth for PP test is selected using the Newey-West Bartlett kernel. Figure in parentheses denotes the optimal lag length and bandwidth. The critical values for ADF and PP tests are obtained from MacKinnon (1996).
Source: Author's calculation

Interestingly, both the ADF and PP unit root test results reported in Table 2 indicate that all the estimated series are integrated of order one, *I*(1) process. These results corroborate with the findings of Nelson and Plosser (1982) that most of the macroeconomics variables are non-stationary at level, but are stationary after first differencing.

With this evidence, we can proceed to investigate the presence of a potential long-run equilibrium relationship between stock price and economic growth in Australia via the bounds testing approach to cointegration.

B. Cointegration Test Results

The initial step in applying the bounds testing approach to cointegration is to determine the optimal combination of lag order for each variable in the ARDL equation. According to Enders (2004), maximum lags order of 3 years or 12 quarters are relatively long to capture the dynamic behavior in a time series analysis. In this context, we begin at 12 lags order and used the Akaike's Information Criterion (AIC) to select an optimal combination lag order. The AIC statistics reveal that ARDL (8, 4) is the best combination. Then, the calculated F-statistic for cointegration together with the critical values and a battery of diagnostic tests on the final ARDL model are reported in Table 3.

TABLE 3: THE RESULTS OF BOUNDS TEST FOR COINTEGRATION

Calculated F-statistic		
$F_Y\left(\ln Y \mid \ln SP\right)$	9.983***	
# Critical values (F-test):		
Significance Level	Lower *I*(0)	Upper *I*(1)
1 per cent	6.84	7.84
5 per cent	4.94	5.73
10 per cent	4.04	4.78
Conclusion:	**Cointegrated**	

Note: The asterisk *** denotes significance level at the 1 per cent. # Case III: Unrestricted intercept and no trend (k = 1) critical values are obtained from Pesaran et al. (2001).
R-squared: 0.280; Adjusted R-squared: 0.217; F-Statistic: 4.444 (0.000);
Jarque-Bera: 3.392 (0.183); Ramsey RESET [1]: 1.447 (0.229);
Breusch-Godfrey LM test [1]: 0.102 (0.749), [2]: 0.775 (0.679);
ARCH test [1]: 1.775 (0.183), [2]: 3.588 (0.166).
[ ] refer to the diagnostics tests order; ( ) refer to the p-values.
Source: Author's calculation

The Ramsey RESET test failed to reject the null hypothesis of no specification error implying that the model is correctly specified. The Breusch-Godfrey LM test demonstrated that the residuals are free from serial correction problem up to order two. Similarly, the autoregressive conditional heteroskedasticity (ARCH) LM test exhibits that the variance of the residuals is constant over time. Moreover, the Jarque-Bera normality test suggests that the residuals are normally distributed. This implied that the standard statistical tests (i.e., R-squares, t-statistics, and F-statistics) are valid.

Nevertheless, the plot of CUSUM of Squares statistics crossed the 5 per cent critical bounds (see Figure 1) implying that the estimated coefficients are not stable over the period of 1975 to 2000. The plausible explanation is the point raised by Narayan and Smyth (2005) that in the first half of 1970s the Australian economy was affected by various external shocks such as world economic shock, a commodity price shock, and the external inflationary pressure. Subsequently, the structural break at the late 1990s and 2000 may be owing to the Asian and Russian economic crises and the slowdown of the United States economy.

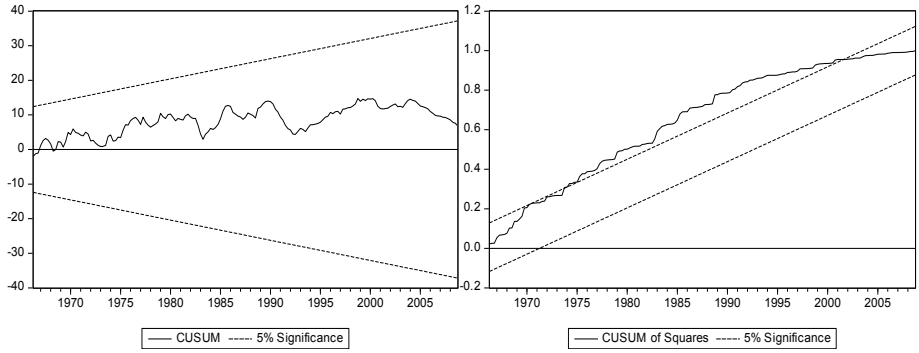


Figure 1: The plots of CUSUM and CUSUM of Squares Statistics

SOURCE: Author's calculation

Beyond that, for testing the presence of long-run equilibrium relationship between stock price and economic growth, the calculated F-statistic is greater than the 1 per cent upper bounds critical value. Thus, we surmise that stock price and economic growth in Australia are co-move in the long run over the analysis period of 1960 to 2007. This result is parallel with the finding of Mao and Wu (2007), but it is contrary with Thangavelu and Ang (2004) study. Since the variables are cointegrated, we estimate the long-run coefficients with four different long-run estimators to check for robustness of the estimation and also to provide more efficient long-run results. In this study we employ the Ordinary Least Squares (OLS) approach advocated by Engle and Granger (1987), the Fully-Modified OLS (FMOLS) approach suggested by Phillips and Hansen (1990), the Dynamic OLS (DOLS) approach suggested by Stock and Watson (1993), and the Autoregressive Distributed Lag (ARDL) approach suggested by Pesaran and Shin (1999). The estimated long-run coefficients are presented in Table 4.

Interestingly, the four estimators provide similar results for the long-run coefficients of stock price and thus affirming that the estimated results are robust. The sign of the long-run coefficient, $\ln SP_t$ is positive and statistically significant at the 5 per cent level. In addition, the long-run coefficient for stock price ranges from 0.57 to 0.88. This implies that a 1 per cent increase in stock price is likely to increase real GDP for Australia's by less than 1 per cent (i.e., inelastic positive relationship). This result is corroborated with the findings of Lamberton (1958), Fama (1981), and Mao and Wu (2007).

TABLE 4: THE RESULTS OF LONG-RUN ELASTICITIES

No.	Cointegrating estimators	Cointegrating vector	
		$\ln SP_t$	Constant
1.	Engle and Granger (1987) – OLS	0.573***	9.101***
2.	Phillips and Hansen (1990) – FMOLS	0.647**	8.797***
3.	Stock and Watson (1993) – DOLS	0.575***	9.056***
4.	Pesaran and Shin (1999) – ARDL	0.881***	9.307***

Note: The asterisks *** and ** denotes the significant level at the 1 and 5 per cent levels, respectively. (1) OLS – Ordinary Least Squares; (2) FMOLS – Fully Modified OLS; (3) DOLS – Dynamic OLS; (4) ARDL – Autoregressive Distributed Lag.
Source: Author's calculation

C. TYDL Causality Test Results

The presence of cointegrating relations between stock price and economic growth implied that there must be Granger-causality in at least one direction, but cointegration doesn't indicate the direction of causation (Tang, 2008b). The application of TYDL causality test requires information about the lag order (k) and maximum order of integration $\left(d_{\max}\right)$ for each variable in the VAR system. In the present study, the optimal lag order was determined by using AIC. The AIC statistic chose k = 5 as the optimal lag order, hence we estimated an augmented-VAR(k+1) model and then calibrated the TYDL test statistics to ascertain the causality direction.

TABLE 5: THE RESULTS OF CAUSALITY TESTS (TYDL)

Null Hypothesis	Estimated TYDL tests	Leveraged bootstrap critical values		
		1 per cent	5 per cent	10 per cent
$\ln SP_t \not\Rightarrow \ln Y_t$	28.130***	15.697	11.651	9.635
$\ln Y_t \not\Rightarrow \ln SP_t$	2.858	14.352	10.926	9.005

Note: The asterisk *** denotes statistically significance at the 1 per cent level. The GAUSS codes were used to perform causality test and compute the leveraged bootstrap critical values.
Source: Author's calculation

The TYDL statistics together with the leveraged bootstrap critical values are reported in Table 5. The causality test results clearly indicate that the null hypothesis of stock price does not Granger-cause economic growth is rejected at the 1 per cent significance level. At the same time, the null hypothesis of economic growth does not Granger-causes stock price cannot be rejected at the 10 per cent significance level. Therefore, our empirical evidence supports unidirectional causality running from stock price to economic growth in Australia rather than reversal causation.

However, another caveat is that the causal relationship between variables may not be stable due to frequent changes in the global economic and political environments (Tang, 2008a).

In this regards, the TYDL causality test using the entire sample period may not reflect such changes. To confirm whether the causal relationship between stock price and economic growth in Australia is stable, the recursive regression approach was incorporated into the TYDL causality test at different lag order (i.e., 4, 5, 8, and 12 lags).[4]

From the visual inspection of Figure 2, we found that the causal relationship between stock price and economic growth in Australia is relatively stable over the analysis period from 1960 to 2008 regardless of which lag order is used. Specifically, the normalized TYDL statistics are consistently rejected the null hypothesis of stock price does not Granger-causes economic growth, except for the period from 1975 to 1978 (see Figure 2(a)). This is nothing to surprise and it is correlated with the economic shocks suggested by CUSUM of Squares statistics (see Figure 1). On the other hands, the normalized TYDL causality test statistics failed to reject the null hypothesis of economic growth does not Granger-causes stock price over the recursive sample period (see Figure 2(b)). Based on the time-varying causality test results, we affirmed that there is a stable unidirectional causality running from stock price to economic growth. This implies that stock market development is always the best indicator or yardstick for future economic growth in Australia. Ironically, our finding also shows that the movement in stock price is not strongly determined by economic growth. This implication may be attributed to the reason that investors are sensitive and overreact to news or even rumors, hence stock market may not be driven by economic growth (Mookerjee and Yu, 1999). Ultimately, the finding of this study gained little evidence that the causal relationship between stock market and economic growth in Australia is not a chicken-and-egg paradox as there is a strong and stable unidirectional causality running from stock price to economic growth.

IV. CONCLUSION

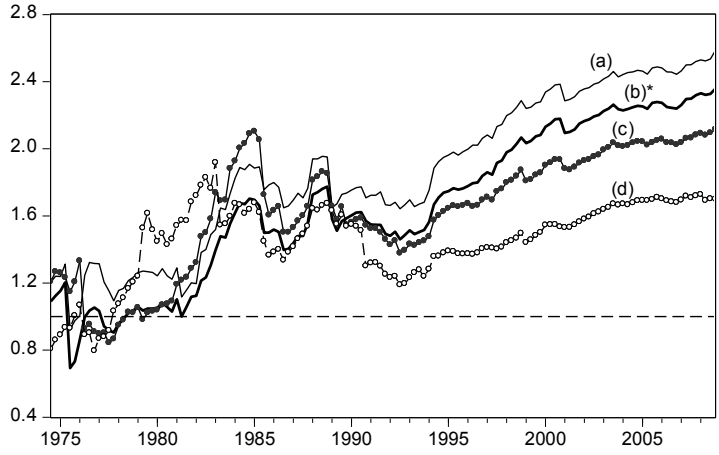
In this paper we re-investigate the stock market development and economic growth nexus for the Australian economy through the bounds testing approach to cointegration and TYDL causality test. In addition to that, we also test the stability of the causal relationship between stock market and economic growth by using the recursive regression-based causality approach. The bounds testing approach to cointegration shows that stock price and economic growth are cointegrated in Australia. This implies that stock price and economic growth have a long-run equilibrium relationship, even though deviations from the steady state may exist in the short run.

Turning to the causality test, this study used the leveraged bootstrap approach to TYDL causality and found strong evidence of unidirectional causality running from stock price to economic growth in Australia; however there is no evidence of reverse causality. Additionally, the recursive regression-based causality test suggests that the causal relationship between stock price and economic growth is stable over the analysis period as the causality inferences are consistent over time.

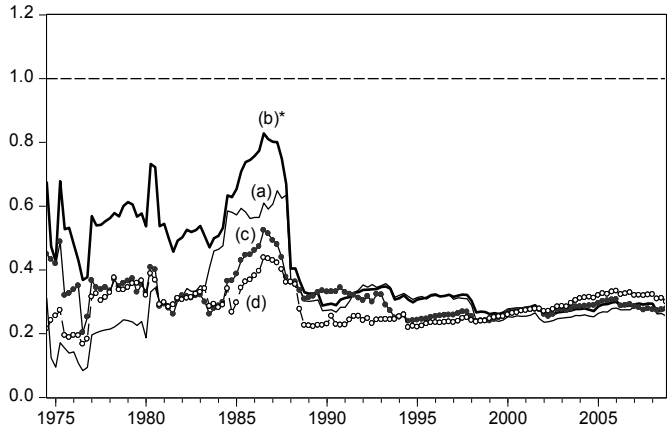
[4] Thornton and Batten (1985) argued that causality results are sensitive to the lag length selected for causality test.

Given these unidirectional causality results, we may conclude that the causal relationship between stock market and economic growth in Australia is no longer a chicken-and-egg phenomenon. As a result, this study attempts to suggest that policymakers may use the stock price as a leading indicator to predict the future economic growth in Australia as the causality tests showed that stock price is consistently Granger-causes economic growth. On the contrary, the findings of this study may also indicate that any negative shocks in the stock market may imply some signals of economic turbulence ahead. For equity investment purposes, investors should not solely depend on the economic environment to judge the future stock market performance, as economic growth in Australia may be not a significant element to influence the stock market development. Therefore, investors are advised to employ fundamental and technical charting analyses on individuals stock or industry in helping them to optimise the rate of return from an investment.

Figure 2: The results of time-varying causality test



(a) $H_0 : \ln SP_t \not\rightarrow \ln Y_t$



(b) $H_0 : \ln Y_t \not\rightarrow \ln SP_t$

Note: The above are the time-varying causality tests for the null hypothesis of (a) Stock price does not Granger causes economic growth and (b) Economic growth does not Granger causes stock price. $\not\rightarrow$ denotes non-Granger causes. The notation (a), (b), (c), and (d) denote the lag orders of 4, 5, 8, and 12 in the VAR system. The asterisk * indicate the optimal lag order selected by AIC.
Source: Author's calculation

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VEZA IZMEĐU CIJENE DIONICA I EKONOMSKOG RASTA U AUSTRALIJI: PARADOKS KOKOŠI I JAJETA?

SAŽETAK

Ovaj rad pokušava ponovno istražiti vezu između cijena dionica i ekonomskog rasta u Australiji koristeći testove kointegracije i Grangerove kauzalnosti. Studija pokriva kvartalne podatke od 1960:Q1 do 2008:Q4. Kointegracijski test pokazuje da su varijable kointegrirane, te se podrazumijeva da se, dugoročno gledano, cijene dionica i ekonomski rast u Australiji kreću zajedno. Ipak, TYDL kauzalni test sugerira da postoji samo jednosmjerna kauzalnost koja ide od cijena dionica prema ekonomskom rastu. Osim toga, TYDL test kauzalnosti zasnovan na rekurzivnoj regresiji potvrđuje da je ova jednosmjerna kauzalnost stabilna kroz cijeli analizirani period. Stoga, veza između cijena dionica i ekonomskog rasta u Australiji više nije nalik paradoksu kokoši i jajeta.

Ključne riječi: Australija; ekonomski rast; cijena dionica; rekurzivni test kauzalnosti


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PARAMETERS THAT PROVIDE HIGHER EXPLANATION ESTIMATING BETAS IN THE PORTUGUESE STOCK MARKET[1]

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ABSTRACT

During decades, tests have been developed to verify whether the beta is the best tool to explain the returns of securities on the stock market. Moreover, the value of the beta and its coefficient of determination (R-squared) vary with different parameters used for estimating the beta. In this paper, we investigate for the parameters that provide a higher explanation when we estimate the beta on the Portuguese stock market. We use all nine economic groups listed on the Euronext Lisbon and, for each of those groups, determine which company has the highest market capitalization and highest turnover at the same time, measured in millions of Euros and thousands of Euros, respectively. The linear regression and correlation coefficient between each of the companies can be calculated by studying two national indexes (PSI20 and PSI General) to determine if they get better results with respect to a given period, frequency data or index.

We conclude that the explanatory power of R-squared in the Portuguese stock market is very low, independent of the parameters used. When analyzing the year 2008 using linear regression, it remains unclear whether it is preferable to use daily returns or weekly returns, since half of the surveyed companies report the highest yield using either method. The explanatory power of R-squared is higher when using extended time periods and monthly returns, and the results become more accurate when doing the regressions with the PSI20 Index.

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I. INTRODUCTION

There is not an agreement in the academic environment on which model is more reliable for the evaluation of companies in order to take the decision to choose one model over another. The feeling that exists when assessing companies is that different methods provide different values for the same organization. Nevertheless, Copeland et al (2002, p. 49) assert that company valuation is a fundamental tool that can be implemented in an organization to guide it in order to find a unique vital goal that is to create shareholder value.

Damodaran (1999) shows that any perception that the analyst brings to the evaluation process will eventually be incorporated into the value. Moreover, analyst proficiency resides in the ability to identify the value of the company and its shares on the market bearing in mind the future expectations of the company business performance. Fernández (1999), Copeland et al. (2002) and Neves (2002) consider that the most consistent valuation model is the Discount Cash Flow, pointing out that the company's value come from the company's ability to generate cash flows to shareholders. There have been many studies using this model. Among them, we may refer: Modigliani & Miller (1958; 1963), Miller & Modigliani (1961), Myers (1974), Arditti & Levy (1977), Kaplan & Ruback (1995), Luehrman (1997), Stewart (1999), Copeland et al. (2002), or Fernández (2008b).

Estimating the value of a company using the discounted cash flow method implies a set of essential variables that goes through cash flows, discount rate, residual value and time horizon. To achieve the discount rate we should be aware that it has to reflect the opportunity cost of not investing in another asset with the same risk level. Although there are studies that criticized the Capital Asset Pricing Model (CAPM), among which Banz (1981) or Bhandari (1988), it remains commonly used in determining the profitability of an asset from the shareholders' perspective because of its simple calculations. However, there is a need to check the risk free interest rate to use (Rf), the risk premium (Rm-Rf) and Beta ( ), representing the systematic risk. Since the last one affects the business in general and commonly is hardly reduced.

The Beta of a particular firm shows different values depending on the used parameters (Damodaran, 1999). The index representing the market, the time period or the frequency used will result in different values for the Beta. Many have been the studies undertaken to demonstrate that the actual estimation of this parameter according to the CAPM is not the best solution, including Elsas et al. (2003) Fernández & Carabias (2007), Fernández (2008a; 2008b), Fernández (2009a; 2009b).

Based on Fernández (2008a) and Carvalho & Barajas (2010), we aim to identify if the Portuguese market is able to record a homogeneous behavior in the use of parameters common to all firms in the sample. To do so it will be considered the R squared and its correlation coefficient. There have been several studies to try to explain why R2 is different between markets and businesses, including: Morck et al. (2000), Durnev, et al. (2003), Piotroski & Roulstone (2004), Jin & Myers (2006) and Chan & Hameed (2006). However its consequences have not been properly investigated.

In this research, we intend to find the parameters used in calculating the beta which achieve a better fit (R2) in the Portuguese market using a sample that includes one company of each economic sector represented in the Euronext Lisbon to further develop its impact on firm value. The analysis has been conducted through a period of five years - from 2004 to 2008. To test the Beta explanation degree (R2) and the correlation coefficient, time periods of one to five years

through daily, weekly and monthly frequencies has been used. The data required for the construction of the resulting Beta were courtesy of Euronext Lisbon.

Apart from the introduction, this article is divided as follows: the empirical model is presented in the next section, in the following point the universe and sample are presented, in order to show the results obtained in Section 4, to finish with the conclusions in Section 5.

II. EMPIRICAL MODEL OF OUR STUDY

The study is developed through the CAPM. Beta is estimated in order to quantify if its explanatory power given by the squared R is relevant. We also test if there are some parameters that ensure a greater degree of adjustment.

We consider the closing price of each title for each of the periods under review to quantify the dependent variables and the independent variable (proxy). We test which of the national index provide better explanation, whether the PSI 20 Index or the PSI General, and if we can standardize it to all companies. We chose to use the closing price of the data on a daily, weekly and monthly basis. With regard to quotations weekly basis it was considered the closing price each Friday. With regard to quotations per month, it was considered the last date value of the last price of each month.

Later through the bivariate analysis, Betas were calculated changing the parameters. We have obtained R-squared and correlation coefficient for each one of the nine companies studied. It has been carried out a sensitivity analysis for different frequencies and five time horizons (annual period of 2008, two-year period between 2007 and 2008, three years between 2006 and 2008, four years from 2006 to 2008 and five years from 2004 to 2008). With those elements, the achievement is to quantify and complete if there is a horizon and a higher frequency to produce systematically greater explanatory power and correlation, and if carried over the same index for all economic sectors under study.

III. UNIVERSE AND SAMPLE

Considering as true the hypothesis of market efficiency, at the semi-strong version, the market capitalization represents the value of the company from the perspective of shareholders and the price per share represents a proxy of the value of the action. As in Carvalho & Barajas (2010) the universe of application are listed companies on the official stock market of Euronext Lisbon at 31stDecember 2008, according to the official bulletin and list report annual data from Euronext Lisbon.

We choose companies listed on the Euronext Lisbon since it is the only national market. Thus, they are the companies with the greatest amount of information available, in accordance with the requirements of the *Comissão de Mercados de Valores Mobiliários* (CMVM), the Portuguese organization equivalent to the US Securities and Exchange Commision. Consequently, it is assumed that the requirements are met by the CMVM and the information provided is credible. In December 2008, there were listed on Euronext Lisbon a total of 55 companies, of which 49 were Portuguese and 6 foreign. According to this information we chose to limit the analysis to Portuguese companies. The choice of the period to analyze includes five years from 1st January 2004 to 31stDecember 2008 for the reasons explained below.

Since 1st January 2005 and by Regulation (EC) 606/2002 1, from the European Parliament and Council of July 19, listed companies were obliged to present accounting information in accordance with International Accounting Standards (IAS) or International Accounting Standards (IAS), now known as International Financial Reporting Standards (IFRS). This was another step taken to remedy any gaps in relation to "real" book value. Thus, it was considered still feasible to use the year 2004, since that the annual report for 2005 contained information regarding 2004.

Carrying the selection of content and companies to investigate, it was considered Neves (2002). He admits that, according to financial theory, the index must have three characteristics: market portfolio should consist of the largest number of investments; the index should be adjusted from dividends; the index should not result from a simple average, but from a weighted average of the assets in the market. However, (Ehrhardt, 1994) concludes that empirical results are identical with or without dividend adjustment. So, we use the data without being adjusted from dividends.

Aggregating in a single index the average returns of all investments existing in the market is not an easy task, maybe impossible. Therefore, usually an index represents the market. Considering the Portuguese market, choice remains on the PSI20 Index or the PSI General. The last one encompasses a larger number of investments. However, it includes assets that are not traded daily. On the other hand, PSI 20 index has higher liquidity and trading volume. We chose to use both as a proxy from the market to validate whether any can register a similar behavior in all companies under analysis.

At the companies selection for the case study some criteria were considered:

a) Being companies with Portuguese funds;
b) Include a company by each economic group in the study. For this purpose it was necessary to identify the economic groups existing in the PSI 20 and PSI General to ascertain whether they were all included in the PSI 20. Noting that there are two groups in the PSI General who were not represented in the PSI 20 index was deemed advisable to incorporate them into the study;
c) Select companies by sector with the highest market capitalization, higher weight in the General Index and higher trading volume;
d) It was decided at the outset that if the companies had the same weight in the index, it would be selected the company with greater market stock capitalization.

The sample is limited to nine companies, each being a representative of the various economic groups contained in the PSI General Index. Initially, only the ones present in the PSI20 index were considered but that meant to not identify and analyze the trends in consumer goods groups and technology. The nine companies selected were based on stock market capitalization, influence in the General Index and the volume traded, and the chosen company was which showed higher values than December 31st 2008 by economic group.

The accepted criteria ensured that all economic groups represented in the Euronext Lisbon were under analysis. Euronext Lisbon was the main source of data through the sale prices of companies under scrutiny, the official stock newsletters and annual reports. The time period of five years allowed us to analyze the evolution of companies. This criterion is not verified in Galp

Energia because it has only been admitted to trading on October 23rd2006. Despite its few historic data it was considered relevant to observe its behavior, as it is the only company in terms of the economic group and being the second in terms of market capitalization as a representation in terms of weight in the index, and third in respect to market transactions.

Based on those criteria's, the general conclusion was that the companies targeted by this investigation were: EDP, Galp Energia, Portugal Telecom, Banco Comercial Português (BCP), Brisa, Jerónimo Martins, Portucel, Sumol + Compal and Novabase.

IV. RESULTS

The results for the R-squared and the correlation coefficient based on daily prices, weekly and monthly rates are presented respectively in Tables 1, 2 and 3. Table 4 presents in summary mode the maximum values obtained in terms of the indicators, identifying where is registered for each company of the nine economic groups represented in the Euronext Lisbon. It should be noted that Galp analysis has only been in two historical periods 2007 to 2008 and 2008, as it has been admitted to listing on 23 October 2006.

According to the following table, it appears that the explanatory power of the R-squared is reduced. However, it increases with decreasing the time horizon. We noted also that there is no homogeneity in the index so as to achieve greater explanatory power.

EDP is the company that presents the higher the R-squared according to daily basis. It verifies that some 71.7% of the company's return is justified by the PSI General Index behavior, i.e. the remaining 28.3% are explained as company specific risks. In contrast, it appears that the company with less explanatory power through the index is Sumolis, noting that this is almost nil throughout the different periods under review. Thus, it can be stated that Sumolis behavior is independent of market behavior, deriving 100% of the specific risk.

Through the correlation coefficient it may be noted that the company's move is the reverse for all periods under review except for the five-year period from 2004 to 2008.

According to the period of measurement using weekly prices, in one hand it is verified that EDP remains the company that simultaneously has higher explanatory power (67.2%) and highest correlation coefficient (82.0%) at the PSI General index and secondly, that Sumol+ Compal is the company that present lower R-squared since the company's returns are only explained at 3.2% by the market returns variation. It should also be noted that Sumolis presents inverse motions to indexes in all periods under review.

Checking the R-squared on a monthly basis, we observe that Portugal Telecom is the company with greater explanatory power and its returns will be explained by market (PSI20) variations at approximately 65.0% and a correlation of 80.7%.

TABLE 1 - EXPLANATORY POWER OF R-SQUARED AND THE CORRELATION COEFFICIENT THROUGH DAILY RETURNS

COMPANIES		2004-2008		2005-2008		2006-2008		2007-2008		2008	
		PSI 20	GERAL	PSI 20	GERAL	PSI 20	GERAL	PSI 20	GERAL	PSI 20	GERAL
Brisa	R^2	0.329	0.313	0.352	0.335	0.379	0.358	0.396	0.372	0.427	0.400
	Corr.	0.574	0.559	0.594	0.579	0.616	0.599	0.629	0.610	0.653	0.632
Portugal Telecom	R^2	0.443	0.408	0.443	0.401	0.445	0.399	0.473	0.427	0.575	0.523
	Corr.	0.666	0.639	0.666	0.633	0.667	0.632	0.688	0.653	0.758	0.723
EDP	R^2	0.570	0.541	0.598	0.580	0.616	0.603	0.647	0.640	0.714	0.717
	Corr.	0.755	0.735	0.773	0.762	0.785	0.776	0.804	0.800	0.845	0.847
BCP	R^2	0.444	0.404	0.437	0.407	0.439	0.414	0.459	0.435	0.461	0.432
	Corr.	0.666	0.635	0.661	0.638	0.663	0.643	0.678	0.660	0.679	0.657
Jeronimo Martins	R^2	0.082	0.088	0.088	0.094	0.092	0.097	0.089	0.094	0.305	0.316
	Corr.	0.286	0.297	0.297	0.307	0.303	0.312	0.299	0.307	0.553	0.563
Galp	R^2							0.432	0.484	0.515	0.583
	Corr.							0.629	0.483	0.553	0.582
Portucel	R^2	0.258	0.281	0.283	0.308	0.337	0.361	0.407	0.426	0.433	0.448
	Corr.	0.508	0.530	0.532	0.555	0.581	0.601	0.638	0.653	0.658	0.670
Sumol + Compal	R^2	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.002
	Corr.	0.008	0.003	-0.020	-0.024	-0.026	-0.030	-0.029	-0.034	-0.033	-0.039
Novabase	R^2	0.162	0.172	0.172	0.184	0.183	0.196	0.195	0.206	0.204	0.213
	Corr.	0.403	0.414	0.415	0.429	0.428	0.442	0.442	0.454	0.451	0.461

Source: Author's calculation

According to Table 4, it is shown that on a daily basis the companies obtain a greater explanatory power when used a shorter and most recent time period, 2008 and one year respectively. It is achieved a greater explanatory power through the PSI General index at most companies. The exceptions are: Brisa, Portugal Telecom and BCP.

TABLE 2- EXPLANATORY POWER OF R-SQUARED AND THE CORRELATION COEFFICIENT THROUGH WEEKLY RETURNS

COMPANIES		2004-2008		2005-2008		2006-2008		2007-2008		2008	
		PSI 20	GERAL	PSI 20	GERAL	PSI 20	GERAL	PSI 20	GERAL	PSI 20	GERAL
Brisa	R^2	0.339	0.307	0.358	0.327	0.393	0.356	0.391	0.353	0.414	0.367
	Corr.	0.582	0.554	0.598	0.572	0.627	0.597	0.625	0.594	0.644	0.605
Portugal Telecom	R^2	0.456	0.439	0.358	0.443	0.466	0.443	0.480	0.455	0.566	0.541
	Corr.	0.675	0.663	0.681	0.665	0.683	0.666	0.693	0.675	0.753	0.736
EDP	R^2	0.559	0.530	0.587	0.443	0.599	0.586	0.622	0.616	0.664	0.672
	Corr.	0.748	0.728	0.766	0.754	0.774	0.765	0.789	0.785	0.815	0.820
BCP	R^2	0.483	0.439	0.485	0.568	0.484	0.453	0.470	0.440	0.451	0.407
	Corr.	0.695	0.663	0.697	0.670	0.696	0.673	0.685	0.663	0.671	0.638
Jeronimo Martins	R^2	0.079	0.086	0.082	0.090	0.085	0.092	0.078	0.085	0.328	0.338
	Corr.	0.281	0.293	0.287	0.300	0.291	0.303	0.279	0.291	0.573	0.582
Galp	R^2							0.361	0.397	0.408	0.472
	Corr.							0.601	0.630	0.639	0.687
Portucel	R^2	0.206	0.224	0.223	0.245	0.242	0.266	0.252	0.276	0.237	0.258
	Corr.	0.453	0.473	0.472	0.495	0.492	0.516	0.502	0.526	0.487	0.508
Sumol + Compal	R^2	0.002	0.002	0.007	0.008	0.009	0.010	0.018	0.018	0.030	0.032
	Corr.	-0.041	-0.049	-0.084	-0.087	-0.096	-0.098	-0.135	-0.135	-0.173	-0.179
Novabase	R^2	0.208	0.214	0.021	0.218	,217	0.223	0.225	0.234	0.272	0.274
	Corr.	0.456	0.463	0.459	0.467	0.465	0.472	0.475	0.483	0.522	0.524

Source: Author's calculation

If analyzed data on a weekly basis, it has to be noted that BCP also gets greater explanatory power in the PSI General index, however, the time horizon is 3 years.

It also notes variation in terms of time horizon in Portucel gaining greater explanatory power when used two years returns. Also on a weekly basis it can be said that there is not a clear tendency from R2 since companies do not behave the same way, even with 1 year time horizon.

If companies are analyzed on a monthly basis, it appears, on global terms, that the index with greater explanatory power is the PSI 20, with Galp and Novabase being the exceptions. We noted also that in terms of time horizons there is great dispersion depending on the company analyzed.

TABLE 3- EXPLANATORY POWER OF R-SQUARED AND THE CORRELATION COEFFICIENT THROUGH MONTHLY RETURNS

COMPANIES		2004-2008		2005-2008		2006-2008		2007-2008		2008	
		PSI 20	GERAL	PSI 20	GERAL	PSI 20	GERAL	PSI 20	GERAL	PSI 20	GERAL
Brisa	R^2	0.426	0.388	0.431	0.386	0.425	0.386	0.361	0.319	0.320	0.284
	Corr.	0.653	0.623	0.656	0.621	0.652	0.622	0.601	0.565	0.565	0.533
Portugal Telecom	R^2	0.469	0.447	0.430	0.415	0.440	0.428	0.376	0.370	0.650	0.628
	Corr.	0.685	0.669	0.656	0.644	0.663	0.654	0.613	0.608	0.807	0.792
EDP	R^2	0.543	0.486	0.551	0.492	0.551	0.493	0.466	0.430	0.430	0.409
	Corr.	0.737	0.697	0.742	0.702	0.742	0.702	0.683	0.655	0.656	0.640
BCP	R^2	0.611	0.604	0.591	0.588	0.580	0.580	0.544	0.545	0.266	0.234
	Corr.	0.782	0.777	0.769	0.767	0.762	0.762	0.737	0.738	0.515	0.484
Jeronimo Martins	R^2	0.013	0.009	0.012	0.008	0.010	0.007	0.000	0.000	0.342	0.314
	Corr.	0.112	0.097	0.107	0.088	0.102	0.083	0.007	-0.011	0.585	0.560
Galp	R^2							0.481	0.512	0.513	0.611
	Corr.							0.693	0.716	0.716	0.782
Portucel	R^2	0.344	0.356	0.368	0.393	0.410	0.443	0.377	0.413	0.333	0.355
	Corr.	0.586	0.596	0.606	0.627	0.640	0.666	0.614	0.643	0.577	0.596
Sumol + Compal	R^2	0.009	0.005	0.003	0.001	0.004	0.001	0.003	0.001	0.003	0.000
	Corr.	0.094	0.067	0.054	0.030	0.064	0.037	0.051	0.023	0.052	-0.002
Novabase	R^2	0.152	0.157	0.142	0.153	0.137	0.148	0.124	0.141	0.292	0.297
	Corr.	0.390	0.396	0.376	0.391	0.370	0.385	0.353	0.375	0.541	0.545

Source: Author's calculation

TABLE 4- SUMMARY OF THE BEST R-SQUARED AND THE CORRELATION COEFFICIENT FOR DIFFERENTPARAMETERS

COMPANIES	Period:	DAILY			WEEKLY			MONTHLY		
		Max.	Index	Year	Max.	Index	Year	Max.	Index	Year
Brisa	R^2	0.427	PSI 20	2008	0.414	PSI 20	2008	0.431	PSI 20	05-08
	Correlation	0.653	PSI 20	2008	0.644	PSI 20	2008	0.656	PSI 20	05-08
Portugal Telecom	R^2	0.575	PSI 20	2008	0.566	PSI 20	2008	0.650	PSI 20	2008
	Correlation	0.758	PSI 20	2008	0.753	PSI 20	2008	0.807	PSI 20	2008
EDP	R^2	0.717	GERAL	2008	0.672	GERAL	2008	0.551	PSI 20	06-08
	Correlation	0.847	GERAL	2008	0.820	GERAL	2008	0.742	PSI 20	06-08
BCP	R^2	0.461	PSI 20	2008	0.568	GERAL	05-08	0.611	PSI 20	04-08
	Correlation	0.679	PSI 20	2008	0.697	PSI 20	05-08	0.782	PSI 20	04-08
Jeronimo Martins	R^2	0.316	GERAL	2008	0.338	GERAL	2008	0.342	PSI 20	2008
	Correlation	0.563	GERAL	2008	0.582	GERAL	2008	0.585	PSI 20	2008
Galp	R^2	0.583	GERAL	2008	0.472	GERAL	2008	0.611	GERAL	2008
	Correlation	0.629	PSI 20	07-08	0.687	GERAL	2008	0.782	GERAL	2008
Portucel	R^2	0.448	GERAL	2008	0.276	GERAL	07-08	0.443	PSI 20	2008
	Correlation	0.670	GERAL	2008	0.526	GERAL	07-08	0.666	GERAL	06-08
Sumol + Compal	R^2	0.002	GERAL	2008	0.032	GERAL	2008	0.009	PSI 20	04-08
	Correlation	0.008	PSI 20	04-08	-0.041	PSI 20	04-08	0.094	PSI 20	04-08
Novabase	R^2	0.213	GERAL	2008	0.274	GERAL	2008	0.297	GERAL	2008
	Correlation	0.461	GERAL	2008	0.524	GERAL	2008	0.545	GERAL	2008

Source: Author's calculation

V. CONCLUSIONS

The explanatory power of R2 in the Portuguese market is very low regardless the used parameters. If last year is used to develop the linear regression, it is unclear how often - daily or weekly - is better, half of the companies have better fit in each case.

The explanatory power improves with extended time periods and monthly returns. In that case, even better results were obtained when using the PSI 20 Index.

It can be stated that the R-squared in the Portuguese market is not relevant, given that very low values are recorded in the vast majority of companies on one hand, and secondly, there is not clear trend in terms of time horizon. Thus, one cannot identify an R2 which permit to homogeneously apply a time period, an index and a frequency for each one company representing the nine economic groups listed on Euronext Lisbon.

Finally, the results could reinforce the position of those, like Fernández (2009a), who affirm that calculated betas do not work better than beta = 1. In fact, in most of the cases (62.5%) in the sample the beta =1 provides a better correlation than calculated betas.

TABLE 5 - BETAS VS. BETA =1. CORRELATION (RT, RM), CORRELATION (RT,RM) AND ITS DIFFERENCE USING CALCULATED BETA FROM DAILY DATA OF ONE YEAR, AT THE END OF THE YEAR VS PSI20.

	corr(Rt, Rm)	*corr(Rt,Rm)*	*Dif.*
BRISA	0,947	0,946	0,001
PORTUGAL TELECOM	0,890	0,858	0,032
EDP	0,964	0,955	0,009
BCP	0,959	0,971	-0,012
JERÓNIMO MARTINS	0,320	0,323	-0,003
PORTUCEL	0,616	0,833	-0,218
SUMOLIS	-0,132	0,439	-0,572
NOVABASE	-0,877	-0,813	-0,064
Average	0,461	0,564	-0,103
MAX	0,964	0,971	
Min	-0,877	-0,813	
<0			5

Source: Author's calculation

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PARAMETRI KOJI DAJU BOLJE OBJAŠNJENJE PRI PROCJENI BETA NA PORTUGALSKOM TRŽIŠTU DIONICA[2]

SAŽETAK

Desetljećima su razvijani testovi koji bi provjerili je li beta najbolji alat za objašnjavanje zarade na vrijednosnicama na tržištu dionica. Osim toga, vrijednost bete i njen koeficijent determinacije (R-kvadriran) variraju s različitim parametrima korištenim za procjenu bete. U ovom radu istražujemo parametre koji daju više objašnjenje prilikom procjene bete na portugalskom tržištu dionica. Koristili smo svih devet ekonomskih grupa kotiranih na Euronext Lisbon te smo za svaku od tih grupa odredili koja kompanija ima najvišu tržišnu kapitalizaciju i najviši promet u isto vrijeme, mjereno u milijunima i tisućama eura, odnosno. Koeficijent linearne regresije i korelacije između pojedinih kompanija može se izračunati proučavanjem dva nacionalna indeksa (PSI20 i PSI General) kako bi se ustanovilo dobivaju li se bolji rezultati u odnosu na dani period, frekvenciju podataka ili indeks.

Zaključujemo da je moć objašnjenja R-kvadriranog koeficijenta na portugalskom tržištu dionica vrlo niska, bez obzira na korištene parametre. Analizirajući godinu 2008. uz pomoć linearne regresije, ostaje nejasno je li bolje koristiti dnevnu ili tjednu zaradu s obzirom da polovica anketiranih poduzeća prijavljuje najveću dobit koristeći obje ove metode. Moć objašnjenja R-kvadriranog koeficijenta je veća kad se koriste duži vremenski periodi i mjesečne zarade a rezultati su točniji kada se regresije rade s PSI20 indeksom

Ključne riječi: Beta, koeficijent determinacije, rizik, portugalsko tržište dionica, procjena

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INTRA-INDUSTRY TRADE IN THE MEDICAL AND OPTICAL INSTRUMENTS INDUSTRY: A PANEL DATA ANALYSIS

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ABSTRACT

This paper analyses the determinants of intra-industry trade (IIT) in the Portuguese medical and optical sector using a static and dynamic panel data analysis. The results suggest that IIT in medical and optical instruments occurs more frequently among countries that are similar in terms of relative factor endowments and are members of the same regional integration agreement. Moreover, this trade increases if the partners are geographically close.

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I. INTRODUCTION

This paper estimates the determinants of intra-industry trade (IIT) in the medical and optical instruments industry. We examine the IIT in this sector between Portugal and the European Union (EU-27). We also consider two BRIC countries (Brazil and China) and the United States, as these countries are also of particular relevance to Portuguese bilateral trade in this industry. The methodology applies a static and a dynamic panel data analysis in order to resolve the problems of endogeneity and autocorrelation (see, for example Arellano and Bond, 1991; Arellano and Bover, 1995; Blundel and Bond, 1998, 2000). The panel is unbalanced due to the lack of information on some countries in all of the years analyzed.

Usually, the empirical studies of intra-industry trade (IIT) focus on a range of industries or countries (see, for example Aquino, 1978; Balassa 1986; Greenaway et al. 1984; Hummles and Levinsohn, 1995). Few empirical works analyze the IIT that occurs in one specific industry (see Tharakan and Kerstens, 1995; Sharma, 2002, Kimura et al. 2007; Clark 2006, Majkovič and Turk, 2007).

The recent trend of globalisation has given rise to a new paradigm in international economics, i.e. the fragmentation theory (see Jones and Kierzkowski, 1990). The trade in medical and optical instruments between different units of multinational corporations is a good example of the fragmentation of the production and of the emergence of IIT through the multinational firms. In the empirical studies about fragmentation of production the dependent variable commonly used is the vertical IIT index. However, as Portuguese IIT is mainly of the vertical IIT (VIIT) type, this variable can also be used as variable proxy measuring the trade between parts and components (see, Leitão and Faustino, 2009; Kierzkowski, 2009).

The results presented in this paper for this specific industrial sector are generally consistent with the expectations of intra-industry trade studies. The remainder of the paper is organised as follows: Section 2 presents the theoretical background; Section 3 presents the measurement of intra-industry trade, Section 4 displays the econometric model; Section 5 presents the estimation results; and the final section provides the conclusions.

II. LITERATURE REVIEW

The traditional trade theories are based on constant returns to scale, homogenous product and perfect competition (Ricardian and Heckscher-Ohlin trade theory). These theories could explain inter-industry trade based on comparative advantages. The pioneering works on IIT (Krugman, 1979, 1980, 1981; Lancaster 1980; Helpman 1981) exclude the idea that traditional theories could explain IIT.

The models of IIT (Krugman, 1979; Lancaster, 1980; Helpman, 1981; Brander and Krugman, 1983; Eaton and Kierzkowski, 1984) are based on monopolistic competition and increasing returns. The Neo-Chamberlinian models, such as the Krugman models, consider the assumption that all varieties enter the utility function symmetrically. By contrast, the neo-Hotelling model, for example, the Lancaster model, assumes asymmetry.

In these models, each variety is produced under decreasing costs and when the countries engage in trading, the similarity of the demands leads to intra-industry trade. This hypothesis of similarity of demands to explain trade between similar countries was first considered by Linder (1961). When product differentiation is considered, we have two types of differentiation and different models of IIT. Horizontal differentiation, or differentiation by attributes other than quality, gives rise to the horizontal IIT models, whereas vertical differentiation – differentiation by quality – originates the vertical IIT models. These models have different underlying determinants (Greenaway et al., 1994, 1995). Vertical IIT can be explained by traditional trade theories (see Davis, 1995). Falvey (1981), Falvey and Kierzkowski (1984), Shaked and Sutton (1984) and Flam and Helpman (1987) introduced the vertical differentiation models. The vertical IIT indexes are also used to measure the fragmentation of the production.

Horizontal differentiation is more likely between countries with similar factor endowments and horizontal IIT cannot be explained by traditional trade theories. The pioneering Krugman models consider that the products are horizontally differentiated. Brander and Krugman (1983) used a Cournot formulation to explain the intra-industry trade. The authors demonstrated that it is possible to explain IIT by reciprocal dumping.

As IIT encompasses both vertical IIT and horizontal IIT, we can test if the factors that explain comparative advantages – differences in relative factor endowments – also explain IIT(Buturac and Rajh, 2006).

III. MEASUREMENT OF INTRA-INDUSTRY TRADE

The level of IIT is generally measured by the so-called Grubel and Lloyd (1975) index. They defined IIT as the difference between the trade balance of industry i and the total trade of this same industry. In order to make the comparison easier between industries or countries, the index is presented as a ratio in which the denominator is total trade.

$$IIT_i = 1 - \frac{\left|X_i - M_i\right|}{\left(X_i + M_i\right)} \Leftrightarrow IIT_i = \frac{\left(X_i + M_i\right) - \left|X_i - M_i\right|}{\left(X_i + M_i\right)} \quad (1)$$

The index is equal to 1 if all trade is of the intra-industry trade type. If IIT is equal to 0, all trade is inter-industry trade.

IV. ECONOMETRIC MODEL

The dependent variable used is the IIT Grubel and Lloyd (1975) index in medical and optical instruments. It is calculated with the disaggregation of five digits CAE (Economic Activities Classification) of the medical and optical instruments. The data sources for the explanatory variables are the World Bank, World Development Indicators (2008). The source used for the dependent variable was INE, which is the Portuguese National Institute of Statistics.

A. EXPLANATORY VARIABLES AND HYPOTHESIS

Linder (1961) considers that countries with similar demands will trade similar products. So, the Linder (1961) hypothesis suggests a negative sign for the coefficient of the variable GDP (differences in per capita GDP). Linder (1961) uses per-capita income differences as a proxy for consumer tastes and preferences. It has been argued that as per capita incomes of two countries become equal, the tastes and preferences of their respective consumers also become similar. Hence, the share of IIT rises as the difference in per-capita income declines. Helpman and Krugman (1985) consider differences in per-capita income as a proxy for differences in the capital-labour ratio. As per-capita income reflects both the demand and supply sides, Hummels and Levinshon (1995) alternatively employ per-capita income and factor ratios. In this paper, we consider different variables for demand and supply sides.

Hypothesis 1: There is a negative correlation between differences in per-capita and IIT

This is the Linder (1961) hypothesis. Linder did not consider the concept of IIT. However, his theory may be used to explain this type of trade.

LogDGDP is the logarithm of absolute difference in per-capita GDP (PPP, in current international dollars) between Portugal and the trading partner. Loertscher and Wolter (1980) suggest a negative sign for the IIT model.

Hummels and Levinshon (1995) and Greenaway,et al. (1994) found a negative sign. The studies of Fertö and Soós (2008) also found a negative sign.

Hypothesis 2: IIT occurs more frequently among countries that are similar in terms of factor endowments.

This hypothesis is based on Krugman (1979, 1980), Bergstrand (1983), Helpman and Krugam (1985), Helpman (1987) and Hummles and Levinsohn (1995).

LogEP is a proxy for differences in physical capital endowments. It is the logarithm of the absolute difference in electric power consumption (Kwh per capita) between Portugal and its partners.

Zhan et al. (2005) and Blanes (2006) found a negative relationship between differences in endowments and intra-industry trade.

We also use EUx EP as a multiplicative dummy variable to distinguish between European partners and other countries. EU is a dummy variable that equals 1 if the country is a European trading partner and 0 otherwise. A negative sign is expected.

Hypothesis 3: There is a positive relationship between the lowest value of GDP per capita and IIT.

The variables (LogMinGDP, and LogMaxGDP) are included to control for relative size effects. The theoretical models of Helpman and Krugman (1985), Flam and Helpman (1987) indicate s suggest a negative (positive) sign for LogMinGDP (LogMaxGDP).

LogMinGDP is a proxy to control for relative size effects. It is the logarithm of lowest value of GDP per capita (PPP, in current international dollars) between Portugal and trading partner.

Helpman (1987), Hummels and Levinsohn (1995), Egger et al. (2007), and Leitão (2011a) found a positive sign, as is theoretically expected.

Hypothesis 4: There is a negative relationship between the highest value of GDP per capita and IIT.

LogMaxGDP is also a proxy to control for relative size effects. It is the logarithm of highest value of GDP per capita (PPP, in current international dollars) between Portugal and trading partner. A negative sign is consistent with the hypothesis that the more similar countries are in economic dimension, the greater the IIT between them (see Hummels and Levinsohn, 1995).

Hypothesis 5: IIT will be greater when trading partners are geographically close.

LogDIST is the logarithm of geographical distance between Portugal and the partner country.

The theoretical models of Krugman (1979), Lancaster (1980), Helpman (1981), Brander and Krugman (1983) can be used to justify the geographical proximity between countries as an explanatory variable of IIT. However, is the gravitacional model that is often used to introduce distance between countries as an important determinant of the IIT (see, Anderson 1979). Following the empirical studies, we use the number of kilometres between the capital cities of trading partners. This proxy is usually as transport cost, or market access barriers. In accordance with the literature the empirical studies, we expected a negative sign (Cieslik 2005; Blanes 2006; Badinger and Breuss, 2008, Leitão 2011b).

B. MODEL SPECIFICATION

Considering these hypotheses, we decided to specify the following econometric model:

$$IIT_{it} = \beta_0 + \beta_1 X_{it} + \delta t + \eta_i + \varepsilon_{it} \quad (2)$$

Where IIT is the Portuguese IIT index, X is a set of countries and industry-specific explanatory variables in logs; η_i is the unobserved time–invariant specific effects; δt captures a common deterministic trend; ε_{it} is a random disturbance assumed to be normal, and identically distributed (IID) with E (ε_{it}) =0 and Var(ε_{it})= ^{2} >0.

The model can be rewritten in the following dynamic representation:

$$IIT_{it} = \rho IIT_{it-1} + \beta_1 X_{it} - \rho\beta_1 X_{it-1} + \delta t + \eta_i + \varepsilon_{it} \quad (3)$$

Since IIT is an index varying between zero and one, we apply a logistic transformation to IIT, as in Hummels and Levinsohn (1995). We decided against using the fixed-effects estimator, because some relevant variables such as distance do not vary along the time. We control for time effects by including a time dummy variable, while the regression coefficients in the static model are estimated using OLS with time dummies.

V. EMPIRICAL STUDIES

In the empirical study, we present the results with country characteristics as explanatory variables. Table 1 shows the results of panel unit root test (ADF- Fischer Chi-square). The main variables such as the intra-industry trade (LogIIT), electric power consumption (LogEP), the lowest value of GDP per capita (LogMinGDP), and the higher value of GDP per capita (LogMaxGDP) do not have unit roots, i.e are stationary with individual effects and individual specifications.

TABLE 1 – PANEL UNIT ROOT TEST RESULTS (INTERCEPT AND TREND)

ADF- Fischer Chi-square	***Statistic***		***Prob***
LogIIT	93.32		0.00
LogEP	151.79		0.00
LogMinGDP	238.59		0.00
LogMaxGDP	211.39	0.00	

Source: Authors calculation

In Table 2, we present the OLS estimator with time dummies. Our analysis is intended to evaluate the signs of the coefficients and the statistical significance of the explanatory variables. The differences between per-capita incomes (LogDGDP), the difference in electricity consumption (LogEP) in Kwh per capita, the higher value of GDP per capita (LogMaxGDP), the geographical distance (LogDIST) and the multiplicative dummy variables (EUxEP) are all statistically significant and their coefficients have the expected sign, except the variable LogDGDP. The model presents five statistically significant variables (LogDGDP, at 5%), electric power consumption (LogEP, at 10%), the higher value of GDP per capita (LogMaxGDP, at 5%), the geographical distance (LogDIST, at 10%), and EUxEP (at 1%).

The difference between per-capita incomes (LogDGDP) presents a positive sign. This result suggests that the higher the difference in GDP per capita (PPP, in current international dollars) between Portugal and the European trading partner, the higher will be IIT in the medical and optical instrument sector. As Portuguese IIT is mainly of the vertical IIT (VIIT) type, this can explain the positive sign coefficient of this variable. The IIT encompasses both horizontal IIT(HIIT) as VIIT. When VIIT is predominant the effect on VIIT is similar to the effect on IIT. Following Falvey and Kierzkowski (1987), the paper introduces a variable proxy for the difference in factor endowments (electric power, LogEP). This variable presents a negative sign, confirming the theoretical forecast suggested by Hummels and Levinsohn (1995). Our results validate the hypothesis: IIT in this industry occurs more frequently among countries that are similar in terms of factor endowments.

Based on Helpman and Krugman (1985) and Hummels and Levinsohn (1995), this paper also includes two variables to control for relative size effects. Only the higher value of GDP per capita (LogMaxGDP) has the expected negative sign.

The geographical distance (LogDIST) presents a negative correlation, confirming the results of Badinger and Breuss (2008). The greater the distance between partners, the lower will be the IIT in the industry. For the proxy EUxEP, we expected a negative coefficient and the estimated sign is negative. We can consider that IIT in this specific industry occurs more frequently among countries that belong to the same integration area. Thus, the integration process reinforces the IIT in the medical and optical instrument sector.

TABLE 2 – INTRA-INDUSTRY TRADE : OLS ESTIMATOR WITH TIME DUMMIES

Variables	*Coef.*	*Signs*
LogDGDP	0.646 (2.27)**	(-)
LogEP	-0.716 (-1.80)*	(-)
LogMinGDP	2.193 (0.826)	(+)
LogMaxGDP	-4.914 (-2.06)**	(-)
LogDIST	-1.296 (-1.91)*	(-)
EUxEP	-0.554 (-3.52)***	(-)
C	5.070 (0.567)	
N	146	
$\overline{R^2}$	0.18	

T-statistics (heteroskedasticity corrected) are in round brackets.
***/**/*-statistically significant at the 1%, 5% and 10% levels

Source: Authors calculation

As in the studies of Faustino and Leitão (2006, 2007), we decide to present the determinants of intra-industry trade using the GMM-System estimator, because the dynamic analysis resolve the problems of endogeneity and serial correlation.

The equation presents consistent estimates, with no serial correlation (M1, M2 statistics). The specification Sargan test shows that there are no problems with the validity of the instruments used. For equations in first differences the instruments in levels used are: (LogIIT

(2,7), Log DGDP(2,7), LogEP(2,7). For levels equations, the instruments used are first differences of all variables lagged t-1.

The equation presents five significant variables (IIT_{t-1}, LogDGDP,LogEP, LogDIST, UExEP). As expected, the lagged dependent variable is positive.

The proxy LogDGDP presents a positive sign and is significant at the 1% level. This positive coefficient result was not expected.

The electric power consumption (LogEP) presents a negative sign, confirming the other empirical studies (see, for example, Zhan et al. 2005).

TABLE 3 – INTRA-INDUSTRY TRADE : GMM-SYSTEM

Variables	*Coef.*	*Signs*
IITt-1	0.324 (3.57)***	(+)
LogDGDP	0.8194 (3.27)***	(-)
LogEP	-1.175 (-2.21)**	(-)
LogMinGDP	0.839 (0.430)	(+)
LogMaxGDP	-1.893 (-1.03)	(-)
LogDIST	-2.853 (-1.97)*	(-)
EUxEP	0.627 (2.39)**	(-)
C	-6.292 (-0.554)	
N	125	
M1	[0.302]	
M2	[0.952]	
Sargan	[1.000]	

Source: Authors calculation

T-statistics (heteroskedasticity corrected) are in round brackets. ***/**/*-statistically significant at the 1%, 5% and 10% levels. P-values are in square brackets. Year dummies are included in specification (this is equivalent to transforming the variables into deviations from time means. M1 and M2 are tests for first-order and second-order serial correlation in the first-differenced residuals, asymptotically distributed as N (0,1) under the null hypothesis of no serial correlation (based on the efficient two-step GMM estimator). Sargan is a test of over-identifying restrictions asymptotically distributed as χ^2, under the null of instruments' validity (with two-step estimator).

The geographical distance variable (LogDIST) - a typical gravity model variable- is used as a proxy for transport cost. The negative sign of this coefficient was expected and the results confirm the static result. Badinger and Breuss (2008) and Clark (2006) also found a negative sign.

EUxEP is a multiplicative dummy variable used to stress the role of economic integration. A negative effect of difference in factor endowments on bilateral intra-industry trade was expected for the European partners and the results do not confirm this expectation. This deserves further research considering separation between HIIT and VIIT, because these two types of trade in optical and medical instruments may have different determinants.

VI. CONCLUSIONS

The objective of this study was to estimate the determinants of intra-industry trade in the medical and optical instruments sector and to analyse whether the results for this specific industry confirm previous results for all industries. Econometric estimations support the hypotheses formulated and confirm that the IIT for the medical and optical instrument sector is well explained by the differences in per-capita income, differences in factor endowments and distance.

Our results are robust with static and dynamic panel data. IIT in medical and optical instrument occurs more frequently among countries that are similar in terms of relative factor endowments and are members of the same regional integration agreement. Moreover, this trade increases if the partners are geographically close. However, the relevance of economic integration deserves more investigation EUxEP is a multiplicative dummy variable used to stress the role of economic integration. This deserves further research considering separation between HIIT and VIIT, because these two types of trade in optical and medical instruments may be different determinants.

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INTRAINDUSTRIJSKA TRGOVINA U INDUSTRIJI MEDICINSKIH I OPTIČKIH INSTRUMENATA: ANALIZA PANEL PODATAKA

SAŽETAK

Rad analizira determinante intraindustrijske trgovine u medicinskom i optičkom sektoru u Portugalu koristeći analizu statičkih i dinamičkih panel podataka. Rezultati sugeriraju da se intraindustrijska trgovina medicinskih i optičkih instrumenata češće događa među zemljama koje su slične po pitanju relativnih proizvodnih faktora te su članovi istog regionalnog ugovora o integraciji. Osim toga, ova trgovina raste ako su partneri geografski blizu.

Ključne riječi: intraindustrijska trgovina, dinamički panelni podaci, panelni test jediničnog korijena

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A NEW SOLUTION TO THE PUZZLE OF FIFTY-FIFTY SPLIT IN SHARECROPPING

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ABSTRACT

This paper mainly discusses the puzzle of fifty-fifty split in sharecropping through an improved principal-agent moral hazard framework. Greatly different from the existing literature, this paper finds a new solution to the puzzle of fifty-fifty split in sharecropping. Equal division between the landowner and the tenant regardless of the land's fertility is incentive compatible, and at the same time the landowner could lease out more fertile land to the relational tenant to improve his utility by using the right of priority. Although fifty-fifty split in sharecropping happens to be fair and comes to be taken for granted as a norm, it is an efficient contractual arrangement in essence.

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I. INTRODUCTION

Sharecropping is an important research area in agricultural economics. Marshall (1920) argues that sharecropping is inefficient because the tenant is paid only a percentage of marginal product. However, sharecropping is prevailing in agriculture in many regions around the world (Cheung, 1968, 1969a, 1969b; Byres, 1983; Bardhan, 1984; Garrett and Xu, 2003). This phenomenon has greatly bewildered economists and many theoretical explanations have been put forward. According to Pi (2011), these explanations can be mainly categorized into four strands. The first strand of literature focuses on risk sharing, which holds that risk dispersion makes sharecropping a dominant arrangement under some conditions (Cheung, 1969a, 1969b; Stiglitz, 1974; Braverman and Stiglitz, 1982; Sen, 2011). The second strand of literature centers on self-selection effects, which supports that sharecropping can effectively tackle the tenant's adverse selection problem (Hallagan, 1978; Allen, 1982). The third strand of literature concentrates on moral hazard, which stresses that sharecropping can handle different types of opportunistic behavior on the part of the landlord or the tenant under different restraints (Eswaran and Kotwal, 1985; Agrawal, 1999; Laffont and Matoussi, 1995; Ghatak and Pandey, 2000; Dubois, 2002). The fourth strand of literature gives prominence to limited liability, which shows that limited liability plays a key role in determining the emergence of sharecropping (Basu, 1992; Sengupta, 1997; Ray and Singh, 2001; Dam and Pérez, 2012). Although the existing mainstream literature sheds some light on the prevalence of sharecropping, it neglects the reason behind the puzzle of fifty-fifty split in sharecropping to a great degree. The fact is that most sharecropping contracts specify to divide the crop equally between the landowner and the tenant regardless of the fertility of the land (Zhao, 2000a; Young and Burke, 2001; Bowles, 2004). For example, equal division in sharecropping has been prevalent in traditional China for more than two thousand years (Zhao, 2000a, 2000b).

According to Bowles (2004, p.94), "The puzzle of fifty-fifty sharecropping is the following: an equal split of the crop means that tenants on fertile land will have higher payoffs to their effort and other inputs than those on poor land. But if tenants are willing to work for the lower returns on the less good land, why should the owners of good land concede half of the crop to their tenants? The conventional economic theory of sharecropping predicts that the owner will capture the returns to land quality through variations in the crop share (Stiglitz, 1974). But Burke and Young (2000) show that the Illinois sharecropping contracts allow the tenants on good land to capture a third of the differential return attributable to land quality, effectively transferring millions of dollars from owners to farmers. A plausible interpretation of these facts is that farmers and owners around the world have hit on fifty-fifty as a seemingly fair division, and that attempts by owners to capture all of the returns to high quality land through the use of variable shares would be defeated by the tenants' retaliation. If true, this interpretation suggests that a predisposition to fairness, as well as the desire to punish those who violate local norms, may be motives as powerful as profit maximization and the pursuit of individual gain." Zhao (2000a) provides another solution to the puzzle of fifty-fifty split in sharecropping which focuses mainly on the reduction of transaction cost in the crop distribution. In the case of equal division, there is no need for the landowner and the tenant to meter the crop exactly, which avoids all the troubles related to metering. The reason behind this point is as follows. When the crop is divided into two seemingly identical piles, the landowner and the tenant choose one of them by casting lots.

Because both the landowner and the tenant do not know which pile will be picked up by themselves, the crop must be divided into two parts as fairly as possible ex ante. Zhao (2000a) looks upon 50% as a magic number which could play a bizarre role, and it is just this role that makes equal division become a norm in practice.

Greatly different from Bowles (2004) and Zhao (2000a), in this paper we show that equal division between the landowner and the tenant regardless of the land's fertility is incentive compatible, and that the landowner could lease out more fertile land to the relational tenant to improve his utility. Equal division not only expresses a relationship of fairness between the landowner and the tenant, and at the same time not only reflects the power of local norms, but also actually stands for the result of an efficient contractual arrangement. Reducing the tenant's share on more fertile land would cause the tenant to exert less effort, which in turn decreases the landowner's utility. The landowner tends to cultivate more fertile land by himself if he has enough physical vigor or to lease out more fertile land to the relational tenant if he has close relatives. This phenomenon often took place in China's history, which just illustrates that the landlord could reduce rent dissipation in Bowles' (2004) sense by using his right of priority (Zhang, 1984; Gao and Yang, 2008). This paper argues that it is fairness that gets a free ride from efficiency, not vice versa.

The rest of the paper is organized as follows. Section II is the basic setup. Section III provides the model of formal sharecropping. Section IV offers the model of relational sharecropping. Section V conducts a comparative analysis of the outcomes derived from two different models. Section VI gives some empirical evidences. Some concluding remarks are made in Section VII.

II. THE BASIC SETUP

In this section, we follow Laffont and Martimort (2002) and Bolton and Dewatripont's (2005) analytical framework. In a principal-agent game with moral hazard, the landowner and the tenant are both risk-neutral.If the tenant exerts effort level e, the land's added-value (also called crop here) will be $V>0$ with probability e, where e is normalized to $e\in[0,1]$.

The tenant's private cost when he exerts effort e is:

$$\Psi(e)=\frac{c}{2}e^2 \tag{1}$$

Here, $c>0$ can be seen as a parameter to capture the land's fertility. The more fertile the land is, the less the value of c is. It is should be noted that there is other parameters that could depict the land's fertility. For example, we can introduce a parameter $k>0$ which affects V. That is, the land's added-value (also called crop here) will be kV. The more fertile the land is, the bigger the value of k is. Although we adopt the parameter c in this paper, the use of the parameter k will not have an essential effect on our new solution to the puzzle of fifty-fifty split in sharecropping.

In order to make our analysis interesting, $\frac{V}{c}$ is normalized to $\frac{V}{c} \in (0,1)$.

The landowner and the tenant sign a share contract which specifies that the landowner gets $1-\alpha$ proportion and the tenant gets α proportion, where $0<\alpha<1$. According to Otsuka et al. (1992), this is a "pure" share contract since the fixed payment is set equal to zero, and at the same time it is also known as the most common form of sharecropping tenancy in practice.

Under the formal sharecropping, both the landowner and the tenant are selfish, and the signed share contract is arm's length. Here, we use the words "formal" and "selfish" in the sense that both the landlord and the tenant do not care about the other side's sharecropping share. In Beckerian (1976) language, the other side's sharecropping share does not enter into the utility function of one's own side. In this case, the landowner and the tenant's utility functions are respectively:

$$U_L^F = (1-\alpha)eV \tag{2}$$

$$U_T^F = \alpha eV - \frac{c}{2}e^2 \tag{3}$$

Throughout the paper, the superscript F denotes the formal sharecropping, and the subscripts L and T stand for the landowner and the tenant, respectively

Under the relational sharecropping, both the landowner and the tenant are tied down to a mutual relation, which results in some kind of altruistic behavior between them in the sense of kinship. Sadoulet et al. (1997) stress that the relation between the landowner and the tenant plays an important role in providing the incentive for cooperative behavior in sharecropping among kin. The relation strength is set as μ, where $0<\mu<1$. $\mu \to 0$ implies that the landowner and the tenant are almost completely selfish, and $\mu \to 1$ means that the landlord and the tenant are almost completely altruistic. On the basis of Khalil (2004), our paper adopts the egocentric perspective which belongs to the rationalistic theory of altruism. The egocentric view maintains that the altruist helps the other because the status of the other is incorporated in the altruist's utility function (see, e.g., Becker, 1976). As far as the mathematical treatment method is concerned, we follow Dur and Sol (2010) by introducing the separatable utility related to altruistic behavior. When the landowner is altruistic, his utility function includes both his own income and his concern for the tenant's sharecropping share. When the landowner is not altruistic, his utility function only includes his own income. The same logic is also applied to the tenant. It should be noted that Beckerian altruism in this paper is outcome-oriented, not pure-utility-oriented, because the focus of everyone's attention is only on the eventual sharecropping share and at the same time the effort exerted by the tenant can be simply seen as sunk cost.

In this case, the landlord and the tenant's utility functions are respectively:

$$U_L^R = (1-\alpha)eV + \mu\alpha eV \tag{4}$$

$$U_T^R = \alpha eV - \frac{c}{2}e^2 + \mu(1-\alpha)eV \tag{5}$$

Throughout the paper, the superscript R denotes the relational sharecropping.

III. FORMAL SHARECROPPING

When it is under the formal sharecropping, the landowner's programming problem will be:

$$\max_{\{\alpha\}}(1-\alpha)eV$$

$$s.t.\ e \in \arg\max\{\alpha eV - \frac{c}{2}e^2\} \tag{6}$$

$$\alpha eV - \frac{c}{2}e^2 \geq 0 \tag{7}$$

(6) and (7) are the tenant's incentive compatibility and participation constraints, respectively. It is easy for us to find that (7) is always satisfied.

From (6), we obtain:

$$e = \frac{\alpha V}{c} \tag{8}$$

Solving this programming problem, we get:

$$\alpha^{F*} = \frac{1}{2} \tag{9}$$

$$e^{F*} = \frac{V}{2c} \tag{10}$$

$$U_L^{F*} = \frac{V^2}{4c} \tag{11}$$

$$U_T^{F*} = \frac{V^2}{8c} \tag{12}$$

Throughout the paper, the superscript $F*$ stands for second-best state under the formal sharecropping.

It is easy for us to find that $\alpha^{F*}/(1-\alpha^{F*})$ is just equal to fifty-fifty under the formal sharecropping, and that α^{F*} and $1-\alpha^{F*}$ are not related to the land's fertility at all.

IV. RELATIONAL SHARECROPPING

When it is under the relational sharecropping, the landowner's programming problem will be:

$$\max_{\{\alpha\}}(1-\alpha)eV + \mu\alpha eV$$

$$s.t.\ e \in \arg\max\{\alpha eV - \frac{c}{2}e^2 + \mu(1-\alpha)eV\} \tag{13}$$

$$\alpha eV - \frac{c}{2}e^2 + \mu(1-\alpha)eV \geq 0 \tag{14}$$

(13) and (14) are the tenant's incentive compatibility and participation constraints, respectively. It is easy for us to find that (14) is always satisfied.

From (13), we obtain:

$$e = \frac{\alpha V + \mu(1-\alpha)V}{c} \tag{15}$$

Solving this programming problem, we get:

$$\alpha^{R*} = \frac{1}{2} \tag{16}$$

$$e^{R*} = \frac{(1+\mu)V}{2c} \tag{17}$$

$$U_L^{R*} = \frac{(1+\mu)^2 V^2}{4c} \tag{18}$$

$$U_T^{R*} = \frac{(1+\mu)^2 V^2}{8c} \tag{19}$$

Throughout the paper, the superscript $R*$ stands for second-best state under the relational sharecropping.

Similar to the case of the formal sharecropping, it is easy for us to find that $\alpha^{R*}/(1-\alpha^{R*})$ is just equal to fifty-fifty under the relational sharecropping, and that α^{R*} and $1-\alpha^{R*}$ are not related to the land's fertility at all.

V. A COMPARATIVE ANALYSIS

In this section, we will conduct a comparative analysis of the equilibrium outcomes under different modes of sharecropping.

By comparison, it is easy for us to obtain the following three propositions.

Proposition 1: In equilibrium, the landowner gets the same proportion whether under the relational sharecropping or under the formal sharecropping.

Proof: From (9) and (16), we obtain: $(1-\alpha^{R*}) - (1-\alpha^{F*}) = 0$.

Proposition 1 implies that fifty-fifty split is robust irrespective of sharecropping modes.

Proposition 2: In equilibrium, the tenant exerts more effort under the relational sharecropping than under the formal sharecropping.

Proof: From (10) and (17), we obtain: $e^{R*} - e^{F*} = \frac{\mu V}{2c} > 0$.

Proposition 2 implies that the relation it self can act as a tool to reduce the tenant's moral hazard.

Proposition 3: In equilibrium, both the landowner and the tenant obtain a more utility under the relational sharecropping than under the formal sharecropping.

Proof: From (11) and (18), we obtain: $U_L^{R*} - U_L^{F*} = \frac{(\mu^2 + 2\mu)V^2}{4c} > 0$.

From (12) and (19), we obtain: $U_T^{R*} - U_T^{F*} = \frac{(\mu^2 + 2\mu)V^2}{8c} > 0$.

Proposition 3 implies that the relation itself has a self-enforcing mechanism, which causes the landowner to hire the relational tenant and the tenant to seek the relational landowner with great eagerness. In Chinese language, there is a well-known proverb describing this phenomenon. It is said that "water beneficial to crops should not pass to other people's fields" ("feishui bu liu wairen tian" in Chinese). That is to say, "benefits should not be allowed to go to others."

Propositions 1-3 show that using the right of priority is an important step to increase the landowner's utility, and that the mechanism behind this process is just relational incentives (Zhang, 1984; Gao and Yang, 2008). However, there are two points that should be noted. Firstly, the landowner's number of relatives is generally limited. Secondly, the majority of the landowner's land is most likely of average quality. For example, Li (2006) find that the infertile land in China does not enter into the lease market at all. These two points can ensure that the landowner's priority right may not be exerted.

VI. EMPIRICAL EVIDENCES

Sharecropping contracts are very striking and popular in agriculture. Here we will show the relative importance of sharecropping from Zhao and Chen's (2006) historical data at the province level in China. The data were collected by the Central Research Institute of Agriculture and issued in 1935. Table 1 reflects that the tenants who adopted sharecropping contracts occupied a significant proportion of the total tenants.

According to Table 1, it is easy for us to find that the average of the sharecroppers' proportion in the surveyed 22 provinces is about 28.1%. This indicates that sharecropping is an important phenomenon worth being analyzed.

In practice, although 50% is benchmark number in sharecropping contracts, there are different possibilities in different situations. In the light of great complexities of actualities, it is not a surprise for us to find different outcomes (Shi, 1997, 1998; Gao, 2005; Long and Peng, 2010). However, our theoretical prediction is that the real-life sharecropping proportion will vary around 50% according to the landowner and the tenant's specific inputs. For example, if the landowner provides some inputs such as farm cattle, agricultural implements, seeds, and so on, then the tenant's sharecropping proportion will be less than 50% (Zhao, 2000a, 2000b; Zhang, 2006). However, if the tenant provides all the important inputs and offers a cash pledge to the landowner, then the tenant's sharecropping proportion will be larger than 50%. Inputs or cash pledges can be seen as proxies for shares in sharecropping contracts, which play an important role of addition or subtraction in mathematical sense. In short, our theoretical prediction is that in most circumstances the tenant's average sharecropping proportion will be in the neighborhood of 50%.

TABLE 1: THE SHARECROPPERS' PROPORTION IN DIFFERENT PROVINCES (1930)

Province	*Average Proportion (%)*	*Province*	*Average Proportion (%)*
Chahar	29.7	Henan	44.0
Suiyuan	45.7	Hubei	21.8
Ningxia	35.4	Sichuan	15.8
Qinghai	35.6	Yunnan	24.9
Gansu	34.5	Guizhou	50.5
Shaanxi	25.9	Hunan	18.4
Shanxi	26.7	Jiangxi	12.8
Hebei	26.1	Zhejiang	7.1
Shandong	39.1	Fujian	25.3
Jiangsu	19.5	Guangdong	17.7
Anhui	33.4	Guangxi	28.5

Source: Zhao and Chen (2006, p. 287)

Shi (1997, 1998), Zhao (2000a, 2000b), and Zhang (2006) show that equal division is the most popular form in sharecropping contracts in traditional China through multidimensional and thorough historical case studies. Zhao and Chen (2006) provide some historical data in China to prove the prevalence of equal division. Their data are contained in Table 2 as below.

TABLE 2:THE TENANT'S AVERAGE SHARECROPPING PROPORTION (1930)

Province	*Average Proportion (%)*	*Province*	*Average Proportion (%)*
Jiangsu	43.6	Shaanxi	46.9
Zhejiang	48.1	Gansu	41.0
Anhui	44.0	Qinghai	60.0
Hubei	42.5	Guangdong	44.7
Hunan	49.1	Guangxi	43.8
Hebei	47.5	Yunnan	45.1
Shandong	53.8	Chahar	35.0
Shanxi	51.4	Suiyuan	37.5
Henan	49.9		

Source: Zhao and Chen (2006, p. 287)

According to Table 2, it is easy for us to find that the tenant's average sharecropping proportion in most of the surveyed 17 provinces is about 50%. If we average all the related proportions in the seventeen provinces, we can obtain 46.1%.

VII. CONCLUDING REMARKS

This paper mainly discusses the puzzle of fifty-fifty split in sharecropping through an improved principal-agent moral hazard framework. Greatly different from the existing views, this paper finds a new solution to the puzzle of fifty-fifty split in sharecropping. Equal division between the landowner and the tenant regardless of the land's fertility is incentive compatible, and at the same time the landowner could lease out more fertile land to the relational tenant to improve his utility by using the right of priority. Although fifty-fifty split in sharecropping happens to be fair and comes to be taken for granted as a norm, it is an efficient contractual arrangement in essence. As far as equal division in sharecropping is concerned, it is fairness that gets a free ride from efficiency, not vice versa. In a word, this paper provides a new perspective on the puzzle of fifty-fifty split in sharecropping, which focuses mainly on the role of incentive systems in agricultural land lease contracts.

We should pay much closer attention to three respects on the basis of our findings. Firstly, the kinship-based relation plays an important role in sharecropping. The landowner has the incentive to hire the relational tenant. Secondly, equal division in sharecropping will influence the landowner's choice between different contractual arrangements in agriculture. Thirdly, there are different variants of fifty-fifty split in sharecropping because the landowner and the tenant may provide different specific inputs, but the existence of different variants could not deny that equal division is a benchmark in incentive compatible sense.

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NOVO RJEŠENJE ZAGONETKE DIJELJENJA POLA-POLA U NAPOLIČARENJU

SAŽETAK

Ovaj rad uglavnom analizira zagonetku dijeljenja po pola u napoličarenju putem poboljšanog okvira moralnog rizika na relaciji principal-agent. Vrlo različit od postojeće literature, ovaj rad nalazi novo rješenje zagonetke podjele po pola u napoličarenju. Jednaka podjela između vlasnika zemlje i zakupca bez obzira na plodnost zemlje je kompatibilna s poticajima dok istovremeno vlasnik zemlje može iznajmiti plodniju zemlju odnosnom zakupcu kako bi poboljšao svoj položaj koristeći pravo prvenstva. Iako je podjela pola-pola u napoličarenju pravedna i uglavnom se uzima zdravo za gotovo kao norma, u biti je to efikasan ugovorni odnos.

Ključne riječi: zagonetka dijeljenja pola-pola, napoličarenje, moralni rizik, odnos

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DESIGN OF PRODUCTS WITH BOTH INTERNATIONAL AND LOCAL PERSPECTIVES BASED ON YIN-YANG BALANCE THEORY AND SWARA METHOD

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ABSTRACT

Producing and designing products are keys of success and have a critical role in industries. This research presents a new framework for special situations using *Yin-Yang* balance (YYB) theory in producing and designing products with new perspectives. This paper considers general situations in producing products for international producers and industries. SWARA method is applied for prioritizing important criteria of this issue. Six criteria of this research based on their priority were considered as important: general features of each product and applications, cost control and final pricing policies, appearance with moderate perspective, marketing researches in details, identifying target markets in details and special attention to production capabilities. This framework can be modified regarding the needs.

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I. INTRODUCTION

In today's dynamic and competitive market environment, NPD (new product development) managers as well as design managers have had to rethink how best to manage design and to integrate the various disciplines involved throughout the NPD process (marketing, marketing research, research and development (R&D), industrial design, engineering, and so forth) (Veryzer and Borja de Mozota, 2005).

One opportunity for gaining diverse advantages in the marketplace is product design (Lobach, 1976; Kotler and Rath, 1984; Lorenz, 1986; Hammer, 1995;Veryzer, 1995; Creusen and Schoormans, 2005).

Product design influences consumer preference in different ways (Bloch, 1995).Product developing as a costly and time consuming preface to the introduction of new products has been studied by practitioners and academics in both marketing and engineering design (Michalek*et al*., 2005). In the academic literature, a number of models has been proposed to provide product planners with information relating to consumer needs or "value systems," as well as to capitalize on synergies in the production process itself (Michalek*et al*, 2005).

It has been long recognized that as competition augments and technological differentiation becomes more difficult, design specifically what is referred to as industrial design offers an efficacious way to position and differentiate products (Borja de Mozota, 1985, 1990; Lorenz, 1986; Hayes, 1990; Hetzel, 1993; Veryzer and Borja de Mozota, 2005).

Some studies enter in to consideration of the influence of good product design on commercial success (Black and Baker, 1987; Bruce and Whitehead, 1988; Roy, 1994; Thackara, 1997; Gemser and Leenders, 2001; Creusen and Schoormans, 2005).

Which product design will lead an organization to commercial success? Being able to outline some guidelines that can be used in NPD, it is necessary to look at the role of product design in consumer evaluation. First, it must be discerned that this role is intricate and different (Creusen and Schoormans, 2005).

The product which looks aesthetically pleasing attracts buyers' attention and since the incitation of product design on consumer evaluation is often complicated, it is difficult to decide upon during the product development process. For example, a product with bright colors may be valued aesthetically, but these same colors may give consumers the idea that the product has a low quality (Creusen and Schoormans, 2005).

It has been realized that effective integration of cross-functional processes has a considerable influence on the success of NPD (Luo *et al*, 2005). Extant research has shown that effective integration can have a positive impact on product development cycle time (Griffin, 1997; Urban *et al*, 1997; Sherman *et al*, 2000), project performance (Griffin and Hauser, 1992; Olson *et al*,2001), and overall company and market performance (Griffin and Hauser, 1996; Gemser and Leenders, 2001; Tatikonda and Montoya Weiss, 2001; Luo *et al*, 2005).

The key characteristic of a cross-functional approach is that a large number of criteria contributed to the design must be considered precisely. Among these criteria, some are specific and unique to individual functions, and some are common across functions. Typically, many of these criteria are interrelated and affect the design decisions that fall under the domain of the different functions. The power of a cross-functional approach cannot be harnessed unless all

these criteria and their interrelationships are systematically considered and are accounted for in the design development. Thus, an effective and efficient method must be utilized for considering and integrating these criteria to decrease the time and cost of developing design prototypes (Luo *et al*, 2005).

This, along with the trends of increasing complexity and aestheticization of everyday products, has made design an important element in the development of products (Bucci, 1998; Cova and Svanfeldt, 1993; Maffesolli, 1993; Borja de Mozota, 2003; Veryzer and Borja de Mozota, 2005). In fact "design is the criterion that will often donate a company its competitive advantage" (Kotler, 2003, p. 321).

Despite design has been widely considered as an important strategic variable, there has not been much studies on the topic of design, and little progress has been made in furthering our understanding of the NPD process with regard to this "potent" marketing variable. Traditionally, industrial design had been viewed as a service either within an organization or as contracted consulting rather than as a strategic business resource (Veryzer and Borja de Mozota, 2005).

As consumer products technologically become increasingly efficient, human behaviour has a weak connection with individual products and services which shows the weak perception of real application and purposes. We buy 'energy-saving' lights and then leave them on all night, boil a kettle-full of water even though we only need a mug-full, and stick with the default setting on the washing machine, afraid of investigating the others (Lockton *et al*, 2009a).

Lot of authors (Lilley *et al*. 2005, 2006, 2009; Rodriguez & Boks 2005; Elias *et al*. 2007, 2009; Bhamra *et al*. 2008; Lockton*et al*. 2008b, 2009b; Wever*et al*. 2008; Pettersen & Boks 2008) have begun to develop the field of 'design interventions' applicable by designers as responses to user behaviour 'problems', particularly environmental, but also 'pro-social' behaviour generally. The Design with Intent method, briefly introduced in this paper, aims to complement and support these approaches, addressing the deficiency mentioned above, by suggesting relevant design techniques for influencing types of behaviour, and bringing examples of how similar problems have been addressed elsewhere (Lockton *et al*, 2009a).

Defining 'Design with Intent' (DwI) as 'design intended to influence or result in certain user behaviour', the authors have reviewed examples from a variety of disciplines (Lockton*et al*, 2008a, 2008b), supported by a blog website and more recently an on-going survey of designers, receiving comments, suggestions and examples from readers around the world, and incorporated this analysis into a tool for designers, the Design with Intent Method (Lockton *et al*, 2009a).

Yin-Yang is a unique Chinese duality thinking bearing some resemblance to the dialectical thinking in the West. 'Dialectical thinking is considered to consist of sophisticated approaches toward seeming contradictions and inconsistencies' (Peng and Nisbett, 1999: 742).

The Chinese have a long-standing reputation for being 'dialectical thinkers' (Peng and Nisbett, 1999: 743) whose reasoning differs from the formal logic dominating the Western philosophical tradition (Needham, 1956; Graham, 1986). *Yin-Yang* captures the Chinese view of paradox as independent opposites compared with the Western view of paradox as exclusive opposites (Chen, 2002). Based on the indigenous Chinese philosophy of *Yin-Yang*, *I* conceptualize culture as possessing inherently paradoxical value orientations, thereby enabling it to embrace opposite traits of any given cultural dimension. *I* posit that potential paradoxical values coexist in any culture and they give rise to, exist within, reinforce, and complement each other to shape the holistic, dynamic, and dialectical nature of culture (Fang, 2011).

The main aim of this study is to apply *YYB* theory in product design with new perspective. Some products are presented with different features in internal and external markets while some of them can be produced and introduced and delivered in both markets without any need to change in their features. In regard to this purpose, authors believe that *YYB* can be useful in product producing and designing. *YYB* is a powerful theory with high ability to consider issues with two perspectives about localization and globalization. *YYB* theory can be functional in many industries and can be applied for the aim of decreasing costs and increasing product diversity.

SWARA method is a new and powerful method that was presented in 2010 (Kersuliene *et al*, 2010). SWARA method can be applied to help researchers who don't have access to information for different reasons. In this research SWARA will apply for identifying important criteria that are critical and vital in producing products with *YYB* perspective. Finally, this research gives a general framework to companies and organizations for applying this research in managing their products.

II. YIN-YANG BALANCE (YYB)

Against the aforementioned backdrop, a duality (dialectical) thinking embedded inthe indigenous Chinese philosophy of *Yin-Yang* is explained to understand culture (Fang, 2011). The Chinese world view is holistic, dynamic, and dialectical (Li, 1998, 2008; Peng and Nisbett, 1999; Chen, 2002). This world view is best embodied by *Yin-Yang*, an ancient Chinese philosophical principle, and arguably the best-known symbol in East Asia (Cooper, 1990). The *Yin-Yang* symbol is denoted by a circle divided into two equal halves by a curvy line, one side of which is black (*Yin*) and the other white (*Yang*). According to the *Yin-Yang* philosophy, all universal phenomena are shaped by the integration of two opposite cosmic energies, namely *Yin* and *Yang*. *Yin* represents the 'female' energy, such as the moon, night, weakness, darkness, softness, and femininity; while *Yang* stands for 'male' energy, such as the sun, day, strength, brightness, hardness, and masculinity (Figure 1). The white dot in the black area and the black dot in the white area connote coexistence and unity of the opposites to form the whole. The curvy line in the symbol signifies that there are no absolute separations between opposites. The *Yin-Yang* principle thus embodies duality, paradox, unity in diversity, change, and harmony, offering a holistic approach to problem-solving (Chen, 2002).

Figure 1.YIN-YANG SYMBOL

There are different views on the origin of the *Yin-Yang* philosophy. Chen (2008) elaborated the historical and philosophical characteristics of *Yin-Yang* in his analysis of the Chinese concept of *bian*(change) in the well-known Chinese classic *I Ching* (also known as the *Book of Changes*), whose history can be traced back over 3000 years ago (Lee, 2000). For centuries the minds of Chinese elites have been fascinated by the question 'What is the fundamental

principle of the universe'? Chen (2008: 7–9) explained that the answer lies in the discourse on the concept of *bian*(change) which relies on the dialectical interaction of *Yin* and *Yang*.

In Chinese intellectual pursuit, the concept of change was mainly stipulated in the ancient Chinese writing, *I Ching,* or the *Book of Changes*. The concept of change not only gives *I Ching*its name but also formulates its system of thought. . . . *I* is comprised of *Sun* and *Moon*. The sun represents the nature of *Yang*, and the moon the nature of *Yin*. Together, the interaction of sun and moon comes to the emphasis of *Yin* and *Yang* in *I Ching*... Change as a fundamental principle of the universe forms ontological assumptions of the Chinese philosophy and was further developed into a set of guidelines for Chinese beliefs and behaviours. *Change discourse* naturally became the central focus in early Chinese discursive practices ... According to *I Ching*, the formation of change relies on the dialectical interaction of *Yin* and *Yang*, the two opposite but complementary forces of the universe, with *Yin* representing the criteria of yieldingness and submissiveness and *yang* representing unyieldingness and dominance ...This discourse of endless, cyclic, and transforming movement of change continues to influence the philosophical discourse and its assumptions never cease to affect Chinese behaviours in the contemporary Chinese world(Fang, 2011).

The *YYB* is a frame of thinking with scientific implications, especially potent for scientifically exploring highly complex phenomena, as evidenced by the advances in science and technology in the history of China before the late Western modernization (Needham, 1956), and it is further evidenced by the stories of some of the most prominent figures in the history of modern science in the West (e.g., Leibniz, Jung, and Bohr). In particular, the *YYB* is an open system (Gu, 2005) to accommodate a balance between "either/or" and "both/and." It is highly distinctive from Aristotle's formal logic, which is mechanistic and reductionist due to its absolute denial of potential contradictions with a permanent "either/or" (but never "both/and"). It is also different from Hegel's dialectical logic, which is ultimately mechanistic and reductionist due to its absolute need for the resolution of transitory contradictions with a temporary "both/and" but ultimate "either/or," so *I* term it "both/or" (Li, 1998; Peng and Nisbett, 1999; Li, 2011).

In contrast, the *YYB* integrates "either/or" with "both/and" for permanent "either/and" in relative terms. In this sense, *I* take the *YYB* as a duality in contrast to Aristotle's logic as an explicit dualism, and Hegel's logic as an implicit dualism (with its temporary tolerance, but ultimate denial, of contradiction with its ultimate goal to resolve all contradictions) (Nisbett, 2003; Li, 2011).

The *YYB* can be integrated with Aristotle's formal logic by revising the latter to accommodate the relatively weak form of contradiction (thus permanent yet relative) given the ontological nature of mutual interdependence and interpenetration (e.g., the two sides of the same coin) in contrast to the absolutely strong form of contradiction for mutual negation (thus temporary yet absolute). Finally, the *YYB* can be integrated with Hegel's dialectical logic by revising the latter to accommodate the relatively weak form of contradiction given the ontological nature of mutual interdependence and interpenetration in contrast to the absolutely strong form of contradiction. In sum, the *YYB* can be expected to have the potential to integrate all extant logical systems into a meta-logical or meta-frame of thinking by accommodating both mutual negation and mutual affirmation between two opposites as a duality (Li, 2011).

To further illustrate why and how to apply the *YYB*, let's refer to the debate over global-local dual requirements. There are two basic perspectives about the global-local link (Prahalad and Doz, 1987). One view asserts that the two are only contrary so that we can be either global or local in perspective and strategy, but the other view claims that the two are absolutely

complementary rather than contrary. The above two views delineate the prevailing typology with four categories: global, local, neither, and both, all assumed to be the case in all aspects at all times (Bartlett and Ghoshal, 1998). This approach represents the typical "either/or" logic by either denying the contrary tendencies of global and local forces (in the category of "both") or denying their complementary tendencies (in the categories of "global," "local," and "neither") (Bartlett and Ghoshal, 1998). In contrast, the *YYB* can help remedy such biases by treating global and local forces as a duality so that they negate and affirm each other in different aspects (more global in basic R&D and market brand, but more local in applied R&D and market channel), at different times (initially more local but more global later), but they negate and affirm each other only to different degrees (always relatively more or less without going to the polarized extremes, see Table 1). In this sense, the *YYB* can apply to all controversies and debates in the domain of organization and management research (competition-cooperation duality, Chen, 2008; exploitation-exploration duality, Li, 2010, and stability-change duality, Farjoun, 2010) as well as the methods of induction and deduction into abduction (Charmaz, 2006).

TABLE 1 – THE *YIN-YANG* BALANCE (*YYB*) OF GLOBALIZATION AND LOCALIZATION

To different degrees without polarized extremes	Low-Globalization	High-Globalization
High-localization	1. High localization & low globalization Typical either/or dualism: high localization in all aspects and/or at all times	2. High localization & high globalization Difficult for either/or dualism; difficult for both/or dualism; easy for *Yin-Yang* Duality: high-localization in some aspects and/or at some times; high globalization in other aspects and/or at other times
Low-localization	3. Low localization & low globalization Difficult for either/or dualism; Easy for both/or dualism; Easy for *Yin-Yang* Duality: low-localization in some aspects and/or at some times; low-globalization in other aspects and/or at other times)	4. Low localization & high globalization Typical either/or dualism: high globalization in all aspects and/or at all times

Source: Li (2011)

This is a typical one-dimensional dichotomy split into two low-high sub-dimensions (Li, 2011)

III. A STEP-WISE WEIGHT ASSESSMENT RATIO ANALYSIS (SWARA) METHOD (Keršuliene *et al.* 2010)

There are various approaches for assessing weights (Zavadskas *et al.* 2010a, b), e.g. the eigenvector method, SWARA (Keršuliene *et al.* 2010), expert method (Zavadskas, Vilutienė 2006), analytic hierarchy process (AHP) (Saaty 1977, 1980), Entropy method, etc (Kersuliene and Turskis, 2011).

In SWARA method each of experts first of all ranks criteria. The most significant criterion is given rank 1, and the least significant criterion is given rank last. The overall ranks to the group of experts are determined according to the mediocre value of ranks (Kersuliene and Turskis,

2011). The step-wise weight assessment ratio analysis (SWARA) (Keršuliene *et al.* 2010) methodology is developed in 2010 and applied for the selection of rational dispute resolution method (Kersuliene and Turskis, 2011). The procedure for the criteria weights determination is presented in Fig. 2.

The main feature of SWARA method is the possibility to estimate experts or interest groups opinion about significance ratio of the criteria in the process of their weights determination (Kersuliene *et al,* 2010).

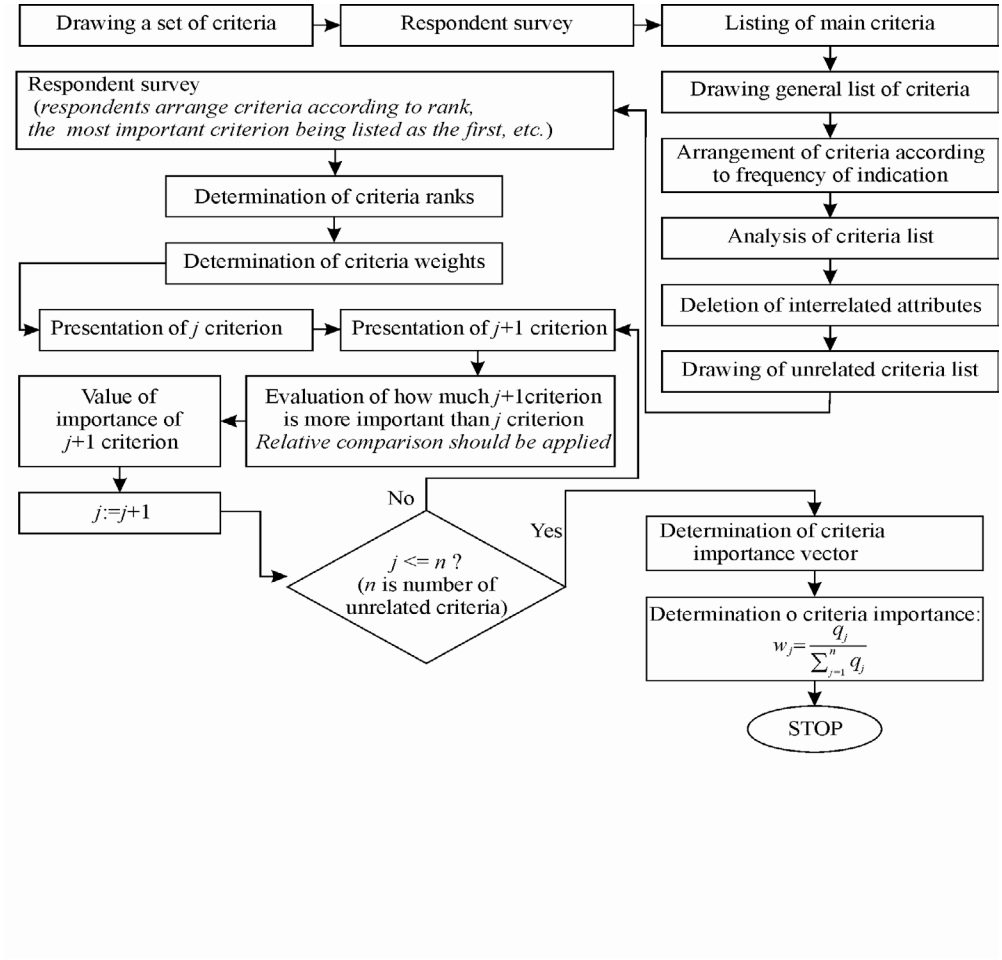

Figure 2.DETERMINING OF THE CRITERIA WEIGHTS BASED ON SWARA

Source: Kersuliene and Turskis, (2011)

A. IDENTIFYING IMPORTANT CRITERIA IN DESIGN PRODUCTS

According to main idea of this research which is designing and producing products with both internal and external perspectives based on *YYB* theory. There are many important criteria in this regard but this research wants to identify criteria that have higher importance in this area.

For this purpose, conference meetings were taken place in two parts and five experts participated in. At the first part of the meeting, the experts discussed about different kinds of problems in industries and then presented their ideas and shared their opinions with others and finally six important criteria were selected due to group ideas. Selected criteria of this research are shown in Table 2.

TABLE 2 - SELECTED CRITERIA

	Important Criteria
C_1	Considering important general features of each product and applications
C_2	Cost control and finally pricing policies
C_3	Appearance considering with moderate perspective
C_4	Marketing researches in details
C_5	Identifying target markets in details
C_6	Special attention to production capabilities

Source: Authors Calculation

Information about experts is shown in Table 3. Three of the experts are in management and business field and two other experts are in engineering field; one of them is in mechanical engineering and the other one is in industrial engineering. All of the experts were interested in this topic and had experiences of this issue.

TABLE 3 - BACKGROUND INFORMATION OF EXPERTS

Variable	Items	NO	Variable	Items	NO
1) Education	Bachelor	0	3)Sex	Male	4
background	Master	1		Female	1
	PhD	4			
2)Fields	Management	3	4)Age	31-40	3
	Engineering	2		41-50	2

Source: Authors Calculation

At the second meeting, the experts stated their opinions in identifying relative importance of each criterion and finally calculating weights of each criterion. Procedure of this section was based on SWARA method and the result is shown in Table 4.

TABLE 4 - FINAL RESULTS OF SWARA METHOD IN WEIGHTING CRITERIA

Criterion	Comparative importance of average value s_j	Coefficient $k_j = s_j + 1$	Recalculated weight $w_j = \frac{x_{j-1}}{k_j}$	Weight $q_j = \frac{w_j}{\sum w_j}$
C_1		1	1	0.21
C_2	0.09	1.09	0.92	0.19
C_3	0.06	1.06	0.87	0.18
C_4	0.12	1.12	0.78	0.16
C_5	0.18	1.18	0.67	0.14
C_6	0.1	1.1	0.61	0.12

Source: Authors Calculation

Due to SWARA method results weight and relative importance of each criterion was calculated.

B. MANAGERIAL TIPS

Producing and designing products with the perspective of *YYB* theory can be useful in industries but producer should pay attention to the design of their products and attempt to produce products that cover expectations. SWARA is a new and powerful method which is applied in this research for identifying relative importance of criteria selected at conference meeting. Considering these criteria will help producers to decrease the risk of their production and introduction of their products and they also can apply this research as a framework. It is suggested that factories establish a team proposed by authors for this purpose and authors believe that a team can decrease the risks, too. This research is useful for industries which have the possibility of developing their products based on *YYB* theory.

V. CONCLUSION

The main new idea of this research was producing and designing products based on new perspective, while *YYB* theory has a historical perspective but it is a powerful perspective and has a special effect in this area. In this research, *YYB* theory was applied for describing goals of this research and the influence of this historical perspective in business and marketing and even engineering.

In this research, five experts participated and they were in management and engineering fields whose detailed information is illustrated in Table 3. Experts participated in a conference meeting in two sections for analysing features of this research. Six important criteria were selected at the first section and then in section two five experts participated in calculating relative importance and weight of each criterion based on the structure of SWARA method.

Based on SWARA method, criteria were selected due to priorities and their importance. Six criteria of this research based on their priority were considered as important general features of each product and applications, cost control and final pricing policies, appearance with moderate perspective, marketing researches in details, identifying target markets in details and special attention to production capabilities.

Based on the results of SWARA method, the weight of each criterion was calculated and the results were shown in Table 4.

This research can be useful as a general framework for producers and industries but it must be mentioned that this research was done in a general form and its goal was introducing this new perspective to the world of business and engineering. This research should adjust based on each industry and business position in each region and area.

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DIZAJN PROIZVODA S ISTOVREMENO MEĐUNARODNOM I LOKALNOM PERSPEKTIVOM NA OSNOVI YIN-YANG TEORIJE RAVNOTEŽE I SWARA METODE

SAŽETAK

Proizvodnja i dizajn proizvoda su ključevi uspjeha te imaju ključnu ulogu u industriji. Proizvođači bi morali biti pažljivi što se tiče njihovih proizvoda, ciljanih tržišta kao i mnogih kriterija koje pri tome moraju uzeti u obzir. Ovo istraživanje predstavlja novi okvir za posebne situacije koristeći teoriju *Yin-Yang* ravnoteže (YYB) pri proizvodnji i dizajnu proizvoda s novim perspektivama. Ovaj rad proučava opće situacije u proizvodnji proizvoda za međunarodne proizvođače i industrije. Proizvođači mogu smanjiti trošak i rizik proizvodnje proizvoda uzimajući u obzir kako unutarnje tako i međunarodne karakteristike proizvoda. U tome smislu se koristi SWARA metoda kako bi se odredio prioritet važnih kriterija u ovom pitanju. Pet stručnjaka je sudjelovalo na konferenciji u dvije sekcije i odabrali su važne kriterije. Prioritet kriterija je baziran na stupanjskoj (stepwise) metodi analize omjera težine. Šest kriterija ovog istraživanja na bazi prioriteta je određeno kao važno: opće karakteristike svakog proizvoda i aplikacije, kontrola troškova i politike finalnih cijena, pojavnost s umjerenom perspektivom, detaljna marketinška istraživanja, utvrđivanje ciljnih tržišta u detalje i posebna pažnja proizvodnim kapacitetima. Najvažniji kriterij među njima jesu opće karakteristike svakog proizvoda i aplikacije. Ovaj okvir se može modificirati s obzirom na potrebe svake industrije te se može primijeniti kao model potpore općem odlučivanju za proizvođače i industriju

Ključne riječi: dizajn proizvoda, Yin-Yang teorija ravnoteže, SWARA metoda

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REAL EXCHANGE RATE WITH NONLINEAR THRESHOLD EFFECT

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ABSTRACT

This study applies the threshold autoregressive model proposed by Caner and Hansen (2001) to examine both linearity and stationarity of Germany's real exchange rate vis-à-vis her 5 trading partner countries. Two main conclusions are drawn. Firstly, the empirical results indicate that Germany's real exchange is a nonlinear process. Secondly, a unit root in real exchange rate was rejected for most of the cases under study. This result provides strong support for purchasing power parity for Germany relative to their major trading partner countries.

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I. INTRODUCTION

Recently, there has been a growing consensus that the real exchange rate (RER) exhibits nonlinearities, and consequently, conventional unit root tests such as the Augmented Dickey Fuller (ADF) test have low power in detecting the mean reversion of exchange rate. Taylor and Peel (2000) demonstrate that the adoption of linear stationarity tests is inappropriate for the detection of mean reversion if the true process of the data generation of the exchange rate is in fact a stationary non-linear process. A number of studies have provided empirical evidence on the nonlinear adjustment of exchange rate. Reasons for the nonlinear adjustment are the presence of transactions costs that inhibit international goods arbitrage and official intervention in the foreign exchange market may be such that nominal exchange rate movements are asymmetric (see Taylor, 2004; Taylor and Peel, 2000; Juvenal and Taylor, 2008; Reitz and Taylor, 2008). Kilian and Taylor (2003) also suggest that nonlinearity may arise from the heterogeneity of opinion in the foreign exchange market concerning the equilibrium level of the nominal exchange rate: as the nominal rate takes on more extreme values, a great degree of consensus develops concerning the appropriate direction of exchange rate moves, and traders act as accordingly. However, the finding of nonlinear adjustment does not necessarily imply nonlinear mean reversion (stationarity). As such, stationarity tests based on a nonlinear framework must be applied[1].

This empirical study contributes to this line of research by determining whether Purchasing Power Parity (PPP) holds for Germany's RER relative to a sample of her major trading partner countries (Canada, France, Italy, Japan, and the United Kingdom), using the threshold autoregressive (hereafter, TAR) model and the test statistics proposed by Caner and Hansen (2001). The major advantage of this approach is that it allows us to simultaneously investigate nonstationarity and nonlinearity. With this, the current research hopes to fill the existing gap in the literature. Otherwise, Germany provides an interesting arena to research for several reasons. First, Germany is the EU's largest economy and a major power with the world's fourth largest economy by nominal GDP and the fifth largest in purchasing power parity. Second, Germany is the world's second-largest exporter and third-largest importer of goods with the foreign exchange reserves estimated at US$ 189 billion at the end of 2009. Third, Germany is the most populous country in the European Union and also home to the third-largest number of international migrants worldwide. We find that Germany's bilateral real exchange rate is a nonlinear process and not characterized by a unit root, consistent with PPP, relative to most of the trading partner countries (four out of five), with the exception of Canada/Germany.

This study is organized as follows. Section 2 presents the data used in our study. Section 3 briefly describes the TAR unit test and our empirical results. Section 4 concludes the paper.

[1] For details on previous studies, please refer to the works of Taylor (1995), Rogoff (1996), MacDonald and Taylor (1992), Taylor and Sarno (1998), Sarno and Taylor (2002), Taylor and Taylor (2004), and Lothian and Taylor (2000, 2008), who have provided in-depth information on the theoretical and empirical aspects of PPP and the RER.

II. DATA

Our empirical analysis covers a sample of 5 countries: Canada, France, Italy, Japan, and the United Kingdom. Monthly data are employed in this study, and the time span is from January 1994 to April 2010. All consumer price indices, CPI (based on 2005 = 100), and nominal exchange rates relative to the Germany Deutsche Mark (DM) data are taken from the International Monetary Fund's International Financial Statistics CD-ROM.[2] Testing for PPP against the Germany is based on the argument that Germany is the major trading partners for these 5 countries for the past decade. As shown from Figure 1, visual inspection of the real exchange rate series for these five country pairs reveals significant upward or downward trend in the real exchange rate series for most of the countries against the DM during this sample period. From these figures, for most of the series, there seem to exhibit some nonlinear adjustment patterns.

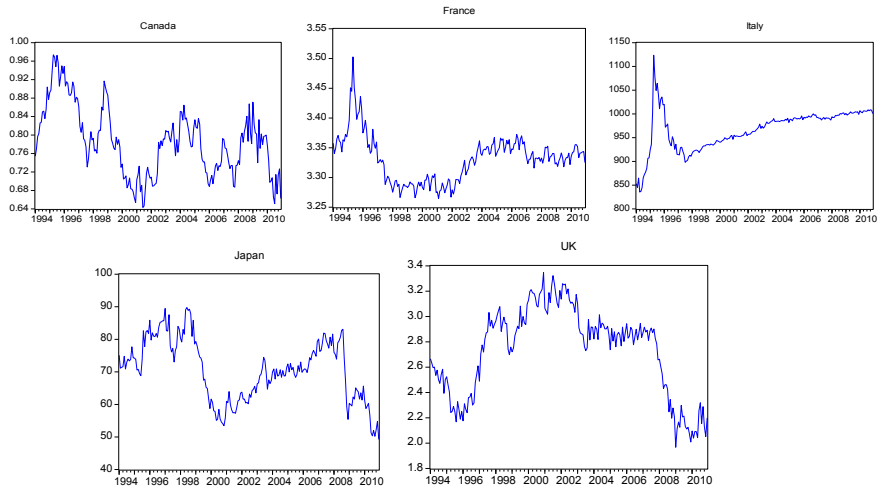

FIGURE 1. THE TENDENCY OF REAL EXCHANGE RATES

Source: Authors calculation

III. METHODOLOGY AND EMPIRICAL RESULTS

A. Caner and Hansen's (2001) Threshold Unit Root Test

Following the work of Caner and Hansen (2001), we adopt a two regime TAR(k) model with an autoregressive unit root as follow:

[2]The real exchange rate series of a country at time t is define as $(S_t \times P_t^H) / P_t^{Germany}$, where S_t is the nominal exchange rate of home country per Mark, $P_t^{Germany}$ and P_t^H denote the consumer price indices of home country and the Germany, respectively.

$$\Delta r_t = \theta_1' x_{t-1} I_{\{Z_t<\lambda\}} + \theta_2' x_{t-1} I_{\{Z_t\geq\lambda\}} + e_t, \quad t = 1, \ldots, T \tag{1}$$

where r_t is the real exchange rate for $t = 1,2....,T$, $x_{t-1} = (r_{t-1}, v_t', \Delta r_{t-1}, \ldots, \Delta r_{t-k})'$, $I_{\{\bullet\}}$ is the indicator function, e_t is an i.i.d. disturbance, $Z_{t-1} = r_{t-1} - r_{t-m}$ is the threshold variable, m represents the delay parameter and $1 \leq m \leq k$, v_t is a vector of exogenous variables including an intercept and possibly a linear time trend. The threshold value λ is unknown and takes the values in the compact interval $\lambda \in \Lambda = [\lambda_1, \lambda_2]$, where λ_1 and λ_2 are selected according to $P(Z_t \leq \lambda_1) = 0.15$ and $P(Z_t \leq \lambda_2) = 0.85$.3 The components of θ_1 and θ_2 can be partitioned as follows:

$$\theta_1 = \begin{pmatrix} \rho_1 \\ \beta_1 \\ \alpha_1 \end{pmatrix}, \quad \theta_2 = \begin{pmatrix} \rho_2 \\ \beta_2 \\ \alpha_2 \end{pmatrix} \tag{2}$$

where ρ_1 and ρ_2 are scalar terms. β_1 and β_2 have the same dimensions as v_t, and α_1 and α_2 are k-vectors. Thus (ρ_1, ρ_2) are the slope coefficients on r_{t-1}, (β_1, β_2) are the slopes on the deterministic components, and (α_1, α_2) are the slope coefficients on $(\Delta r_{t-1}, \ldots, \Delta r_{t-k})$ in the two regimes.

The threshold effect in Equation (1) has the null hypothesis of $H_0 : \theta_1 = \theta_2$, which is tested using the familiar Wald statistic: $W_T = W_T(\hat{\lambda}) = \sup_{\lambda\in\Lambda} W_T(\lambda)$.4 The stationarity of the process r_t can be established in two ways. The first is when there is a unit root in both regimes (a complete unit root). Here the null hypothesis is of the form $H_0 : \rho_1 = \rho_2 = 0$, which is tested against the unrestricted alternative $\rho_1 \neq 0$ or $\rho_2 \neq 0$ using the Wald statistic. The parameters of ρ_1 and ρ_2 from the Equation (1) will control the regime-dependent unit root process of the RER. If $\rho_1 = \rho_2 = 0$ holds, the RER has a unit root can be described as a rejection of PPP. This statistic is:

$$R_{2T} = t_1^2 + t_2^2 \tag{3}$$

where t_1 and t_2 are the t ratios for $\hat{\rho}_1$ and $\hat{\rho}_2$ from the ordinary least squares estimation. However, Caner and Hansen (2001) claim that this two-side Wald statistic may have less power than a one-sided version of the test. As a result, they propose the following one-sided Wald statistic as follows:

[3] According to Andrews (1993), this division provides the optimal trade-off between various relevant factors, which include the power of the test and the ability of the test to detect the presence of a threshold effect.

[4] $W_T = W_T(\hat{\lambda}) = \sup_{\lambda\in\Lambda} W_T(\lambda) = T\left(\frac{\hat{\sigma}_0^2}{\hat{\sigma}^2(\lambda)} - 1\right)$, where $\hat{\sigma}_0^2$ and $\hat{\sigma}^2$ are residual variances from least squares estimation of the null linear and TAR models, respectively.

$$R_{1T} = t_1^2 I_{\{\hat{\rho}_1<0\}} + t_2^2 I_{\{\hat{\rho}_2<0\}} \quad (4)$$

To distinguish between the stationary case given as H_1 and the partial unit root case given as H_2, Caner and Hansen (2001) suggest using individual t_1 and t_2 statistics. If only one of $-t_1$ and $-t_2$ is statistically significant, this will be consistent with the partial unit root case. This means RER behaves like a "nonstationary process" in one regime; but exhibits a "stationary process" in the other regime, vice versa. Caner and Hansen (2001) show that both tests R_{1T} and R_{2T} will have power against both alternatives.5 To obtain maximum power form these tests, critical values are generated using bootstrap simulations with 10,000 replications, as suggested by Caner and Hansen (2001).

B. EMPIRICAL RESULTS

For the sake of comparison, we also incorporate the ADF, PP (Phillips and Perron, 1988), and KPSS (Kwiatkowski et al., 1992) tests into our study. The results of these three conventional unit root tests -- ADF, PP, and the KPSS tests, as shown in Table 1, indicate that the RERs are non-stationary for Germany relative to its major trading partners. As stated earlier, there is a growing consensus that the RER exhibits nonlinearities, and consequently, conventional unit root tests such as the ADF test, have low power in detecting the mean reversion of exchange rate. A number of studies have also provided empirical evidence on the nonlinear adjustment of exchange rate. Therefore, we proceed to test the RER by using Caner and Hansen's (2001) nonlinear TAR unit root tests.

[5] As stated by Caner and Hansen (2001) that R_{1T} has more power than that of R_{2T}, here we only report the results of R_{1T} in our study.

TABLE 1. UNIVARIATE UNIT ROOT TESTS

	Level			1st difference		
	ADF	PP	KPSS	ADF	PP	KPSS
Canada	-1.563(0)	-1.680(2)	0.914[11]***	-13.53(0)***	-13.53(2)***	0.113[0]
France	-1.592(3)	-1.911(9)	1.279[11]***	-16.60(0)***	-18.74(17)***	0.055[19]
Italy	-2.088(8)	-1.416(6)	1.287[11]***	-4.91(10)***	-12.87(5)***	0.052[5]
Japan	-1.529(0)	-1.669(3)	0.956[11]***	-13.09(0)***	-13.12(5)***	0.073[4]
UK	-1.308(0)	-1.373(4)	0.582[11]**	-13.48(0)***	-13.49(3)***	0.306[3]

Note: *** indicates significance at the 1% level. The number in parenthesis indicates the lag order selected based on the recursive t-statistic, as suggested by Perron (1989). The number in the brackets indicates the truncation for the Bartlett Kernel, as suggested by the Newey-West test (1994).
Source: Authors calculation

First, we use the Wald test W_T to examine whether or not we can reject the linear autoregressive model in favor of a threshold model. The results of the Wald test along with the bootstrap critical values generated at conventional levels of significance are reported in Table 2. The bootstrap p-value for threshold variables of the form $Z_{t-1} = r_{t-1} - r_{t-m}$ for delay parameters m varies from 1 to 12. Since the parameters m is generally unknown, there is no reason to think the optimal delay parameter will be the same across countries. To circumvent this, Caner and Hansen (2001) suggest making m endogenous by selecting the least squares estimate of m that minimizes the residual variance. This amounts to selecting m at the value that maximizes the W_T statistic. We find that the W_T statistic is maximized for Italy/Germany when $m = 3$, for both Canada/Germany and Japan/Germany when $m = 5$, for France/Germany when $m = 7$, and for UK/Germany when $m = 10$. Taken together, these results imply strong statistical evidence against the null hypothesis of linearity at least at the 5% significance level for all the cases indicating that simple linear models are inappropriate and the TAR model is our preference.

TABLE 2. THRESHOLD UNIT ROOT TEST

Countries	Wald Statistic	Bootstrap p-value	m	Threshold $\hat{\lambda}$	Number of observations in Regime 1 and its percentage
Canada	68.993	0.003***	5	-0.0366	59(32.24%)
France	145.713	0.000***	7	0.0049	155(84.69%)
Italy	541.249	0.000***	3	0.0019	155(84.69%)
Japan	62.302	0.048**	5	-0.0378	41(22.40%)
UK	83.979	0.032**	10	0.0348	129(70.49%)

Note: ** and *** indicate significance at the 5% and 1% level, respectively. Following much of the existing empirical literature on monthly real exchange rates and PPP, we set a maximum lag of 12 and base all our bootstrap tests on 10,000 replications. Most of the statistics are significant, which supports the presence of threshold effects.

Source: Authors calculation

Next, we explore the threshold unit root properties of RER based on the R_{1T} statistic for each delay parameter m, ranging from 1 to 12, paying particular attention to the results obtained for our preferred model. The R_{1T} test results, together with the bootstrap critical value at the conventional levels of significance and the bootstrap p-value, are reported in Table 3. We are able to reject the unit root null hypothesis for all of cases at the 10% significance level, with the exception of Canada/Germany. Taken together our results provide strong support for PPP for most of the Germany's trading partner countries and point that the RERs of these countries are non-linear stationary, implying that deviations of exchange rate is mean reverting towards the PPP equilibrium. As we mentioned earlier that trade barriers, transaction costs, as well as interventions in the exchange market, could be behind this nonlinear behavior. The one-sided test statistic of R_{1T}, however, is not able to distinguish the complete and partial unit root in real exchange rate, we examine further evidence on the unit root hypothesis (partial unit root) by examining the individual t statistics, t_1 and t_2. The results are reported in Table 4. These statistics are associated with delay parameters chosen from the linearity test, and their p-values are also obtained using 10,000 bootstrap. This means that the unit root null is strongly rejected in favor of $\rho_1 < 0$ in the outer regime. In contrast, the p-values for the t_2 statistic indicate that we are unable to reject the unit root null hypothesis in the inner regime for all countries at any conventional level of significance. Moreover, the magnitudes of ρ_1 and ρ_2 suggest that in the outer regime, the real exchange rate displays mean reversion, while in the inner regime it is highly persistent and is best described as a random walk. Note that for France, Italy, Japan and UK, the p-values of t_1 for these four countries are less than 10%, we can find while a partial unit root exists for the PPP may be characterized as a stationary TAR.

Also, with the exception of the Canada/Germany, the statistics for t_1 are smaller than the critical value at the 10% level of significance, and this leads us to the conclusion that RERs in most of the Germany's trading partner countries are nonlinear process that are not characterized by a unit root process, consistent with the PPP. Therefore, it is possible to claim that deviations in the

short-run form the PPP are not prolonged for Germany and there are some forces which are capable of bringing the exchange rate back to its PPP values in the long-run.

TABLE 3. ONE SIDED UNIT ROOT TESTS

Countries	m	R_{1T}	Bootstrap critical values			Bootstrap p-value
			10%	5%	1%	
Canada	5	4.918	9.775	11.886	16.972	0.371
France	7	11.074	10.893	14.139	22.235	0.091*
Italy	3	14.226	12.496	17.378	32.518	0.075*
Japan	5	13.075	9.266	11.653	16.743	0.033**
UK	10	11.558	10.659	13.111	18.405	0.075*

Note: * and ** indicate significance at the 10% and 5% level, respectively.

Source: Authors calculation

TABLE 4. PARTIAL UNIT ROOT RESULTS

Countries	m	t_1^2	Bootstrap p-value	t_2^2	Bootstrap p-value
Canada	5	0.916	0.555	2.019	0.187
France	7	3.659	0.091*	-0.951	0.941
Italy	3	3.771	0.033**	-4.306	0.994
Japan	5	3.432	0.016**	1.137	0.474
UK	10	3.218	0.039**	1.094	0.500

Note: * and ** indicate significance at the 10% and 5% level, respectively.

Source: Authors calculation

The major policy implication that emerges from our study is that the government in Germany can use PPP to determine the equilibrium exchange rate and the unbounded gains from arbitrage in traded good are not possible in Germany.

The findings of PPP hold between Germany and its major trading partners implied that the Germany economy is integrated with these countries. Hence, these had important policy implication on cross-border agreement for international trade and investment with these countries. Given the goods and services markets appeared quite integrated, future liberalization will be likely pronounced in financial markets. If we envision this process of integration continuing, in particular in the European region, and to the extent that this process requires even

more political engagement, we believe the prospects for cooperation along a variety of dimensions are good.

IV. CONCLUSIONS

This study applies the TAR model proposed by Caner and Hansen (2001) to examine both linearity and stationarity of Germany's real exchange rate vis-à-vis her 5 trading partner countries. Two main conclusions are drawn. Firstly, the empirical results indicate that Germany's real exchange is a nonlinear process. Secondly, a unit root in real exchange rate was rejected for most of Germany's trading partner countries while a partial unit root exists for the PPP under study. This provides strong support for purchasing power parity for Germany relative to their major trading partner countries.

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REALNA TEČAJNA STOPA S NELINEARNIM EFEKTOM PRAGA

SAŽETAK

Ovaj rad koristi TAR autoregresijski model kojeg su osmislili Caner i Hansen (2001) za istraživanje linearnosti i stacionarnosti njemačke realne tečajne stope u odnosu na njenih 5 zemalja trgovinskih partnera. Donose se dva glavna zaključka. Prvo, empirijski rezultati ukazuju na to da je njemački realni tečaj nelinearni proces. Drugo, jedinični korijen u realnoj tečajnoj stopi je odbačen za većinu istraženih slučajeva. Takav rezultat snažno podupire paritet kupovne moći za Njemačku u odnosu na njene glavne trgovinske partnere

Ključne riječi: test jediničnog korijena nelinearnog efekta praga, linearnost i stacionarnost, paritet kupovne moći,

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THE PRICING OF SIZE, BOOK TO MARKET AND FINANCIAL LEVERAGE IN EURO STOCKS

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ABSTRACT

The relevance of financial leverage in a firm's capital structure holds great significance, however its role in asset pricing remains under investigated. In this paper we investigate if financial leverage is priced employing a sample of listed equities from nine European Union countries spanning over a period of twenty years (1989 - 2008). We form size, book to market, and leverage portfolios, to examine if leverage premium is systematic and whether augmenting the three factor model by including leverage variable would better explain the portfolio returns. Moreover, the paper investigates if size and value will capture financial distress in the presence of a superior measure based on net leverage. Our results suggest that the explanatory power of a four factor model is substantially superior to the "*vanilla*" version of a three factor model. Despite significant size and book to market coefficients, we could not find evidence that size and book to market factor capture financial distress in presence of a leverage mimicking factor.

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I. INTRODUCTION

Financial leverage represents the capital mix that firms use to finance their asset base and it reflects the flexibility of a firm to raise incremental capital to sustain its business operations. Firms with higher debt ratios have an augmented cost of capital, which require higher coverages, and consequently, face difficulties in raising more capital. Firms with a weak equity base are sensitive to financial distress as a result of a consistently high leverage. Therefore, leverage is the primary source of financial risk that could lead to insolvency and bankruptcy of firms. Inspite of the critical role of leverage in a firm's funding and associated financial risk, capital mix as an essential factor has been largely ignored in asset pricing literature.

Modigliani and Miller (1958) proposed that expected return on equity should increase with an increase in financial leverage in the capital structure. This was substantiated by Hamada (1969), who combined the Modigliani - Miller proposition with capital asset pricing model (CAPM) of Sharpe (1964) and Lintner (1965), and suggested that an increase in financial leverage will result in an increase in the firm's beta. Therefore, if CAPM holds, financial risk from leverage will be captured by the beta coefficient, and hence does away with the need for a separate risk premium factor. However, the recent empirical evidence could not provide strong results in favor of CAPM, leading to the conclusion that a single factor beta could not solely explain the variation in stock returns.

The subsequent asset pricing propositions have extended the CAPM framework by including firm specific factor. Bhandari (1988) suggested that leverage is priced in stock returns and financial risk premium should be included as an independent risk factor. Fama and French (1992) criticized the inability of CAPM's beta to capture variation in stock returns and suggested a three factor model to include size (SMB) and book to market (HML) as additional explanatory variables. They argued that these factors explain the return premium that small firms receive over big firms and the premium higher book to market firms get over lower book to market firms.

The controversy around the three factor model relates to the type of risk, if any, captured by SMB (small minus big) and HML (high minus low) factor. Fama and French (1995) proposed that the three factor model has better explanatory power because size and value factor capture the financial risk emanating from an increase in financial leverage. They suggested that since financial distress is captured by book to market, leverage should not be priced as a separate factor. Vassalou and Xing (2004) examined the pricing of default risk for US equities in the context of three factor model. Their findings suggested that financial distress and default risk is systematic in nature and is priced in equity returns. They reported that SMB and HML contain some leverage related information, however that was not the only reason for these factor to be significant explanatory variables. As a result, they concluded that the three factor model augmented by a default factor that emanates from financial leverage is a better predictor of equity returns.

An increase in leverage conveys mixed signals to financial markets. On one side, this indicates possible investment opportunities for the firm which would be financed through debt acquisition, while on the other side, the incremental debt may exert pressure on the financial structure and increase financial risk. Despite the importance of financial leverage, there is scarce evidence in literature of the role of leverage vis-à-vis asset pricing. Moreover, such evidence is only for domestic markets and to the best of our knowledge, no study has attempted to examine the impact of leverage in cross country stock portfolios. The aim of this paper is two fold. We examine if leverage premium is systematic or not, and whether augmenting the three factor model through the leverage variable would better explain portfolio returns. Also, the paper investigates if SMB and HML will capture financial distress in presence of leverage which is a primary indicator of financial panic. A sample of listed equities from nine European Union

countries is used that spanned a period of twenty years (1989 – 2008) to examine if leverage is priced in global stock returns. To test for leverage premium, Fama and French size and book to market portfolios are extended to a three way sort by including a leverage mimicking portfolio to form a leverage factor *HLML* (*high leverage minus low leverage*). Our empirical results support the notion of leverage premium in international portfolios. The explanatory power of portfolio returns sorted for size, value, and leverage, substantially increased with the inclusion of the leverage factor, thereby validating the relevance of capital structure in pricing of financial assets. Moreover, inclusion of the leverage factor did not distort the explanatory power of SMB and HML, indicating that Fama and French factor do not account for the financial distress from use of leverage – at least not in international portfolios.

This paper makes multiple contributions towards existing literature on asset pricing. Firstly, it introduces a net leverage based risk factor and mimicking leverage portfolios to explain the role of capital structure vis-à-vis risk premiums. Secondly, our sample constitutes of firms from various European countries and our evidence explains the risk return profile in international portfolios. Lastly, previous evidence demonstrates weak significance for size and value three factor model in international settings; however, we propose that Fama and French factor model augmented by a leverage premium factor better explains the variation in portfolio returns.

The rest of the paper is organized as follows. Section II will review some of the existing literature, Section III will discuss data and methodology, Section IV will comprise of empirical findings, and Section V will conclude.

II. LITERATURE REVIEW

Most existing literature on financial leverage relates to the determinants of capital structure and the role of financial leverage as a risk factor in asset pricing has been largely ignored. There are however, evidences on the relationship between financial leverage and variation in stock returns. In this section, we present an overview of some existing literature on financial leverage and stock returns.

Bhandari (1988) investigated the role of financial leverage in explaining variation of US stock returns between 1948 and 1979. To analyze the impact of capital structure on stock returns, the estimates were controlled for beta and firm size along with January anomaly. The January anomaly refers to higher returns that cannot be explained with conventional asset pricing models. The results suggested a positive relationship between debt to equity ratio and stock returns, with higher stock returns for firms with high leverage compared to low leverage firms. They concluded that the risk which emerged from financial leverage is not covered by CAPM's beta and calls for a unique premium that is different from compensation of market risk.

Ferguson and Shockley (2003) reported the significance of firm's leverage and relative distress in asset pricing. They argue that empirical failure of CAPM is attributed to the widely used proxy of market returns from stock indices that only include equity investments, and neglect the debt claims. Their results suggest that the explanatory power of single factor models increase when they are augmented by leverage and distress. They concluded that in the presence of an all equity based market proxy, a leverage and distress augmented model outperformed the Fama and French three factor model in explaining cross sectional variation in returns.

Dhaliwal, Heitzman and Zhen (2006) examined the impact of financial leverage, corporate taxes, and personal taxes for investors, on the corporate cost of equity. The empirical findings demonstrate a positive relationship between leverage and cost of equity, which reflects an increasing risk premium for firms with high leverage. They also report a negative relationship between this equity premium and corporate tax rates. They concluded that an increase in a firm's leverage would increase the cost of equity; however, the tax benefits emanating from the presence of a tax shield would offset some of the leverage related equity premium.

Penman, Richardson and Tuna (2007) decomposed the book to market ratio into two components: enterprise book to price, and leverage. The enterprise book to price was estimated as the ratio of book value to market value of operating assets. This ratio aims to capture the operating risk while the leverage component, measured as net debt to equity, was expected to reflect the financing risk. Their results suggest a positive relationship between operating risk and returns and a negative relationship of leverage with stock returns. They concluded that the negative relationship between leverage and returns was surprising, and attributed the possibility to be sample specific that warrants some more control variables.

Campbell, Hilscher and Szilagyi (2008) posed a serious challenge to the claims that size and value factor proxy financial distress premium. They noted that financially distressed stocks, despite having high volatilities, market beta and size and value loadings, were offering low returns. To account for the distress anomaly, they proposed a hazard model for default prediction comprising of firm specific variables, notably, leverage and cash holdings, and reported that firms with high leverage and low cash holdings are more likely to file for bankruptcy. They further demonstrated a strong negative correlation of abnormal returns with the bankruptcy risk as captured by their model. These findings remained robust even after conditioning on size and book and market. Campbell et al (2008) concluded that investors require risk premium for investing in financially challenged stocks and SMB and HML factor do not account for distress risk.

Wah, Strange and Piesse (2008) studied the impact of corporate financial leverage on asset pricing using stocks from the Hong Kong market between 1980 and 1998. Their results reported evidence for pricing of financial leverage in stock returns. These results remained robust in conditional estimations when data was segmented into bearish and bullish markets. They concluded that leverage is a relevant risk factor along with beta, size, and book to market, and is consequently priced in stock returns.

George and Hwang (2010) analyzed the relationship between stock returns, leverage and distress intensity, for a sample of firms from NYSE, Amex and Nasdaq between 1965 and 2003. They observed a negative relationship between stock returns and distress intensity and suggested that firms maintain capital structure based on distress costs. Firms with high costs are expected to maintain low leverage to avoid probability of financial distress. The higher equity participation exposes firms to more systematic risk as compared to firms with high leverage, and therefore calls for a higher market premium. Furthermore, they observe that inclusion of leverage or default probability does not erode the significance of book to market. They concluded that book to market ratio does not act as a proxy for financial distress or any other risk related to capital structure.

III. DATA AND METHODOLOGY

A. Data and Sample

The data for this study comprises of listed non financial stocks from nine European countries. These euro currency countries include Austria, Belgium, Finland, France, Germany, Ireland, Italy, Netherlands and Spain. Our sample period with monthly frequency spans over twenty years between 1989 and 2008. We do not include period after 2008 as it is marked with extreme financial turbulence where asset pricing dynamics are expected to depict extreme volatility. The initial sample constitutes all listed firm from these nine countries whose month end dividend adjusted prices are available on Thomson data stream. To be eligible for inclusion in sample in a particular year $t + 1$, the selected stocks should have fundamental data available in year t. The fundamental data includes book value of equity, book value of long term debt, book

value of assets, and number of shares outstanding. The firm size is calculated as market price time outstanding shares, book to market is represented as the ratio of book value of equity to market value of equity, while leverage is computed as book value of net long term debt to book value of total assets.

The asset pricing models in general and three factor model in particular have been subject to the criticism of survivorship bias. To account for this issue, we adapt Fama and French (1993) and consider only those stocks for our final sample that have been listed for at least two years. Similarly, all those firms which have been delisted or merged were not considered in the sample. Moreover, firms with negative book value of equity were also discarded. The empirical tests of asset pricing are likely to be impacted by the frequency of trading. If in a portfolio, one stock is less frequently traded than the other, this could exhibit some serial autocorrelation[1]. This spurious autocorrelation in closing prices could bias the empirical results and to account for this, stocks which have zero returns for more than 85% of the observations were excluded. Lastly, for meaningful international portfolios cross country outliers are accounted for. The combined countries data is ranked on basis of firm size, book to market and leverage individually and remove top and lower 5% stocks from each ranking. Based on this criterion, the numbers of selected stocks from each country are reported in Table 1.

TABLE 1 : YEAR WISE SAMPLE STOCKS

	1990	1995	2000	2005	2008
Austria	50	100	210	250	270
Belgium	45	110	230	260	280
Finland	30	80	100	120	130
France	100	280	500	680	720
Germany	140	350	630	820	850
Ireland	30	50	80	120	140
Italy	55	120	220	280	290
Netherlands	45	80	150	180	220
Spain	55	100	230	290	300
Total	550	1270	2350	3000	3200

Source: DataStream and Authors' Estimations

The firm size statistics for our sample are reported in Table 2. The average firm size is increasing over the years owing to both an increased number of firms in sample and their transition to ecology of large size. The difference between sample median and average over the years is due to diversified presence of large and small size firms that is vital to observe the relevance of a significant size effect. The firms above median will be classified as large firms while those below would be small firms. The average book to market ratio was maximum in 2003, while it was lowest in 1998. The median did not show any significant change throughout the sample

[1] After accounting for our sample criterion, we report a kurtosis of 2.95 and skewness of 0.004. Hence, we can safely assume our returns' distribution to be normal. Our regression results had a Durbin Watson statistics close to 2, so our findings are not subject to any violation of OLS. DW statistics are not reported for space constraints and are available on request.

period representing a maintained book to market profile of sample firms. The statistics on book to market and leverage ratio are reported in table 3.

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Median	0.53	0.48	0.55	0.57	0.66	0.53	0.65	0.60	0.54	0.42
Average	0.70	0.60	0.70	0.72	0.79	0.60	0.75	0.72	0.68	0.54
Std Dev	1.28	0.78	0.58	0.50	0.53	0.35	0.52	0.66	0.57	0.57
Descriptive Statistics : Net Debt to Total Assets										
	1989	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**
Median	34.61	36.08	37.24	38.87	37.45	35.72	34.71	33.92	33.08	33.68
Average	35.70	37.01	38.06	39.30	38.77	37.27	36.62	37.22	36.87	36.11
Std Dev	20.77	20.27	20.82	21.66	22.36	21.73	21.12	22.38	26.29	25.73

TABLE 2: DESCRIPTIVE STATISTICS FIRM SIZE

	1990	1993	1994	1995	1996	1997	1998
Median	118.48	76.32	94.67	96.54	108.75	127.38	145.90
Average	764.29	759.90	868.13	859.08	1097.62	1564.52	1789.56
Std Dev	2372.14	2666.81	2841.82	2830.74	3836.00	6013.93	6816.03

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Median	118.54	138.07	86.04	56.54	53.59	67.86	91.05	106.86	122.87	85.37
Average	1700.39	2119.06	1697.74	1371.21	1100.77	1363.86	1620.65	1804.84	2199.89	1695.41
Std Dev	7516.09	10291.34	8198.59	6722.32	5270.10	6199.45	7541.51	7892.86	9502.64	7875.12

Source: DataStream and Authors' Estimations

TABLE 3

Descriptive Statistics: Book to Market

Descriptive Statistics: Book to Market

	1989	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Median	0.53	0.50	0.43	0.53	0.62	0.83	0.60	0.58	0.47	0.43	0.56
Average	0.70	0.64	0.58	0.67	1.06	1.29	1.12	1.14	0.91	0.86	1.04
Std Dev	1.28	0.59	0.58	0.59	2.59	2.45	3.04	3.30	2.88	2.79	2.87
Descriptive Statistics : Net Debt to Total Assets											
	1989	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Median	34.61	32.83	31.21	33.50	34.35	34.09	33.20	30.78	30.44	30.91	36.52
Average	35.70	35.63	33.70	35.44	37.09	37.05	36.33	35.12	34.01	33.87	37.06
Std Dev	20.77	24.00	22.99	25.35	25.47	26.53	27.46	25.90	23.51	22.07	21.86

Source: DataStream and Authors' Estimations

The average leverage of sample firms has been range bound between 30% and 37% depicting no substantial overall variation in the capital mix of the selected firms. The choice of book value of leverage instead of market value is primarily for two main reasons. Firstly, market value is not observable for bank borrowings and privately placed funds, leaving book value of debt as general representation for financial leverage. Secondly, book leverage represents more closely the actual cash flow that is available to managers for capital budgeting purposes[2]. Therefore, the long term debt is adjusted for available cash and equivalents to get net long term debt. The net debt would account for the available cushion and represent a more accurate measure of financial risk emanating from capital structure. The median leverage ratio is then used to sort firms into a high leverage and a low leverage group.

The selected stocks will be combined to form international portfolios. One issue in cross country portfolios relates to the difference in currencies. However, our sample countries are all Euro denominated and even pre 2001 price data from Thomson Financial is available in Euros, hence the prices are already homogenized in a single currency. Based on month end prices, the logarithmic returns of the following form will be computed.

$R_{i(t)} = LN\left[\frac{P_{i(t)}}{P_{i(t-1)}}\right]$, where $R_{i(t)}$ represents return for stock i in month t while $P_{i(t)}$ and $P_{i(t-1)}$ represent price (in euro) for stock i in month t and $t-1$ respectively. These individual returns are then used to estimate value weighted portfolios that are constructed using the following procedure.

B. Portfolio Construction

The portfolios are constructed using a three way sort based on size, book to market, and leverage factor. The sample stocks from all countries are combined and ranked on the basis of size. The median for market value of equity in year t is used as a cut off point for a firm to be classified as big (B) or small (S) in year $t+1$. Once the two groups based on size are created, the firms in these groups are sorted into three book to market portfolios using book to market ratio with top 30% as high (H), middle 40% as (M) and bottom 30% as low (L). The result is six size and book to market portfolios with three book to market portfolios in each size group. The stocks from these six portfolios are then ranked on the basis of their leverage ratio. There are numerous financial ratios that are acceptable to depict the financial leverage of a firm. These include both long term and short term measures of leverage. The short term measures of leverage are relevant for the liquidity of a firm while the long term leverage ratios relate to the solvency and long term survival of a firm.

The main focus of this paper is on the pricing of risk premium that emanates from the use of leverage due to loss in financial flexibility and a potential increase in credit risk, therefore, net long term debt (long term debt less cash and cash equivalents) to total assets is taken as the relevant measure of leverage[3]. The stocks from the size and book to market portfolios are then

[2] We acknowledge that book value of debt adequately relates to available cash flows in the early years and with time the variance in book value of debt and cash flows will increase as accounting variables lose saliency while aging.

[3] We considered alternate definitions of leverage including total debt to total assets, long term debt (without adjusting for cash and equivalents) to total assets. The portfolios formed on these two leverage measures are not materially different from the one we are reporting in the paper and hence results remained robust. We are not reporting these for space constraints, however, they are available on request.

ranked on the basis of leverage ratio and firms with debt ratio of more than the median are classified as high leverage (*HL*), while those below median are recognised as low leverage stocks (*LL*). This would result in a total of twelve value weighted portfolios at the intersection of size, book to market and leverage. These portfolios are rebalanced every year in June based on their respective market value of equity, book to market ratio, and financial leverage. Figure 1 illustrates the portfolio construction procedure.

Figure 1: Portfolio Construction Procedure

Market Capitalization	Book to Market	Leverage	Portfolios
Big MV	High B/M	Low Leverage	BHLL
		High Leverage	BHHL
	Medium B/M	Low Leverage	BMLL
		High Leverage	BMHL
	Low B/M	Low Leverage	BLLL
		High Leverage	BLHL
Small MV	High B/M	Low Leverage	SHLL
		High Leverage	SHHL
	Medium B/M	Low Leverage	SMLL
		High Leverage	SMHL
	Low B/M	Low Leverage	SLLL
		High Leverage	SLHL

The names of these twelve portfolios represent their characteristics with respect to size, book to market and leverage. The portfolio BHHL includes stocks that are big in size with high book to market ratio and high financial leverage. Similarly, SLLL represents portfolio of stocks with small size, low book to market ratio and low financial leverage.

C. Variables and Model Estimation

The paper estimates a four factor asset pricing model that includes leverage as an explanatory variable for portfolio returns. The study also reports estimation of a single factor CAPM and Fama and French three factor model for twelve portfolios, and compares these results with a leverage augmented model. The regression equation (Ordinary Least Squares) that will be estimated for each of the twelve portfolios is represented as follows.

$$R_{p(t)} - R_f = \alpha + (R_{m(t)} - R_f)\beta_{1p} + (SMB_t)\beta_{2p} + (HML_t)\beta_{3p} + (HLML)\beta_{4p} + \varepsilon_t \quad \text{..... (1)}$$

Where $R_{p(t)} - R_f$ represents excess stock returns for each value weighted portfolio, $(R_{m(t)} - R_f)$ represents market risk premium, *SMB* [*small minus big*] represents size premium, *HML* [*high minus low*] represents value premium, *HLMLL* [*high leverage minus low leverage*] is the proxy for

leverage premium, while β_{1p}, β_{2p}, β_{3p} and β_{4p} are factor loadings for market, size, value and leverage premiums respectively.

The excess portfolio return is the difference between value weighted portfolio return and the risk free rate of yield on one month Treasury bill of France. The market risk premium is the difference between monthly return on S&P Euro index and risk free rate. The size premium is the difference between arithmetic average return of six portfolios with small firms and that of large firms. Fama and French (1992) argue that small firms are more vulnerable to business volatility and therefore investors require a size premium while investing in these firms. The size premium will be calculated as follows.

$$SMB = \frac{(SHHL + SHLL + SMHL + SMLL + SLHL + SLLL)}{6} - \frac{(BHHL + BHLL + BMHL + BMLL + BLHL + BLLL)}{6}$$

The value premium accounts for the premium that investors demand for investing in value stocks over growth stocks. Value stocks are those that have high book to market ratio while stocks having low book to market stocks are categorised as growth stocks. Fama and French (1992) proposed value premium as compensation for investing in financially distressed firms that is reflected through a high book to market ratio. The value premium is the difference between the average returns on four value weighted portfolios with high book to market ratio and four portfolios with low book to market ratio. Mathematically it is,

$$HML = \frac{(BHHL + BHLL + SHHL + SHLL)}{4} - \frac{(BLHL + BLLL + SLHL + SLLL)}{4}$$

We propose a leverage premium to account for the higher return on firms with a leveraged capital structure. This is in conjunction with Modigliani and Miller (1958) who proposed that the increase in leverage would result in an increase in required returns for equity and this increase in cost of equity would offset the benefits (mainly tax) derived from introducing leverage in capital structure. The leverage premium will be estimated as the difference between average returns of six high leverage portfolios and six low leverage portfolios.

Mathematically, *HLMLL* is represented as

$$HLMLL = \frac{(SHHL + BHHL + SMHL + BMHL + SLHL + BLHL)}{6} - \frac{(SHLL + BHLL + SMLL + BMLL + SLLL + BLLL)}{6}$$

The sorting process ensures that each factor is unique, so size will be free of value and leverage premium; similarly, value premium would be independent of size and leverage affects and same will be true for leverage premium. These factor will be used to estimate equations 1, 2 and 3. Fama and French (1992) contest that size and value factor are prices because investors require premium for firms that are financially distressed. Our leverage factor addresses the source of financial distress, i.e. the capital structure of a firm. If investors are sensitive towards financial leverage, significant coefficients for the leverage factor should be expected. Moreover, it should be noted that if *SMB* and *HML* proxy some form of financial panic emanating from use of debt, then in presence of the leverage factor, the estimates of size and value premium in equation 3 should lose their significance in explaining portfolio returns. The dependent variables are excess returns on our 12 portfolios sorted for size, value and leverage factor.

IV. EMPIRICAL RESULTS

The regression estimates[4] for CAPM, Fama and French three factor model and a leverage augmented four factor model are presented in Tables 4, 5 and 6, respectively. The regression coefficients for CAPM are discouraging for the time series model with insignificant risk premium and significant[5] intercepts for all portfolios. This finding suggests that market risk premium is clearly not sufficient to explain the variation in portfolio returns. This evidence adds to the existing literature against CAPM, demonstrating poor performance of beta coefficient as the only systematic risk, especially when portfolios comprise of cross country stocks.

TABLE 4 : SINGLE FACTOR (CAPM) REGRESSION ON PORTFOLIOS SORTED FOR SIZE, BOOK TO MARKET AND LEVERAGE

	α	β_1	t(α)	t(β_1)	R^2
BHLL	0.00702	-0.11113	2.95746	-1.85402	0.01895
BHHL	0.00628	-0.05817	2.18600	-0.80152	0.00360
BMLL	0.00897	-0.06927	3.69335	-1.12956	0.00712
BMHL	0.00709	-0.03792	2.74960	-0.58214	0.00190
BLLL	0.01173	-0.02381	4.53312	-0.36433	0.00075
BLHL	0.00799	-0.04065	2.95770	-0.59596	0.00199
SHLL	0.00054	-0.02198	0.21647	-0.35035	0.00069
SHHL	-0.00089	-0.04524	-0.35512	-0.71705	0.00288
SMLL	0.00228	-0.00014	0.95918	-0.00236	0.00562
SMHL	-0.00163	-0.04504	-0.74264	-0.81333	0.00370
SLLL	-0.00003	-0.08277	-0.01010	-1.22674	0.00838
SLHL	-0.00621	-0.05425	-2.44589	-0.84669	0.00401

Table 4 represents regression results for single factor CAPM with excess return as dependent while risk premium as independent variable. represents the intercept for the model, while $_1$ is the loading on CAPM based risk premium with t( ) and t($_1$) representing their respective statistical significance.

The results on Fama and French factor model provide evidence for size and value factor. It must be noted that beta coefficient in CAPM was the sole predictor of return while in multi factor models (Fama and French and the one augmented for leverage), the CAPM shares its prediction capacity with other risk premiums. The intercepts for all twelve portfolios are insignificant, which is an improvement as compared to CAPM results. The market risk premium is not significant at any instance, supporting our earlier finding that a CAPM based risk premium is not priced in international portfolios. The SMB factor loadings are significant and negative for big stocks (six portfolios) while they are insignificant for small firms. The negative sign of coefficients of big firms are in agreement with size proposition that suggests a negative relationship between *SMB* factor and big stocks. The HML factor depicts a better explanatory power with significant coefficients for eight out of twelve portfolios. These eight portfolios include four high book to market and four low book to market portfolios. The coefficient signs are negative for low book to market firms while they are positive for high book to market firms. Given the significance of coefficients complemented by their signs, HML appears to be an explanatory factor for both high and low book to market stocks. Therefore, it can be concluded that both factors, particularly

[4] These time series regressions are estimated using EVIEWS.

[5] The significance level refers to 95% (t > 1.96)

HML, are predictors of international stock returns. For significant SMB and HML regression estimates, we report a maximum adjusted R^2 of 34.5%[6].

TABLE 5: THREE FACTOR REGRESSION ON PORTFOLIOS SORTED FOR SIZE, BOOK TO MARKET AND LEVERAGE

	α	β_1	β_2	β_3	t(α)	t(β_1)	t(β_2)	t(β_3)	R^2
BHLL	0.000464	-0.096902	-0.720294	0.36955	0.19607	-1.83377	-5.955	4.108808	0.247089
BHHL	-0.00352	-0.037155	-1.076908	0.523795	-1.3282	-0.62755	-7.94646	5.197889	0.34523
BMLL	0.001604	-0.057472	-0.802488	-0.05079	0.64219	-1.03104	-6.28955	-0.53535	0.189963
BMHL	-0.0017	-0.023762	-0.958147	-0.052662	-0.6613	-0.41379	-7.28926	-0.53879	0.23387
BLLL	0.004716	-0.01752	-0.756301	-0.599047	1.91363	-0.31849	-6.00631	-6.39801	0.300785
BLHL	-0.00166	-0.027816	-1.04722	-0.358762	-0.6468	-0.48492	-7.97583	-3.67464	0.30295
SHLL	0.002888	-0.021957	0.24994	0.437582	1.08218	-0.36859	1.833012	4.315773	0.110295
SHHL	-0.00019	-0.041194	0.06766	0.579853	-0.0729	-0.70966	0.509235	5.869113	0.266048
SMLL	0.002646	-0.001603	0.041717	-0.094134	0.98219	-0.02665	0.303131	-0.91989	0.005366
SMHL	-0.00203	-0.044003	-0.044596	0.040194	-0.8147	-0.79034	-0.34994	0.424163	0.005445
SLLL	0.001459	-0.090672	0.170836	-0.605064	0.5246	-1.4605	1.202186	-5.72617	0.170981
SLHL	-0.00487	-0.0612	0.153084	-0.526347	-1.8168	-1.02214	1.116986	-5.1649	0.141399

Table 5 represents regression results for Fama and Frecnch three factor model with excess return as dependent while risk premium, SMB (size) and HML (value) as independent variables. represents the intercept for the model, while $_1$, $_2$ and $_3$ are loadings on CAPM based market risk premium, Size (SMB) and Value (HML) factor respectively. t( ), t($_1$), t($_2$) and t($_3$) representing statistical significance for corresponding factor loadings.

The results for leverage augmented four factor model are encouraging. In 11 out of 12 portfolios significant slope coefficients for HLMLL are reported. The coefficient signs are negative for low leverage firms and positive for high leverage firms. This depicts a positive relationship between our leverage factor and firm leverage demonstrating pricing of leverage premium in portfolio returns. Since most of the portfolios of high and low leverage firms have significant betas for HLMLL, the capital structure is relevant in asset pricing for firms with leverage. The inclusion of leverage factor improved the significance of SMB and HML with non zero slopes on eight size portfolios and nine book to market portfolios. In the system regressions with leverage factor, SMB become marginally relevant for small firms with positive significant betas for two small portfolios. The average adjusted R^2 for the three factor model regressions was 19.3% that increased to 31.9% with inclusion of leverage mimicking variable which indicates a significant improvement in variations explained by a four factor model.

[6] R^2 refers to coefficient of determination that present a meaningful measure of explanatory power of independent variables. A high coefficient will represent a higher tendency of explanatory variables to explain variations in dependent variable and vice versa.

TABLE 6: FOUR FACTOR REGRESSIONS ON PORTFOLIOS SORTED FOR SIZE, BOOK TO MARKET AND LEVERAGE

	α	β_1	β_2	β_3	β_4
BHLL	-0.001511	-0.093274	-0.797823	0.422775	-0.426950
BHHL	-0.001434	-0.040993	-0.994904	0.467499	0.451591
BMLL	0.000958	-0.056285	-0.827846	-0.033382	-0.139644
BMHL	-0.000092	-0.026718	-0.895000	-0.096014	0.347750
BLLL	0.002692	-0.013802	-0.835742	-0.544511	-0.437474
BLHL	-0.000324	-0.030274	-0.994710	-0.394810	0.289171
SHLL	-0.000364	-0.015982	0.122279	0.525222	-0.703018
SHHL	0.002900	-0.046870	0.188929	0.496601	0.667818
SMLL	0.000559	0.002230	-0.040168	-0.037919	-0.450931
SMHL	-0.000030	-0.047682	0.034002	-0.013763	0.432832
SLLL	-0.002046	-0.084233	0.033275	-0.510627	-0.757539
SLHL	-0.000731	-0.068810	0.315658	-0.637956	0.895283

t(α)	t(β_1)	t(β_2)	t(β_3)	t(β_4)	R^2
-0.599282	-1.781718	-6.372781	4.570234	-2.126172	0.326048
-0.506778	-0.697918	-7.082991	4.504260	2.004379	0.459924
0.355929	-1.007556	-6.196816	-0.338174	-0.651688	0.231924
-0.033529	-0.467003	-6.541535	-2.949724	1.984615	0.294707
1.025245	-0.253157	-6.410036	-5.652000	-2.091897	0.367843
-0.117609	-0.528583	-7.262488	-3.901080	2.316264	0.397830
-0.130090	-0.274866	0.879399	5.111898	-3.152086	0.458094
1.061180	-0.826087	1.984370	4.953261	3.068554	0.309252
0.194643	0.037374	-0.281496	-0.359637	-1.970174	0.269480
-0.011170	-0.863651	0.257534	-0.141080	2.043850	0.286320
-0.702252	-1.392799	0.230072	-4.778151	-3.265522	0.218596
-0.264412	-1.198182	2.298438	-6.286572	4.064206	0.215451

Table 6 represents regression results for four factor model (Fama and French augmented for leverage premium) with excess returns as dependent while risk premium, SMB (size), HML (value) and Leverage premium (HLMLL) as independent variables. represents the intercept for the model, while $_{1,}$ $_{2,}$ $_{3}$ and $_{4}$ are loadings on CAPM based market risk premium, Size (SMB), Value (HML) and Leverage (HLMLL) factor respectively. t( ), t($_{1}$), t($_{2}$), t($_{3}$) and t($_{4}$) representing statistical significance for corresponding factor loadings.

These results have surprising implications for theoretical foundations of Fama and French factor that suggests the pricing of SMB and HML is to capture the premium for financially distressed firms. A firm would be in financial distress when it finds difficulty in honouring its creditors' obligations through free cash flows or by raising external capital. Therefore, firms with

increased business risk and less financial flexibility could face such a condition. The primary indicator of financial distress is an increase in financial debt. An increasing net debt would put constraints on raising incremental capital and firms with high leverage would find it difficult and costly to access funds as compared to firms with less leverage. If SMB and HML are reflecting financial panic of a firm then inclusion of HLMLL will be explaining a similar risk premium. Hence, a four factor model including SMB, HML and HLMLL will be insignificant or at least SMB and HML would lose their significance in presence of a superior proxy of distress. Clearly, this is not the case and results demonstrated that in four factor regressions, the overall explanatory power of the model improved substantially while the significance of coefficients on size and value premium remained intact.

These findings from regression estimates indicate that SMB and HML are not a proxy for financial distress emanating from financial leverage, *at least not for the international portfolios,* and the leverage premium is systematic which should be priced separately. Our findings about size and value factor are similar to those of Vassalou and Xing (2004) who assessed the pricing of default risk in equity returns and concluded that significance of SMB and HML is not related to default related information. However, it is important to note that the significance of SMB and HML factor clearly reflects that they are priced but, given our results, the nature of risk they specify remain a puzzle. Vassalou (2003) attributed the relevance of size and book to market factor to macroeconomic factors like news related to future GDP growth.

V. CONCLUSION

Earlier proposition of Modigliani and Miller (1958) who suggested that cost of equity will increase due to increase in debt was a part of limited literature on impact of leverage on stock returns. This paper notably extends the literature on asset pricing in an international context by investigating the impact of leverage mimicking factor portfolios on variations in stock returns. The main aim of the paper was to examine if a multi factor model including a leverage premium would better explain equity returns compared to a single factor CAPM and a size and book to market three factor model. Our findings suggest that CAPM based market risk is unable to explain any variation in returns with significant intercepts and insignificant betas for all regressions. The traditional three factor model provided a better estimate by capturing some of the variations. However, the four factor model that is augmented by leverage mimicking factor has superior explanatory power of explaining time series variations of stock returns and consequently leverage premium is a systematic risk that is priced in corresponding returns. We also observe that when leverage is regressed with size and book to market factor, the latter variables did not lose any significance, indicating that the three variables are priced for independent risks. Since the level of financial leverage is the primary reflection of financial distress of any firm, it can be concluded that although SMB and HML are significant, they do not account for financial distress as proposed by Fama and French (1995). The alternate explanations for existence of size and book to market effects in a domestic context find its origin in macroeconomic variables such as future GDP growth. The source of significance of SMB and HML in international portfolios is beyond the scope of this paper and we leave that to further research.

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THE EVALUATION OF FINANCIAL STABILITY AND SOUNDNESS OF LITHUANIAN BANKS

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ABSTRACT

The successful development of economy is based on effective and stable performance of commercial banks. The evaluation of stability and soundness of banks is a complex task, involving a considerable number of multidimensional criteria. It is an idiosyncratic task because of a complicated internal business structure of banks, intertwined cash flows and strong influence of market conditions on soundness levels. In this paper, soundness and stability dynamics of commercial banks registered in Lithuania was evaluated by using several multiple criteria methods from simpler ones to the more sophisticated PROMETHEE method. The results obtained indicate that the levels of soundness and stability of banks operating in the developing Lithuanian market of commercial banks noticeably fluctuate. A comparison of the obtained results reveals the causes of the fluctuations. A simultaneous use of different multiple criteria methods for evaluating the soundness and stability of commercial banks increases the robustness of the evaluation.

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I. INTRODUCTION.

One of the most important factors influencing cohesive economic development of any country is effective performance and reliability of its banks. The evaluation of soundness and stability of the commercial banks and the stability of the financial system of a country are closely related (Miletic, 2009). In fact, if the evaluation reflects the influence of the contributing factors to the soundness and stability of each commercial bank in the market in formats, which are clear and understandable to groups of users, as well as adequately and promptly reflecting the reality, it considerably decreases information asymmetry in the banking sector. This in turn raises confidence of depositors in the group of stable banks (Ergungor, Thomson, 2005). The complexity of the task of evaluating the commercial banks is predetermined by the complicated internal business structure of banks, intertwined cash flows and strong influence of market conditions on soundness levels of banks, as a result, a considerable number of criteria of various dimensions is involved in the above problem solution.

The choice of evaluation techniques, applicable to the particular market of the commercial banks of a country is very important. Clear advantages of MCDA methods, branch of OR methods, become intensely evident wherever complexity is involved in creating an objective, thus considerably enhancing the risk-return modelling (Spronk, Steuer, Zopounidis, 2005). MCDA methods allow for using a wide range of multi-dimensional criteria and expressing the evaluation results in the clear form of ranking tables.

Advantages of using MCDA methods in finance are outlined by Zopounidis (1999). The MCDA approach allows for decreasing the level of subjectivity and accelerating decision-making. It provides a worthy possibility of structuring complex evaluation problems. The MCDA approach allows setting a structure to the problem of the evaluation by using quantitative criteria. Values of the criteria are expressed in quantitative terms and are extracted from the statistical data present in financial statements of commercial banks. At the next stage, the weights of the criteria are determined. Both stages of laying out of the criteria and determining their weights are based on eliciting knowledge from the employed experts, who define quantitative criteria and determine their weights in relation to the goals of the evaluation.

Hence, the uniform unequivocal framework of evaluation for the whole set of banks in question is set. The considered approach allows to make a transparent presentation and description of the evaluation method and to obtain prompt results. It is useful in making real-life decisions at minimal costs. These features are particularly valuable in the countries of the developing economy such as Lithuania, where economic parameters are fluctuating to great extent, decisions have to be made promptly, and cost of evaluation is of prime importance.

White, Smith, Currie (2011) point out that small developing countries have been overlooked by OR activities in contrast to large countries. In particular, this is true for Lithuania in the field of finance. Lithuanian scientists pay some attention to the problem of evaluating domestic banks by MCDA methods (Brauers, Ginevicius, Podviezko, 2012; Zavadskas, Kaklauskas, Banaitis, Kvederyte, 2004; Ginevicius, Podvezko, 2008a; Ginevicius, Podvezko, Novotny, 2010; Ginevicius, Podvezko, Podviezko, 2012; Zvirblis, Buracas, 2010; Podviezko, Ginevicius, 2010; Stankeviciene, Mencaite, 2012).

However, the research is fragmentary and cannot provide a clear picture of soundness and stability of local commercial banks and their dynamics. This paper aims to fill this gap.

The aim of the paper is to propose an evaluation methodology, which does not delay reporting of the banks' financial position. Criteria (variables) of evaluation are chosen to reflect

the aspirations of depositors in terms of soundness and stability of banks. The uniform framework of evaluation decreases subjectivity of evaluation by experts, in contrast to the approach of rating agencies, when different experts evaluate different banks.

The evaluation of soundness and stability of commercial banks presented in this paper is targeted at the decision-makers representing depositors, bank managers, and comptrollers and is intended to serve the task of decreasing financial instability. Bank runs can happen with no relation to the levels of soundness and stability of a bank for the reasons of information asymmetry (Gorton, Huang, 2006), which considerably decreases the stability of the financial system during a financial crisis (Mishkin, 1999). Besides, the quality of management and regulation depends on both promptness and clarity of information on soundness and stability of banks. Decreasing levels of information asymmetry are achieved by providing the evaluation results in various formats understandable to all above-mentioned groups of decision-makers (Podviezko, 2012). The monitoring of the levels of soundness and stability of commercial banks by every criterion and by CAMEL categories of criteria could help not only bank management, but also comptrollers to take timely preventing and stabilising regulatory actions. The ranking of banks obtained by MCDA methods is one of the major clear and understandable formats available for providing decision-aid information for decision-makers.

The paper is structured as follows. In Section 2, following the Introduction, ten criteria for the evaluating the stability and soundness of the banks are described and the 2007-2009 statistical data, presenting the performance of eight Lithuanian banks is given. In Section 3, MCDA methods (SAW, COPRAS, TOPSIS, PROMETHEE II) and their main characteristics and features are described. In Section 4, the results of the evaluation of the stability and soundness of Lithuanian commercial banks, based on the use of each particular MCDA method, as well as the final ranking of the banks, the analysis of the evaluation results and the dynamics of the relative positions of the banks in the period of evaluation, are given. Finally, in Section 5 some concluding remarks are provided.

II.VARIABLES AND DATA

Contemporary research in the field of evaluating the commercial banks has been divided into two branches: one concentrating on macroprudential, another on microprudential variables (studies using both sets of variables are also found in the literature) (González-Hermosillo, 1999; Evans, Leone, Gill, Hilbers, 2000; Sufian, 2010). Banks operating in the same macroeconomical environment, under the Lithuanian Law on Banks were chosen for the present research.

The deposits of all above-mentioned banks are covered by the same deposit insurance scheme, provided by the State deposit insurance company of Lithuania „Deposit and Investment Insurance". Both business conditions of the considered banks, the methodology of evaluation proposed in this paper are uniform. The uniformity of the latter results from the use of the MCDA framework. This allows for evaluating all banks present in the market and operating in the same environment. Consequently, in this work the range of the influencing factors is limited the micro level.

Over the whole investigated period from 2007 to 2009, there were eight commercial banks registered in Lithuania: AB DnB NORD bankas (on 11 November, 2011 it was renamed to DNB bankas), UAB Medicinosbankas, AB Parexbankas (on 26 August, 2010 it was renamed to AB "Citadele" bankas), AB SEB bankas, AB Šiauliųbankas, AB bankas SNORAS, AB Swedbank and AB Ūkiobankas.

To avoid subjectivity, we limit ourselves to quantitative evaluation of commercial banks. The banking business is complicated and so is the evaluation, which should reflect different aspects of bank activities. MCDA research must take into account a complete set of various types of criteria of soundness and stability of banks, describing major aspects of bank stability. The criteria should be of a limited number (Podviezko, Ginevicius, 2010). This may be achieved by dividing the criteria into core categories, thus creating a hierarchy, and then by filling each category with the best representative criteria, keeping in mind that the selected criteria should be non-overlapping, non-correlated, or in other words, not over-excessive. In addition, the categorisation of criteria facilitates the process of determining the weights. As we use the CAMEL approach, our criteria are intended to represent all five categories of soundness and stability as follows: Capital, Asset quality, Management, Earnings, and Liquidity. The criteria are listed in Table 2, indicating the respective ratios, the type of the criterion (which may be maximising or minimising), and the assigned weights. The weights were obtained by taking the average values of the weights elicited from seven experts in Lithuanian commercial banking. The statistical data obtained from the annual statements of the commercial banks registered in Lithuania are presented in Table 3.

TABLE 2. LIST OF CRITERIA DESCRIBING SOUNDNESS AND STABILITY OF COMMERCIAL BANKS

Code	Category	Cumulative weights of categories	Financial ratio	Max or Min	Weights
CAPITAL	Capital	0.223	ω_1 · Tier1/RWA+ ω_2 · Tier2/RWA	+	0.223
NII	Assets	0.208	Net interest income/RWA, %	+	0.052
TL			Total loans/Total assets, %	-	0.052
DELINQ			Delinquent loans/Total assets, %	-	0.052
LD			Loan value decrease/Total assets, %	-	0.052
NIC	Management	0.166	Non-interest cost/Total income, %	-	0.166
PPP	Earnings	0.225	Pre-provision profit/RWA, %	+	0.153
NI			Net income/RWA, %	+	0.072
DEP	Liquidity	0.178	Total deposits/Total loans	+	0.080
LIQ			Regulatory liquidity ratio, %	+	0.098

Notes: ω_1 and ω_2 are average weights assigned by experts to Tier 1 and Tier 2 ratios($\omega_1 = 0.666$, $\omega_2 = 0.334$); RWA denote risk-weighted assets, provided in annual statements.

Source: Authors' Estimations

Capital, represented by the first of the considered categories, serves as a buffer for absorption of possible losses of a bank. The bigger is the capital, the more it can absorb losses incepting out from bad loans, low *cost* and *earning* efficiency, as well as interest rate and FX fluctuations, trading, etc. While both Tier 1 and Tier 2 ratios in sum are forming the capital adequacy regulatory ratio, the two types of capital differ in riskiness. Naturally, experts assigned different weights ω_1, ω_2 of magnitude of contribution to soundness and stability of banks to these types of capital, namely 0.666 and 0.334 in average. For evaluation simplicity both values

representing capital adequacy ratio were multiplied by corresponding weights and added together to form the variable CAPITAL.

Assets category is represented by four ratios. The first ratio presents the magnitude of net interest income, divided by RWA (risk-weighted assets). We believe that this is a better measure than that based on dividing interest income by total assets, since it corresponds to the risk-adjusted return on capital measurement. A skewness of the ratios may appear because of an imprecise definition of risk categories of assets under Basel I framework, which was allowed to be used in Lithuania until the end of the transition period by the end of 2011. All the remaining ratios are common and obvious. The second is the ratio between loans, the most risky assets and total assets. The third ratio is delinquent loans to total assets. And finally, the last ratio within the category is the decrease of value of assets divided by total assets.

Management category is represented by a single ratio, expressing cost-efficiency of a bank. Since the aim of the research is to consider only quantitative financial criteria, we did not include the qualitative criteria to the analysis.

The category of *earnings* is represented by two ratios, which gauge pre-provision profits and net income, comparing them to risk-weighted assets. The first ratio reveals the capability of a bank to generate cash, which could then serve as a remedy for various losses, while the second ratio expresses remaining profits after all deductions have been made. The chosen ratios well agree with the findings of Wheelock and Wilson (2000): higher earnings, bigger capital ratios, cost-efficient management and better loan portfolio reduce a likehood of failure.

Finally, the last *liquidity* category is represented by the ratio between deposits and total loans, and the regulatory liquidity ratio imposed by the central bank, i.e. the Bank of Lithuania. In the former ratio, we chose the deposits represented only by customer deposits and excluded more volatile inter-bank deposits. The latter ratio indicates the short-term liquidity position of a bank within a month term.

TABLE 3. PERFORMANCE RATIOS OF COMMERCIAL BANKS REGISTERED IN LITHUANIA, %

Ratios	2007							
	AB DnB NORD bankas	UAB Medicinosbankas	AB Parexbankas	AB SEB bankas	AB bankas SNORAS	AB Swedbank	AB Šiaulių bankas	AB Ūkio bankas
CAPITAL	5.61	5.50	7.62	5.45	7.15	6.17	10.04	6.95
NII	2.64	2.91	1.54	2.59	2.55	3.55	2.36	2.90
TL	83.42	64.21	78.93	71.35	46.03	71.21	76.79	75.71
DELINQ	0.26	1.15	0.05	0.31	0.74	0.43	0.41	0.29
LD	0.19	0.39	0.24	0.13	-0.20	0.10	0.26	0.61
NIC	30.61	46.41	50.38	23.23	34.64	34.28	29.46	42.34
PPP	1.71	1.52	0.26	3.02	2.14	3.03	2.15	3.20
NI	1.23	0.87	0.00	2.47	2.08	2.34	1.71	2.43
DEP	48.08	97.04	52.95	61.42	155.43	90.48	78.72	89.85
LIQ	36.24	45.51	32.79	42.78	50.63	42.20	44.03	49.43

Source: Authors' Estimations

Ratios	2008							
	AB DnB NORD bankas	UAB Medicinosbankas	AB Parexbankas	AB SEB bankas	AB bankas SNORAS	AB Swedbank	AB Šiauliųbankas	AB Ūkiobankas
CAPITAL	6.59	10.08	7.78	6.59	6.47	9.28	10.04	7.85
NII	2.60	3.86	2.36	2.50	2.33	4.56	2.44	2.61
TL	85.95	65.53	67.14	77.92	60.60	76.57	82.06	82.19
DELINQ	1.06	8.39	0.26	1.14	3.00	1.10	0.69	1.29
LD	0.50	1.21	0.84	0.59	0.67	0.25	0.36	0.72
NIC	24.62	36.27	43.99	21.87	34.33	29.14	25.73	36.77
PPP	1.58	2.20	-0.05	2.35	1.54	3.78	1.54	2.53
NI	0.62	0.85	-1.67	1.49	0.51	2.92	1.00	1.57
DEP	34.27	102.62	29.86	50.72	113.17	72.06	74.90	87.93
LIQ	37.47	59.43	32.93	38.99	36.37	39.76	38.75	42.45

Source: Authors' Estimations

Ratios	2009							
	AB DnB NORD bankas	UAB Medicinosbankas	AB Parexbankas	AB SEB bankas	AB bankas SNORAS	AB Swedbank	AB Šiauliųbankas	AB Ūkiobankas
CAPITAL	6.39	10.29	10.14	7.31	6.43	11.29	9.26	8.05
NII	2.58	2.77	2.17	2.09	0.08	3.15	1.52	0.80
TL	86.36	66.17	87.00	71.10	53.18	76.60	80.05	71.82
DELINQ	3.36	3.02	5.56	2.94	7.66	6.45	0.95	5.51
LD	4.77	1.88	4.33	6.45	1.39	5.52	2.08	2.12
NIC	24.33	30.95	52.82	29.61	27.66	27.61	22.15	32.25
PPP	2.47	1.98	-0.75	1.25	1.95	3.16	0.78	0.08
NI	-3.93	0.05	-7.77	-10.60	0.18	-9.11	-1.67	-2.08
DEP	33.10	113.31	41.55	56.57	148.07	84.11	92.74	110.93
LIQ	37.61	55.31	40.74	60.31	41.26	45.50	34.61	50.86

Source: Authors' Estimations

Table 3 can give some basic idea of the relative soundness and stability position of banks and be used in thorough evaluation of banks based on each criterion. However, the following shortcomings of this type of evaluation can be listed:

- weights of criteria are not accounted for;
- integrating relative positions of banks into a single criterion of soundness and stability is still an overwhelming task;
- distortion of data mostly referring to the categories, where data is often imprecise (e.g. within the assets and earnings categories, where data often strongly depends on the accounting policies of a bank) is not taken into consideration.

Nevertheless, the criteria values are perfect to show the levels of riskiness of a bank with respect to every criterion, particularly, when the level of soundness and stability a bank is relatively low. Even at this stage it is possible to make conclusions by considering data in Table 3.

Final rankings of the banks reflecting their evaluation by all MCDA methods will appear at the end of Section 4.

III.THE APPLIED METHODS

Compromising of the following intrinsic conflicts between the goals for optimising the values of criteria observed within the categories is facilitated by the MCDA approach. For example, the variables under the category of assets standing for the quality of loans are set, taking into account the objective of maximal safety of bank assets (in terms of our analysis), while the variables under the category of earnings are set to account for the objective of increasing profits, which usually implies an increase of assets risk. Another conflict is between the goals set for the variables under the category of liquidity and efficiency, since liquid assets usually generate lower yields. MCDA methods are designed to cope with the task of evaluation, when the goals are conflicting. Different MCDA methods were chosen and applied to the analysis of the financial data for 2007, 2008, and 2009 contained in the financial statements of the commercial banks registered in Lithuania. Each method yields rankings of the banks. The dynamics of soundness and stability of the banks is demonstrated. Based on the cumulative criterion of all MCDA methods used, the ranking tables of banks will be created.

There is no single best MCDA method, which guarantees precision of evaluation. Each MCDA method has its specific features and logic, therefore discrepancies in the results of evaluation obtained by each method may occur. Only the simultaneous use of several MCDA methods can increase the reliability of the results. In this paper, some popular MCDA methods, such as SAW, and TOPSIS, as well as created in Lithuania method COPRAS and more sophisticated PROMETHEE II method with deeper intrinsic logic are used. The average of cumulative criteria for each bank obtained by using each of the above-mentioned methods is finally taken, which provides a basis for the final ranking of the considered banks. The dynamics of the positions of the banks in the market in the period of 2007-2009 is shown in Table 6.

The MCDA methods use a decision matrix containing the statistical data or experts' assessment data $\mathbf{R}=\left\|r_{ij}\right\|$ characterising the objects being evaluated, and weights of criteria ω_i ($\sum_{i=1}^{n}\omega_i=1$), $i=1,2,...,m;\ j=1,2,...,n$, where m is the number of criteria, n is the number of the evaluated objects or alternatives, outlined in Table 3. Every criterion must be defined as maximising or minimising. The maximum values of maximising criteria are considered to be the best, while the minimum values are the best for minimising criteria.

A. THE SAW METHOD.

The SAW (Simple Additive Weighting) (Hwang, Yoon, 1981; Ginevicius, Podvezko, Bruzge, 2008) method is the oldest most widely known and practically used MCDA method. The method was applied after normalisation of data (Ginevicius, Podvezko, 2009) and after transformation of values in case if there are negative ones (Ginevicius, Podvezko, 2007). The results of evaluation S_j are expressed in convenient relative values making the unity in the total $\sum_{j=1}^{n}S_j=1$. The

alternatives could be ranked in the decreasing order in accordance with the value of the cumulative criterion of the method S_j.

B. THE COPRAS METHOD.

The COPRAS (Complex Proportional Assessment) method was created in 1996 and quickly became popular (Ginevicius, Podvezko, 2008b;Zavadskas, Turskis, 2011; Podvezko, 2011; Kildienė, Kaklauskas, Zavadskas, 2011). This method, unlike previously described methods uses both minimising and maximising criteria and does not require the transformation of the former into the maximising ones. The cumulative criterion of this method has two components, where one of them S_{+j}, is designed to comprise the maximising criteria, and is identical to the respective additive of the cumulative criterion of the SAW method S_j.

The cumulative criterion of the COPRAS method is expressed by the following formula:

$$Z_j = S_{+j} + \frac{S_{-\min} \sum_{j=1}^{n} S_{-j}}{S_{-j} \sum_{j=1}^{n} \frac{S_{-\min}}{S_{-j}}} \tag{4}$$

where

$S_{+j} = \sum_{i=1}^{m} \omega_{+i} \tilde{r}_{+ij}$ represents the contribution of the *j-th* alternative's maximising weighted values of criteria $\tilde{r}_{+ij}$, normalised in accordance with the formula (2), to the cumulative criterion of the method.

The contribution of minimising criteria is represented by the other component, where $S_{-j} = \sum_{i=1}^{m} \omega_{-i} \tilde{r}_{-ij}$, which is *j-th* alternative's weighted sum of minimising values of criteria $\tilde{r}_{-ij}$, normalised in accordance with the formula (2). $S_{\text{-min}} = \min_{\text{j}} S_{\text{-}j}$ is the minimal value of all minimising criteria.

C. THE TOPSIS METHOD.

The TOPSIS (Technique for Order Preference by Similarity to an Ideal Solution) (Opricovic, Tzeng, 2004) method has its unique exciting idea and therefore is one of the most interesting and therefore popular. The alternative is considered as the best solution in the case when the distance to the best hypothetical solution V^* is the shortest, while the distance to the worst hypothetical solution V^- is the largest. The method could be directly applied without the transformation of

minimising criteria into the maximising ones. Normalisation of the criteria in the TOPSIS method transforms a vector to the unit vector by the following formula:

$$\widetilde{r}_{ij} = \frac{r_{ij}}{\sqrt{\sum_{j=1}^{n} r_{ij}^2}} \quad (i = 1, ..., m; \ \ j = 1, ...n), \tag{5}$$

where $\widetilde{r}_{ij}$ is the normalised value of the *i-th* criterion for the *j-th* alternative.

The distances of each *i-th* alternative to the best hypothetical solution and to the worst hypothetical solution are calculated as follows:

$$D_j^{\ *} = \sqrt{\sum_{i=1}^{m} (\omega_i \widetilde{r}_{ij} - V_i^*)^2} \tag{7}$$

$$D_j^{\ -} = \sqrt{\sum_{i=1}^{m} (\omega_i \widetilde{r}_{ij} - V_i^-)^2} \tag{8}$$

The cumulative criterion $C_j^* \ (0 \le C_j^* \le 1)$ of the TOPSIS method is calculated in this way:

$$C_j^* = \frac{D_j^-}{D_j^* + D_j^-} \quad (j = 1, 2, ..., n) \tag{9}$$

Ranking is made in the decreasing order in accordance with the values of the cumulative criterion of the TOPSIS method. The highest value of the criterion corresponds to the best alternative, and its lowest value corresponds to the worst alternative.

D. THE PROMETHEE METHOD

The PROMETHEE (Preference Ranking Organisation Method for Enrichment Evaluation) methods (Brans, Mareschal, Vincke 1986; Figueira, Greco, Ehrgott, 2005) differ from other multicriteria methods by the depth of their intrinsic logic and by the use of the preference functions, which make a basis of the methods. The shapes of the functions and their parameters are chosen by decision-makers. The PROMETHEE methods integrate the values of the selected criteria and their weights in a more sophisticated way by using preference functions with few

parameters. The shapes of the preference function and their parameters are chosen by the persons responsible for evaluation, i.e. by decision-makers or qualified experts.

The PROMETHEE methods use the values of the so-called preference functions $p(d)$ rather than normalised values of the criteria $\widetilde{r}_{ij}$. The values of the functions account for the level of preference of one alternative over another. This ensures clear advantages of the method over other approaches. The need for transforming the minimising criteria into the maximising ones, and, what is more important, the negative values of the criteria into the positive ones in the process of data normalisation is eliminated.

The shapes of the functions, as well as boundary parameters *q* and *s* for each criterion *i*, are chosen by decision-makers, e.g. q_i is chosen for the lower and s_i - for the upper boundary of the argument, where the preference function ranges in the interval $0 < p(d) < 1$ (Podvezko and Podviezko, 2010a,b). A single type *V*-shape with the indifference preference function was chosen for all the criteria to reflect the proportional preference for the alternatives compared, wherever $d_i(A_j, A_k)$ falls between the parameters q_i and s_i:

$$p_i(d) = \begin{cases} 0, \text{ when } d_i \le q_i \\ \dfrac{d_i - q_i}{s_i - q_i}, \text{ when } q_i < d_i \le s_i \\ 1, \text{ when } d_i > s_i \end{cases} \quad (10)$$

We obviously use the advantage of the PROMETHEE II method and set different degrees of tolerance for obtaining the levels of indifference, depending on the degree of precision of data given. For example, the data on the deterioration of loan portfolio strongly depends on the accountancy method used by each bank and is therefore rather imprecise. The liquidity ratio LIQ imprecision is highlighted by another argument: it reflects the bank's liquid position only within a month's period. On the other hand, the data on the capital, for example, has a much higher degree of precision. Parameters *q* and *s* for each criterion *i* and the year of the analysed period are obtained in accordance with the algorithm described in Podvezko and Podviezko (2010a). The values of the parameters q_i and s_i are presented in Table 4

TABLE 4. THE VALUES OF THE PARAMETERS Q_I AND S_I

Code	2007		2008		2009	
	q_i	s_i	q_i	s_i	q_i	s_i
CAPITAL	0.20	4.46	0.11	3.50	0.18	4.75
NII	0.11	1.91	0.13	2.11	0.23	2.92
TL	0.05	2.11	0.16	2.11	0.23	2.11
DELINQ	0.05	1.06	0.28	7.89	0.25	6.51
LD	0.11	0.72	0.16	0.85	0.64	4.46
NIC	1.71	25.82	1.59	21.04	1.59	29.14
PPP	0.16	2.80	0.19	3.64	0.23	3.71
NI	0.16	2.35	0.30	4.36	0.66	10.24
DEP	3.83	104.16	5.26	80.90	5.76	111.59
LIQ	1.44	16.98	1.55	25.19	1.78	24.44

Source: Authors' Estimations

The PROMETHEE II method yields the cumulative criterion of evaluation F_j. The method ranges the alternatives in the decreasing order in respect of the values F_j.

The authors also obtained the results for the same group of banks using the PROMETHEE I method. The results obtained using the PROMETHEE II method match the results yielded by the PROMETHEE I method, which is designed only to indicate the best alternative.

IV. THE RESULTS OBTAINED.

The evaluation of the banks in terms of soundness and stability was made by four MCDA methods: SAW, TOPSIS, COPRAS, and PROMETHEE II, using the formulas (1)-(13). The methods generated cumulative criteria, representing a relative level of soundness and stability of banks, which then were used to perform the ranking of banks by each method. The results (presented in Table 5) demonstrated rather good concordance. The correlation coefficients between all pairs of cumulative criteria obtained by MCDA methods range from 0.98 to 0.80, which shows a very good agreement. Insignificant exceptions reinforce the statement that several MCDA methods should be used simultaneously in order to increase the reliability of the result.

TABLE 5. THE RESULTS OF EVALUATION OF STABILITY AND SOUNDNESS OF LITHUANIAN COMMERCIAL BANKS IN THE PERIOD OF 2007-2009

2007		AB DnB NORD bankas	UAB Medicinosbankas	AB Parexbankas	AB SEB bankas	AB bankas SNORAS	AB Swedbank	AB Šiaulių bankas	AB Ūkio bankas
SAW	S_j	0.108	0.102	0.106	0.137	0.140	0.134	0.137	0.135
	No.	6	8	7	3	1	5	2	4
TOPSIS	C_j^*	0.436	0.306	0.307	0.593	0.593	0.607	0.670	0.621
	No.	6	8	7	4-5	4-5	3	1	2
COPRAS	Z_j	0.112	0.101	0.089	0.141	0.139	0.138	0.141	0.137
	No.	6	7	8	1-2	3	4	1-2	5
PROMETHEE II	F_j^+	0.595	0.742	0.646	1.644	2.126	1.499	2.263	1.522
	F_j^-	1.844	2.016	3.180	0.925	0.585	0.741	0.730	1.017
	F_j	- 1.249	-1.274	-2.534	0.719	1.541	0.758	1.533	0.505
	No.	6	7	8	4	1	3	2	5
Cumulative rank		24	30	30	13	9.5	15	6.5	16
Rank		6	7-8	7-8	3	2	4	1	5

Source: Authors' Estimations

2008		AB DnB NORD bankas	UAB Medicinosbankas	AB Parexbankas	AB SEB bankas	AB bankas SNORAS	AB Swedbank	AB Šiaulių bankas	AB Ūkio bankas
SAW	S_j	0.113	0.133	0.102	0.125	0.112	0.156	0.136	0.124
	No.	6	3	8	4	7	1	2	5
TOPSIS	C_j^*	0.502	0.504	0.336	0.584	0.468	0.778	0.613	0.594
	No.	6	5	8	4	7	1	2	3
COPRAS	Z_j	0.117	0.128	0.090	0.129	0.114	0.157	0.139	0.127
	No.	6	4	8	3	7	1	2	5
PROMETHEE II	F_j^+	0.661	2.554	0.583	1.130	0.928	2.604	1.817	0.978
	F_j^-	1.829	1.084	2.857	1.395	1.608	0.494	0.735	1.254
	F_j	- 1.168	1.470	-2.274	- 0.266	-0.679	2.110	1.082	-0.276
	No.	7	2	8	4	6	1	3	5
Cumulative rank		25	14	32	15	27	4	9	18
Rank		6	3	8	4	7	1	2	5

Source: Authors' Estimations

2009		AB DnB NORD bankas	UAB Medicinosbankas	AB Parexbankas	AB SEB bankas	AB bankas SNORAS	AB Swedbank	AB Šiauliųbankas	AB Ūkiobankas
SAW	S_j	0.119	0.151	0.091	0.110	0.133	0.137	0.145	0.115
	No.	5	1	8	7	4	3	2	6
TOPSIS	C_j^*	0.554	0.804	0.299	0.470	0.570	0.664	0.614	0.478
	No.	5	1	8	7	4	2	3	6
COPRAS	Z_j	0.119	0.158	0.093	0.109	0.128	0.136	0.140	0.117
	No.	5	1	8	7	4	3	2	6
PROMETHEE	F_j^+	0.954	2.400	0.766	1.188	1.565	2.186	1.579	1.202
II	F_j^-	1.906	0.294	2.865	1.691	1.516	0.999	1.159	1.409
	F_j	-0.952	2.107	-2.099	-0.503	0.049	1.186	0.420	-0.207
	No.	7	1	8	6	4	2	3	5
Cumulative rank		22	4	32	27	16	10	10	23
Rank		5	1	8	7	4	2-3	2-3	6

Notes: S_j, C_j^*, Z_j, are the cumulative criteria of the respective SAW, COPRAS and TOPSIS methods, F_j^+, F_j^- are "outgoing" and "incoming" ranking cumulative indices, F_j is the cumulative criteria of the PROMETHEE method, *No.*is the outranking position determined by each method, *Cumulative rank* is the sum of ranks obtained by each method, *Rank* is the cumulative outranking position

Source: Authors' Estimations

The final ranking is presented in Table 6.

TABLE 6. AVERAGE RELATIVE SOUNDNESS AND STABILITY POSITIONS OF LITHUANIAN COMMERCIAL BANKS IN 2007-2009

	AB DnB NORD bankas	UAB Medicinosbankas	AB Parexbankas	AB SEB bankas	AB bankas SNORAS	AB Swedbank	AB Šiauliųbankas	AB Ūkiobankas
2007	6	7-8	7-8	3	2	4	1	5
2008	6	3	8	4	7	1	2	5
2009	5	1	8	7	4	2-3	2-3	6

Source: Authors' Estimations

The market of Lithuanian commercial banks in terms of soundness and stability appears to comprehend a considerable portion of instability and turbulence of the emerging market. Due to this instability, it seems impossible to disaggregate the considered banks into categories according to the levels of their soundness and stability. The banks once appearing to be most stable yield their positions to other banks. Only two banks AB Šiauliubankas and AB Swedbank, could be assigned to the upper-stability group. In addition, AB Parexbankas steadily exhibited the tardiness over the considered period. More detailed examination based on the key factors influencing soundness and stability positions of commercial banks is provided in Podviezko (2012).

V. CONCLUSIONS

The successful development of economy is based on effective and stable performance of commercial banks, as the analysis of performance of the financial system of Lithuania revealed that it is bank-based. The evaluation of stability and soundness of banks is a complex task, requiring the use of a number of multi-dimensional criteria. MCDA methods are well suited for solving such problems, especially in the cases, when data is too scarce to use statistical methods.

MCDA methodology was applied to the financial data of the period from 2007 to 2009 reported by all eight commercial banks registered in Lithuania. The methodology is based on the comparison of the financial performance ratios and ultimately yields the relative levels of soundness and stability of commercial banks in the form of annual rankings, based on which the dynamics of soundness and stability of commercial banks can be observed. Several MCDA methods, including SAW, TOPSIS, COPRAS and PROMETHEE II were used in the investigation. The latter method does not require the transformation of data with negative values, which was very useful for the present analysis. Another very useful feature of the method was used in the methodology, such as degrees of tolerance, which create levels of indifference, depending on the degree of precision of data given.

The evaluation based on the described methodology is very important for the clients of the banks, for regulatory purposes, and for banks' management, since the format of the results, presented both as the ranking tables, and by the average values of the cumulative criteria obtained by using the above-mentioned different MCDA methods is understandable by the considered groups of users. The former type of presentation indicates a general position of the bank in the market in terms of its soundness and stability, while the latter more precisely expresses a relative position of banks in real numbers. The requirement for developing more formats for presenting the results obtained by using MCDA methods, which can demonstrate the causes of either the prominence or lagging of a bank has been raised in the paper. In the fluctuating market, MCDA provides the opportunity of prompt evaluation, allowing for rapid reaction of bank management or comptrollers to the situation.

The deviations in the results, obtained by using different MCDA methods, were found to be insignificant, as correlation of values between the cumulative criteria of each method are ranging from 0.8 to 0.98. Precision of the ultimate result was increased by taking the average of the cumulative criteria. Additional considerations explaining the application of different MCDA methods and the average stem from the well-known fact that the best MCDA method cannot be identified. This approach reduces the model risk found in the cases, when unacceptable distortions of the results obtained by using different methods can be observed.

The evaluation results revealed certain instability of Lithuanian commercial bank market. First, a clear leader, i.e. the most stable bank has not been found. Second, the fluctuations of the positions of the banks were considerable over the period analysed. Relative soundness and stability positions of two banks drastically changed over the period of investigation. For example, from the last place to the leading place (UAB Medicinosbankas) and from the highest position to the bottom position (AB SEB bankas).

For increasing the reliability of the results additional statistical methods could be used when the extensive statistical data have been obtained. The using other MCDA methods such as UTA, DEA, ELECTRE III, IV, MUSA, and DEA should increase the reliability as well. The classification of banks into the categories representing reliable, sufficiently reliable and relatively weak banks, using the methods M.H.DIS, UTADIS I,II,III, ELECTRE TRI, RANGU, ROSE, PREFDIS

and others could further increase the reliability of the obtained results as well. Moreover, the latter results would serve as an additional valuable reporting tool for the groups of users involved in the evaluation.

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EVALUACIJA STABILNOSTI TRŽIŠTA I SIGURNOST LITVANSKIH BANAKA

SAŽETAK

Uspješan razvoj ekonomije se bazira na učinkovitom i stabilnom poslovanju komercijalnih banaka. Evaluacija stabilnosti i sigurnosti banaka je složen zadatak koji uključuje znatan broj multidimenzionalnih kriterija. To je i idiosinkratski zadatak radi komplicirane interne strukture banaka, isprepletenih tokova novca i snažnog utjecaja stanja na tržištu na razine sigurnosti. U ovom radu se procjenjuje dinamika sigurnosti i stabilnosti komercijalnih banaka registriranih u Litvi uz pomoć nekoliko metoda s višestrukim kriterijima, od jednostavnih do sofisticirane PROMETHEE metode. Dobiveni rezultati upućuju na to da su razine sigurnosti i stabilnosti banaka koje posluju na novonastalom litvanskom tržištu komercijalnih banaka uočljivo fluktuirajuće. Usporedba dobivenih rezultata otkriva uzroke fluktuacija. Istovremeno korištenje različitih kriterija u metodama procjene sigurnosti i stabilnosti komercijalnih banaka povećava čvrstinu procjene.

Ključne riječi: analiza višestrukih kriterija, OR u bankarstvu, sigurnost i stabilnost banaka, CAMEL


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THE INFLUENCE OF OWNERSHIP STRUCTURE ON THE PERFORMANCE IN CROATIAN HOTEL INDUSTRY

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ABSTRACT

Transition from the socialist to market economy required, in one of its stages, a change in ownership structure and privatisation of enterprises. Privatisation developed differently in former socialist countries: in some countries, the process has been completed fully, while in other countries, it has been completed only partially. In addition to differences in the dynamics of privatisation across countries, privatisation evolved differently across sectors within a single national economy. Moreover, the birth of the Croatian state and a shift towards the market economy evolved in specific conditions due to the Croatian War of Independence, which placed an additional burden on the transition process which is difficult as it is. This paper examines the privatisation of hotel industry in Croatia, its dynamics and its results in the light of two facts. Firstly, tourism represents a major driver of economic growth in Croatia, and secondly, the resources available within this sector are very specific. The paper therefore evaluates the justification of privatisation by studying various facets of economic performance among privatised and non-privatised enterprises, e.g. their level of productivity and structure of debt, with special emphasis on the performance of mixed enterprises. The study results indicate a far better performance of private firms in relation to state-owned enterprises. More precisely, better economic performance is noticed in enterprises where state holds minority ownership interest than in enterprises where state holds majority ownership interest.

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I INTRODUCTION

The issue of privatisation has long been the object of discussion in economic history albeit with different intensity. Ever since A. Marshall, privatisation has been understood as the sale of state-owned enterprises to the private sector. It is also generally understood that privatisation has had varying degrees of importance in particular countries. Still, the literature suggests that greater significance of privatisation was especially evident at the end of the 20th century when, on the one hand, developed countries launched privatisation of particular sectors, e.g. financial sector, telecommunications etc., and on the other, centrally planned economies embarked on mass privatisation.

After a long period of stagnation of economic development during the 1980s, centrally-planned economies (12 Eastern European countries and 15 states within the former USSR) initiated various changes in economies and society in general, thus marking the beginning of the transition process. It should be mentioned that at the end of the 1980s Croatia was still a constituent republic of the former federation, suffering from high debt related to short-term loans. This resulted in Croatia being classified on the list of seventeen world's biggest debtor nations. As a result of permanent rollovers of loans and high interest, huge funds had been drained out from the economy and allocated to consumption, which only worsened the problem. As Yugoslavia dissolved, economies of its former constituents revealed an encumbered economic structure mired in heavy industry, uncompetitive manufacturing industry, technological inferiority and overemployment. These are but a few examples illustrating the economic situation in Croatia at the beginning of the 1990s.

Transition in Croatia began after the Constitution of the Republic of Croatia was passed in December 1990. This period was marked by the onset of war in autumn 1991, as well as by big numbers of displaced persons and refugees, human casualties and immense material damage. In those circumstances, unsurprisingly, the Croatian economy recorded a dramatic fall in GDP (-11.7% in 1992) and faced the problem of inflation (over 1,000% in 1993).

In addition to monetary independence, transition also required changes in institutional and legal frameworks. In that respect, it could be said that the process of ownership transformation in Croatia began in 1991 with the passing of the Law on the Transformation of Socially Owned Enterprises. This Law provided for ownership transformation of state-owned enterprises into joint stock companies (Croatian: *d.d.* or *d.o.o.*) and privatisation, or selling state ownership and state rights to private legal and physical entities, could begin.

Before privatisation, in 1990, the Croatian economy consisted of 10,859 enterprises, of which 3,637 (33.49%) were state-owned, employing 97.62% of the labour force. On the other hand, there were 6,785 private firms (62.48%) employing 1.73% of the labour force.[1] In view of that, the course of transition of the Croatian economy from state-ownership to market economy can be, under certain conditions, be divided in two stages: ownership transformation as the first stage, and privatisation as the second. Each of the two stages employed specific and complementary privatisation-aimed methods, which makes it difficult to pinpoint precisely a specific privatisation method and modality in a particular stage within the given period.

The deadline for transformation of ownership was 30 June 1992 after which the enterprises which had not completed ownership transformation were assigned to *Hrvatski fond za razvoj* (Croatian Fund for Development). If we further take into account the fact that banks,

[1] According to Družić I. et al. *Hrvatski gospodarski razvoj,* Ekonomski fakultet Sveučilišta u Zagrebu, Zagreb, 2003.

which were then mostly state-owned, transformed their claims on loans into ownership shares during ownership transformation, we can conclude that in the stage of ownership transformation in Croatia, privatisation actually increased state ownership in business organisations.

Even though the process of privatisation began in 1992, after a legally determined deadline for completion of the ownership transformation stage, privatisation was formalised only when the Privatisation Act was passed in 1996.[2] Prior to that, a Regulation of 1993 enabled the sales of Croatian Privatization Fund's portfolio via a public tender in order to attract capital from diaspora, while a Regulation from 1994 allowed for purchases of shares with "old savings" in foreign currency from the former country. Until the end of 1995, the private sector accounted for less than 50% in economic activities, which means that privatisation only partially succeeded. Bendeković's study on the effect of privatisation in Croatia (Bendeković, 2000) indicates that legal regulations and procedures were not respected in privatisation, and that judging by the results available at that time, privatisation did not achieve its goals. Quite to the contrary, privatisation created a negative effect from political, social and economic point of view.

So, to what extent did privatisation yield positive results and did it succeed in the hotel industry? These are the questions we have set out to explore in this paper. It should be mentioned that the economic literature shows opposing views on the efficiency of private and state ownership, although as a rule, the private sector is thought to create positive effects in introducing innovations and improving cost management.

II PRIVATISATION IN TRANSITION COUNTRIES

Since the main cause of debt crisis in developing economies in the 1980s was poor competitiveness, the International Monetary Fund and World Bank programs shifted toward a microeconomic approach, demanding from transition countries to implement structural adjustment policies to raise competitiveness of enterprises and increase their nation's creditworthiness. Typically, developing countries faced proposals to implement comprehensive measures of structural adjustments which included privatisation, stabilisation, market orientation and internal and external liberalisation.

Privatisation held a central position in reform policies of former socialist countries. It also represented a cornerstone of transition as it was expected to solve the problem of technologies which were lagging behind in these countries. Interestingly enough, the model of privatisation of socialist economies, especially self-governing socialism, had not been known in the scientific literature and practise of that time, so that the case of Croatian privatisation proved to be even more complex. Privatisation generally includes four elements: mass privatisation, mostly in the sphere of manufacturing, privatisation of the service sector, land reform or reprivatisation of agriculture and finally, denationalisation. Moreover, together with mass

[2] The Privatisation Act (NN 21/96) allowed the possibility to grant shares, without any payment in return, to certain categories of citizens, primarily Homeland war veterans, war invalids, family members of the killed, imprisoned and persons pronounced missing, displaced persons and refugees. The right to hold shares through vouchers was exercised by acquiring shares at the auction, or by proxy through an investment fund, as well as by direct investment in company shares.

privatisation in transition economies, ownership transformation was under way in some mixed economies of developed countries such as Italy, France and Austria since they had a bigger share of state ownership than for example USA and Japan. Overall, the last decades of the 20th century were marked by privatisation in transition countries, but also by privatisation of major state-owned enterprises in developed countries, especially in the sphere of iron and steel production, energy sector, telecommunications and financial sector.

Many research studies on the performance of enterprises in private and state ownership indicate increased efficiency of private firms, even though in certain sectors the results are ambiguous. For example, Bennett and Johnson (1979), as well as De Alessi (1980) argue that the private sector is far more efficient than the public sector, whereas other authors such as Millward and Parker (1983) and Borins and Boothman (1985) do not find any significant interdependence between performance and ownership structure even though, in certain interpretations, they favour the public sector, especially when this relates to the production of electrical energy and water supply. This is important because there are not many private firms in these sectors, and even if there are, they are often regulated or are allowed limited competition. A comprehensive overview of related research between 1970 and 1995 is given in Villalonga's paper (Villalonga, 2000) where this author shows that in the total of 153 research studies conducted, 104 show higher efficiency of private firms, 14 show smaller efficiency of private firms and 35 studies are neutral in that respect. Even though there are evidently contradictory findings, it is clear that findings vary according to the structure of the market for a particular industry, features of the country itself and also according to employed efficiency indicators.

Differences in performance of private firms and state-owned enterprises can be analysed using the principal and agent theory which takes into account the relationship of manager (agent) and owner (principal). The assumption is that managers will, irrespectively of ownership structure, rather invest their efforts into maximizing their own benefits than the benefits of the entire organisation, but this attitude is less visible in private firms due to fears of takeovers, sales in case of poor results, danger of bankruptcy, and high turnover of managers. Shapiro and Willig (1990) emphasise that the main difference between private firms and state-owned enterprises lies in the information flows in the framework of hierarchical relationships between public officials and managers, and private owners and managers. In state-owned enterprises this relationship transforms into the relationship between a state-public official and public official-manager (Villalonga, 2000). According to Laffont and Tirole (1991), state-owned enterprises use their resources suboptimally considering that some of them are geared towards satisfying social aims.

The processes of ownership transformation and privatisation in Croatia have led to the formation of mixed ownership enterprises, which in turn has intrigued scholars to analyse their performance. Although research on mixed enterprises is less prevalent, Eckel and Vininga (1985) suggest that mixed enterprises have better performance than state-owned enterprises, but poorer performance than private firms. Villalonga (2000) in his study analyses 24 Spanish enterprises facing numerous political and organisational factors which affect the process of privatisation. Privatisation results and efficiency of enterprises vary according to the stage of post-transition period. Negative effects of privatisation in initial post-privatisation years were exceeded by positive effects in the seventh and eighth year after privatisation, which points to the need of observing transition in a longer span of more post-transition years.

Privatisation in particular countries in transition varied according to the methods applied even though the goal was always to privatise enterprises and to make a shift towards the market economy. Table 1 shows different methods of privatisation in a selected number of

countries in transition. Among the total of 23 analysed countries, exclusive prevalence of one single method in the first and second stage cannot be established. Actually, it is clear that vouchers prevailed in stage one while direct sale and voucher methods prevailed in the second stage. In addition to these methods, MEBO was used more in the first than in the second stage. MEBO privatisation method developed as a sale of shares of the enterprise to managers and employees of the enterprise while in direct sales the enterprise was sold using a public tender according to predetermined criteria. The voucher privatisation model was adopted in 1991 by the Czechoslovakian government, after which it spread to other countries in transition (Russia, Estonia, Romania etc.). In the narrow sense, it represents issuing vouchers which citizens can use to buy shares/stakes of the enterprise.

TABLE 1 PRIVATISATION MODELS IN SELECTED COUNTRIES IN TRANSITION

COUNTRY	PRIVATISATION TYPE	YEAR OF PRIVATISATION*	PRIMARY METHOD	SECONDARY METHOD
Albania	mixed	1995	MEBO	coupon
Armenia	mass	1994	coupon	direct sale
Azerbaijan	mass	1997	coupon	direct sale
Belarus	mixed	1994	MEBO	coupon
Bulgaria	complete	1993	direct sale	coupon
Croatia	mixed	1992	MEBO	coupon
Czech Republic	mass	1992	coupon	direct sale
Estonia	complete	1993	direct sale	coupon
Georgia	mass	1995	coupon	direct sale
Hungary	complete	1990	direct sale	MEBO
Kazakhstan	complete	1994	direct sale	coupon
Kirgizstan	mass	1996	coupon	MEBO
Latvia	complete	1992	direct sale	coupon
Lithuania	mass	1991	coupon	direct sale
Macedonia	mixed	1993	MEBO	direct sale
Moldavia	mass	1995	coupon	direct sale
Poland	complete	1990	direct sale	MEBO
Romania	mixed	1992	MEBO	direct sale
Russia	mass	1993	coupon	direct sale
Slovakia	complete	1995	direct sale	coupon
Slovenia	mixed	1998	MEBO	coupon
Ukraine	mass	1994	coupon	MEBO
Uzbekistan	mixed	1996	MEBO	direct sale

*Note: Year of privatisation has been determined on the basis of EBRD data for primary privatisation and chronology of privatisation. Source: Adjusted by the authors on the basis of Bennett J. et al: Privatisation Methods and Economic Growth in Transition Economies.

As for Croatia, enterprises were able to make a decision on which method to use in ownership transformation after they had assessed their capital value, i.e. the share capital of the newly formed company. This assessment was based on the book value of state-owned capital, and an assessment of assets and liabilities. In the ownership transformation stage, Croatia transformed ownership through the sale of enterprises to strategic partners and through insider privatisation involving employees and management (MEBO). Until the end of 1995, ownership transformation was completed in 2,598 companies, of which 1,146 were transformed to completely private ownership (44%), whereas other enterprises remained in minority or majority state ownership. This clearly indicates that the success of ownership transformation stage is only partial (Crnković B., 2010).

Voucher privatisation included a total of 471 companies with the capital valued at DEM 3,668,440,618 to be privatised. It is worth mentioning that 75.5% of that capital came from manufacturing industry, mining, catering and tourism.[3] In addition, 281 of 471 enterprises to be privatised through vouchers were not solvent and profitable. Considering the value of share capital designated for voucher privatisation, 23.6% were auctioned successfully in the first round, 23.2% in the second round and around 53.2% were auctioned successfully in the third round. The bidders showed the keenest interest in the shares of companies which were traded on capital markets (there were 11 publicly traded companies whose shares were offered through vouchers). In the sector of tourism, 85 companies participated in voucher privatisation, which represented 18.1% of the total number of enterprises which participated in voucher privatisation.

Voucher privatisation ended at the end of 1998 even though its aftermath proved critical for some companies. Namely, due to the crisis of 1999 many of these companies went bankrupt and many small shareholders, and even tycoons, returned their shares to the portfolio of the Croatian Privatization Fund. The government then adopted a plan and program to privatise all enterprises which included the basic model of public tenders for strategic enterprises, and the sale on Zagreb and Varaždin Stock Exchange. On 30 June 2002, as a result of privatisation, the portfolio of the Croatian Privatization Fund included a total of 1,091 enterprises. Ever since that day, the Croatian government has not ceased to sell shares that it owns through public tenders, albeit at a different pace and intensity.

According to EBRD, the worst results in the privatisation of state-owned enterprises were recorded by Serbia, with grade 2.7 in 2012, followed by Bosnia and Herzegovina and Slovenia with grade 3.0. Croatia received grade 3.3 although it is worth emphasising that Croatia accomplished far better results in relation to other transition countries in the privatisation of small enterprises earning grade 4.3, which launched it to the top of other successful transition countries such as Estonia, Hungary, Lithuania and Latvia. The privatisation of SMEs has especially contributed to the high share of the private sector in the entire business structure of Croatia, which in 2010 was 97.7%.[4] The private sector was less significant in the share of the number of employees (73.6% in the total number of employees). The participation of the private sector in the total income of the Croatian economy was 73.3%, its share in profit was 71.8% and in loss 72.7%. It is disconcerting nevertheless that the private sector participated with only 55.1% in investments in fixed assets in 2010 (according to data by FINA, Croatian Financial Agency).

According to data collected by FINA, 797 enterprises were owned by the state in Croatia in 2010, 644 were mixed enterprises and 788 were joint ownership enterprises. These relatively low shares of state ownership, which show that privatisation has not been completed, continued

[3] The report of the State Audit Office on the audit of voucher privatisation, Zagreb 2002.

[4] In the first nine months of 2012 this share increased to 98%.

to fall so that in the first nine months of 2012 the number of enterprises in state ownership fell to 759 (share in the number of total businesses was 0.8%), the number of mixed enterprises was 577 (0.6%) and the number of joint ownership enterprises fell to 547 (0.6%). It can be concluded that privatisation has been relatively completed in the entire economy.

If we direct our analysis now to the sector of hotels and accommodation, according to the data collected by AUDIO (Government Asset Management Agency), it is clear that of the total number of enterprises already-mentioned, 117 were in mixed ownership (in which state has 0-49% ownership share), which represents a 19% share, while 16 enterprises maintained the majority state-owned package (2.0% of fully state-owned enterprises).

Judging from the economic aspect and on the basis of the data presented, the share of almost 20% of non-privatised enterprises in the sector which has a critical role in the economic growth and development of the country can be assessed as negative, especially when theoretical and empirical research emphasises their inefficiency. Numerous economists since Marshall's days have advocated a shift away from state ownership. Marshall in particular was sceptical of state ownership because state is not good at innovations and it is known that innovations, together with cost reductions, are deemed indispensable for better competitiveness of enterprises. Justifications for maintaining the role of the state in the economy (Schleifer, A. 1998) are only valid if a) cost reductions lead to a significant decrease in quality, b) innovations are not important, c) competition is weak and consumer choice is inadequate, and d) reputation mechanism weakens. Considering that in the sector of tourism none of these four factors are present to a significant extent, any justification for maintaining state ownership, from an economic point of view, simply does not prove valid. Therefore, in the next chapter we shall continue to analyse to what extent new owners contribute to the development of the sector and yield both individual, but also socially acceptable results when compared to the state as the owner.

III THE SUCCESS OF TRANSITION IN THE HOTEL INDUSTRY

The data obtained by FINA show that in the Republic of Croatia at the end of 1990s there were around 2,000 business organisations within the activity of hotels and restaurants (activity H55 according to NKD, National Classification of Activities, 2007). Small-sized enterprises prevailed in that number, accounting for 93.4% in 1999, while medium-sized enterprises accounted for 5.4% and large enterprises accounted for 1.2% of that number. In the years which followed there was a sudden increase in the number of business organisations, especially small enterprises, whose average rate of growth was 10% in the period 2000-2007. The average growth rate of medium-sized enterprises in that period was negative, which may be the consequence of restructuring in a certain number of enterprises and related reductions in the number of employees. This is an important observation considering that the determining criteria for classifying enterprises was the number of employees. In that respect, possible in-depth analysis should analyse the survival rate, as well as the rate at which new enterprises were set up. Although the growth dynamic in the tourism sector is big, it is not above average. To be more precise, the period between 1999 to 2007 saw a rapidly growing number of new enterprises in the real estate segment, which typically require little initial capital, as well as in health services, public administration, insurance and transport. Similarly, above average rates of setting up new business enterprises were registered in

activities which began with liberalisation and deregulation, such as post and telecommunications and electrical energy sector.

In 2007, the National Classification of Activities (NKD) was revised, which caused changes in the analysed sector, primarily in the segment of small-sized enterprises, while there were no significant changes in medium-sized and large enterprises in terms of numbers. In 2008, the number of small enterprises fell from 4,041 (2007) to 1,554 to rise again in 2010 to 1,634. It is important to stress that the decrease of 2,500 enterprises does not indicate their disappearance from the market but rather reflects their statistical transfer to another category, i.e. preparing and serving food and beverages.

Since the aim of this paper is to determine the difference in efficiency of private firms and state-owned enterprises, and since according to the data of Government Asset Management Agency, the remaining state-owned enterprises are mainly hotels, our sample is narrowed down to activity 55.10, i.e. hotels. The total number of enterprises and their classification was conducted by combining data from three sources: AMADEUS data basis, FINA and GAMA data.

TABLE 2 NUMBER OF ENTERPRISES IN THE ACTIVITY HOTELS AND ACCOMMODATION (NATIONAL CLASSIFICATION OF ACTIVITIES 55.10) FROM 2003 TO 2011.

OWNERSHIP	2003	2004	2005	2006	2007	2008	2009	2010	2011
TOTAL NO. OF ENTERPRISES	332	373	430	483	521	576	652	673	645
SMALL	146	172	211	247	281	327	380	397	373
MEDIUM	115	125	141	155	157	166	187	191	186
LARGE	71	76	78	81	83	83	85	85	86
Of that number, according to ownership interest.									
50-100% of state ownership share*	not known	not known	not known	not known	not known	23	22	18	18
0-49% of state ownership share**	not known	not known	not known	not known	not known	105	100	95	95

**Data for the number of enterprises in state and mixed ownership were obtained from the Financial Agency (FINA), while other data were obtained from AMADEUS data base. According to the data of the Croatian Privatization Fund there were 16 enterprises with state as majority owner and 107 enterprises with state as minority owner at the beginning of 2013.

Source: The authors used Amadeus, Financial Agency (FINA) and GAMA data bases.

The number of enterprises classified as hotels and accommodation (National Classification of Activities 55.10) continually rose at the average rate of 9% annually in the period from 2003 to 2011, increasing from 332 to 645, which accounts for 0.5% in the total number of business organisations in the Croatian economy (on 31 December 2011 there were 128,930 business organisations, according to the data obtained by the State Bureau of Statistics 2012). The average rate of growth of small-sized enterprises was around 13% while the dynamic of medium-sized and large enterprises was 6% and 2% respectively. It is clear that the number of business organisations was reduced in 2011 in all categories of size, except in large enterprises, which can be a result of bankruptcy procedures and closing of SMEs. Of the total number of business organisations according to FINA, the number of enterprises where state holds majority ownership interest was around 20 at the end of the analysed period, which accounts for 3.9% (2008) or 2.8% (2011). The number of mixed enterprises was around 100, which accounts for 18.3% (2008), or 14.7% (2011). By summarizing these two categories it can be concluded that

state is highly present in the sector of hotel industry in terms of ownership. However, a more in-depth analysis based on GAMA data from the end of 2012,[5] whose data comply with the data collected by FINA, makes it clear that there are enterprises in the category of mixed ownership where the share of the state is below 1% and that these shares were kept by the state in privatisation as reservations. Of the total number of 107 mixed enterprises in 2012 only 34 had a share of state ownership bigger than 10%.

On the basis of the stated data, three groups of enterprises have been formed. Group I includes state-owned enterprises where state holds majority ownership interest. Group II includes mixed enterprises where state ownership interest is bigger than 10% but lesser than 49%, while Group III comprises all other enterprises. Groups I and II have a smaller number of enterprises in relation to the list obtained from GAMA because some enterprises are not included in the activity classified as 55.10 as its main activity according to the AMADEUS base, so that Group I includes 10 instead of 16 and Group II includes 18 instead of 34 enterprises. Similarly, the authors have transferred from Group II to Group III all enterprises which according to GAMA have less than 2% share of state ownership. These are enterprises in majority private ownership while a small number of shares owned by the state has been kept as reservations, or provisions for bad debt arising from ownership transformation and privatisation. Most of these enterprises are quoted on the Zagreb Stock Exchange.

IV EVALUATION OF PERFORMANCE OF ENTERPRISES WITHIN THE HOTEL INDUSTRY IN CROATIA RELATIVE TO OWNERSHIP STRUCTURE

Our study has analysed the difference in performance of enterprises considering their ownership structure. The performance of enterprises was measured with the rate of growth of revenue in relation to previous year, EBIT, revenue per employee, return on assets (ROA) as ratio of EBIT to total assets, and return on equity (ROE) as a ratio of EBIT to equity. Table 3 shows these indicators of performance of enterprises in groups considering the type of ownership structure for the period 2004-2011 as average values of analysed enterprises in the group.

[5] In 2012, 16 enterprises were in majority state ownership while 107 companies were in mixed ownership with minority share owned by state.

TABLE 3 PERFORMANCE INDICATORS OF PRIVATE FIRMS, ENTERPRISES WHERE STATE HAS MINORITY INTEREST AND ENTERPRISES WHERE STATE HAS MAJORITY INTEREST, 2004–2011.

Year	2004	2005	2006	2007	2008	2009	2010	2011	Average
Group					**Revenue growth rate (%)**				
I	3.43	27.67	12.17	19.83	2.96	-4.22	-0.64	10.88	**9.01**
II	5.64	12.23	-1.43	4.33	3.67	-8.78	-4.30	5.25	**2.08**
III	9.80	8.20	-4.56	5.24	0.32	9.10	8.34	-7.36	**3.63**
Group					**EBIT, EUR**				
I	7,257	135,061	65,742	138,310	62,400	-24,399	5,885	46,882	**54,642**
II	111,670	92,768	-282	-	-	-	-	-	**-**
				185,527	238,414	318,113	269,118	146,295	**119,164**
III	228,112	153,321	-	-	-	-	-	139,176	**-56,259**
			18,573	517,807	165,200	125,256	143,848		
Group					**Revenue per employee (EUR)**				
I	35,000	40,000	34,000	34,000	46,000	46,000	51,000	54,000	**42,500**
II	24,000	28,000	27,000	27,000	30,000	40,000	29,000	31,000	**29,500**
III	36,000	41,000	34,000	34,000	36,000	37,000	72,000	39,000	**41,125**
Group					**ROA, %**				
I	-2.18	-1.59	-2.42	-1.13	-1.28	-2.02	-3.04	-2.19	**-1.98**
II	-2.55	-3.19	-4.59	-2.84	-4.06	-4.42	-4.78	-4.76	**-3.90**
III	-0.07	-0.30	0.18	0.45	-0.80	-1.92	-6.02	-3.37	**-1.48**
Group					**ROE, %**				
I	-4.30	0.46	3.63	-0.83	-12.56	1.26	-8.35	-3.62	**-3.04**
II	-9.65	-19.35	-9.35	-5.31	-8.16	-12.47	-19.62	-114.04	**-24.74**
III	-15.25	-12.48	-5.73	1.43	-3.52	-4.51	-46.60	-35.63	**-15.29**

Source: The authors used Amadeus (BvD) data basis.

The above table shows that enterprises in private ownership have the highest rate of revenue growth which in the period analysed was 9.01% on average, followed by enterprises where state has minority ownership interest (3.63%), and enterprises in majority state ownership which recorded the smallest rate of growth (2.08%). It is clear that in the years of prosperity private firms grew fastest and in the years of crisis they recorded the smallest decline. The exception includes mixed enterprises which recorded a rise in revenue in the years of crisis. The analysis of individual data indicates that the rise in 2009 and 2010 is the result of high rates generated by two enterprises only, while the rest of the Group recorded mainly a slight drop in revenue. Generally speaking, privatised enterprises show better responsiveness to the positive and negative environment, or put differently, these enterprises are more flexible and thus more competitive than the enterprises with state as a share owner.

The analysis of revenue per employee indicates the relevance of capacity and the economic strength of the company in all three groups considering relatively small differences in revenue generated at the beginning of the analysed period. Revenue per employee in 2004 was highest in enterprises where state holds minority ownership interest (EUR 36,000) while in private firms it was EUR 35,000. At the beginning of the analysed period, enterprises where state holds majority ownership interest recorded around EUR 27,000 revenue per employee. A significant change in revenue generated per employee is evident in private firms which in 2008 recorded a jump from 34,000 to 46,000, which led to an average of EUR 42,500. The exception in Group III in terms of sudden rise of average revenue per employee in 2010 was the result of exceptionally good results by several enterprises in the Group which recorded a steep rise in revenue per employee. At this

stage of analysis, it can be concluded that increases in revenue per employee are the result of completed restructuring process in a certain number of enterprises, but also the result of significant investments from the previous years which enabled higher prices. In state-owned enterprises there were growth periods but also sudden decreases. Reasons for that can be found in overemployment but also in the smaller number of visitors. So, the lowest average revenue per employee in the period from 2004 to 2011 was recorded by enterprises where state holds majority ownership interest (EUR 29,500).

The average EBIT was also highest in private firms (EUR 54,642) which on average maintained positive results throughout the period analysed, with the exception of 2009. The worst result was recorded by enterprises where state holds majority interest (average loss of the period was EUR -119,164) which accumulated losses continually from 2006. Enterprises where state holds minority interest recorded better, but on average still negative results (EUR -56,259). The last Group mentioned also recorded losses in 2006 with extremely poor performance in 2007.

Other performance indicators include return on assets (ROA) and return on equity (ROE) which were, on average, negative for all three groups of enterprises in the period analysed. The average ROA in private firms was -2% while in enterprises where state holds majority interest it was -1.5% and in enterprises where state holds minority interest it was -4%. Return on equity was on average -3% in private firms while in state-owned enterprises it was -15.3% (with majority interest) and -28.4% (with minority interest). On the basis of this analysis, it can be concluded that state-owned enterprises incurred debts while managing equity with no profitability and adequate returns, which is not the case with private firms. The analysed indicators of performance of enterprises within the hotel industry relative to ownership indicate that private firms show better performance relative to enterprises with minority state interest, and even better performance in relation to enterprises with majority state interest. Hotel enterprises where state is the majority shareholder have significant long-term debt towards banks and other financial institutions. Since some of these loans are in CHF which, due to its appreciation in the period 2009-2011 additionally increased debt by almost 50%, it is important to add this factor to the indicators used. All in all, due to outstanding debt arising from loans, financial expenditure made up of interest payments and increases in foreign exchange differences, the hotel industry has remained burdened by losses for years.

Considering that the analysed activity is highly labour-intensive, in continuation we shall explore in more detail the shifts in productivity, adjusted for trends in the number of employees. In particular, we will analyse the turnover in the average number of employees in the enterprise, average salaries measured by the average cost of employees, and the share of costs employees generate in revenue (Table 4).

TABLE 4. NUMBER OF EMPLOYEES AND THE RATE OF FLUCTUATION OF THE AVERAGE NUMBER OF EMPLOYEES AND AVERAGE COST OF EMPLOYEES AND THE AVERAGE SHARE OF THE COST OF EMPLOYEES IN REVENUES IN PRIVATE FIRMS, IN ENTERPRISES WHERE STATE IS MAJORITY AND MINORITY OWNER, 2004-2011.

Year	2004	2005	2006	2007	2008	2009	2010	2011	Average
Group	**Number of employees (total)**								
I	16,080	17,418	18,722	20,207	23,568	20,309	18,519	19,260	**19,260**
II	1,938	1,932	1,918	1,871	1,914	1,598	1,641	1,630	**1,805**
III	1,883	1,815	1,849	1,871	1,659	1,715	1,620	1,613	**1,753**
Group	**Number of employees (average per enterprise)**								
I	61	59	56	58	64	48	44	46	**55**
II	194	193	192	187	191	160	164	163	**181**
III	105	101	109	110	104	95	90	90	**101**
Group	**Rate of fluctuation of the average number of employees per enterprise (%)**								
I	0.00	-3.28	-5.08	3.57	10.34	-25.00	-8.33	4.55	**-2.90**
II	3.19	-0.52	-0.52	-2.60	2.14	-16.23	2.50	-0.61	**-1.58**
III	-6.25	-3.81	7.92	0.92	-5.45	-8.65	-5.26	0.00	**-2.57**
Group	**Average cost of employees (EUR)**								
I	8,000	9,000	11,000	10,000	11,000	11,000	12,000	12,000	**10,500**
II	9,000	10,000	11,000	11,000	12,000	17,000	12,000	12,000	**11,750**
III	9,000	11,000	11,000	12,000	13,000	14,000	14,000	13,000	**12,125**
Group	**Average share of the cost of employees in revenues (%)**								
I	29.92%	29.77	34.43	28.67	29.55	36.45	31.02	28.69	**27.36**
II	37.62%	37.6	41.64	41.03	42.32	45.11	45.71	43.47	**37.16**
III	31.63%	31.88	34.43	34.43	32.94	36.45	34.06	35.82	**30.04**

Source: The authors used Amadeus (BvD) data basis.

From 2004-2011 private firms employed an average of 19,260 employees. Enterprises where state has minority ownership interest had 1,753 employees while enterprises in which state has majority ownership interest employed 1,805 employees on average in the same period. Although they employed the highest number of employees in absolute values considering their frequency (the Group counts 345 of 617 enterprises), private firms employed on average the smallest number of employees individually (55) considering the ratio of employees and total number of firms. Enterprises where state has minority interest employed 101 workers on average while enterprises with majority state interest employed the highest number of workers on average, 181 per enterprise. In private firms, apart from the biggest total decrease in the number of employees on average, another trend is also discernible and that is the biggest decrease in the average number of employees per firm in relation to enterprises where state holds both minority and majority interest. In 2009, private firms decreased the number of employees from an average of 64 to 48, and continued reductions in 2010. State-owned enterprises responded to the 2009 crisis by reducing the number of employees, but these reductions were significantly smaller in enterprises where state holds majority interest. The lowest average cost per employee was recorded in private firms in the analysed period (on average it was EUR 10,500 annually), while in enterprises where state holds minority interest it was EUR 11,750 and in enterprises where state holds majority interest it was EUR 12,125. The data indicates that the highest degree of rationalisation of business activity in terms of the number of employees was in private firms. The share of costs of employees in revenue in the period analysed was also the smallest in private firms (27.36%), followed by enterprises where state holds minority interest (30.04%) while the

costs of employees were the highest in enterprises where state holds majority interest (37.16%). All that can point to the conclusion that, apart from other reasons, private firms owe their better performance results compared with enterprises where state holds majority and minority interest mainly to the rationalisation of business activity, to the highest dynamic of reducing the number of employees and to lower salaries, which therefore produces lowest costs of employees in total revenue. All this leads to higher productivity of workers in private firms than in state-owned enterprises.

The authors proceed to explore debt dynamics relative to ownership structure. For that purpose Table 5 provides an overview of trends of total long-term debt, average long-term debt per enterprise and debt dynamics measured by the rate of growth of long-term debt.

TABLE 5 SHIFTS IN TOTAL AND AVERAGE LONG-TERM DEBT AND DEBT DYNAMICS IN PRIVATE FIRMS AND IN ENTERPRISES WHERE STATE HAS MINORITY AND MAJORITY OWNERSHIP INTEREST, 2004–2011.

Year	2004	2005	2006	2007	2008	2009	2010	2011	Average
Group	Long-term debt (EUR)								
I	737,935,323	868,122,929	1,098,312,420	1,359,874,849	1,717,377,973	1,769,264,331	1,708,726,116	1,784,026,104	**1,380,455,006**
II	75,245,382	77,357,409	68,647,767	67,134,460	62,431,901	64,497,560	62,290,392	57,792,343	**66,924,652**
III	101,124,779	104,726,784	104,447,032	164,986,752	136,518,867	185,040,944	200,177,262	191,292,845	**148,539,408**
Group	Average long-term debt per enterprise (EUR)								
I	2,138,942	2,159,509	2,408,579	2,752,783	3,128,193	2,835,359	2,649,187	2,891,452	**2,620,501**
II	7,524,538	7,735,740	6,864,776	6,713,446	6,243,190	6,449,756	6,229,039	5,779,234	**6,692,465**
III	5,618,043	5,818,154	6,143,943	9,705,103	8,030,522	10,280,052	11,120,959	10,627,380	**8,418,020**
Group	Rate of growth of long-term debt (%)								
I	33.03	17.64	26.52	23.81	26.29	3.02	-3.42	4.41	**16.41**
II	-5.61	2.81	-11.26	-2.20	-7.00	3.31	-3.42	-7.22	**-3.83**
III	3.08	3.56	-0.27	57.96	-17.25	35.54	8.18	-4.44	**10.80**

Source: The authors used Amadeus (BvD) data basis.

Table 5 shows that the highest average debt per enterprise is seen in enterprises where state holds minority interest, then in enterprises with majority state interest and in private firms, but it is worth highlighting that the rate of growth of long-term debt is highest in private firms: 16.41% on average per year in the period studied. This rate rose especially until 2008. It is clear that enterprises where state holds minority interest increased long-term debt on average by 10.80% while enterprises where state holds majority interest reduced long-term debt by 3.83%. Although from the aspect of debt dynamics, state-owned enterprises show better results it must be added that these are long-term debts and since the size of average debt per enterprise is almost 4 times higher in state-owned enterprises than in private firms it can be concluded that they reached the maximum level of debt and that they were not able to take on new debt which is why they have negative growth rates. The analysis of short-term loans still remains to be researched to show to what extent negative growth rates, i.e. decreasing long-term debt, is the result of increased income, and to what extent they are the result of new short-term debts. On the basis of all that, it is clear that privatised enterprises had less debt burden which allowed them to generate new long-term loans in the name of new investments in the process of restructuring, thus raising the quality of accommodation, which in turn allowed higher prices and therefore higher revenue. On the other hand, state-owned enterprises did not complete the process of restructuring, and the only step forward in that respect was reducing long-term loans, which in these enterprises reached their maximum level, especially if it is known that in the past couple of years they have been accumulating losses.

V. CONCLUSION

The process of privatisation represented a stage in transition from the centrally-planned to the market economy. Even though transition developed differently in the countries mentioned, two main paths can be detected in that process: one is "shock therapy" and the other is gradual transition. The lack of one single transition strategy resulted in different ways of implementation of various stages within transition, i.e. privatisation. More precisely, privatisation developed from voucher privatisation, direct sales to MEBO method.

It is quite clear that the success of privatisation varies not only across different transition countries but within one single country, across its sectors. Croatia has been evaluated as a relatively successful country when it comes to privatisation of small sized enterprises which make up the corpus of the Croatian economy. Yet, in the privatisation of medium and large sized enterprises Croatia has been less successful. Croatia has been especially unsuccessful in privatising enterprises in tourism, namely hotel industry, which is all the more disconcerting since it is generally perceived that foreign investors are usually highly interested in the unique resources within this particular sector.

The share of state-owned enterprises in the segment of hotel industry is around 20%, which is very high considering the strategic significance of these enterprises and especially considering their performance. Our study has shown that enterprises which have not been privatised are quite large, with an average of 181 employees, which, adjusting for the regional aspect, prevail in coastal regions. At the same time, throughout the period analysed, i.e. from 2004 to 2011, state-owned enterprises achieved poor results, did not complete the process of restructuring and recorded high debt.

Our study shows that it is necessary to privatise the remaining portfolio of the hotel industry to decrease costs and increase the quality of service in these enterprises. State-owned enterprises simply must undergo the process of restructuring which implies layoffs of a certain number of employees, reductions in salaries and recapitalisation to solve the problem of outstanding debts. It would be logical to assume that if strategic partners were attracted to buy these enterprises through public tenders, new owners would start new investment cycles necessary to raise the level of competitiveness of these enterprises. However, the size of outstanding debt along with ruined and poorly maintained accommodation facilities which had not seen any investment for years (e.g. hotels, buildings in tourist resorts and camping facilities), make it imperative that future owners invest substantial funds in these facilities, which decreases the interest of investors. Furthermore, financial crisis has decreased the inflow of foreign direct investments, which only prolongs the completion of privatisation. In addition, let us not forget unresolved legal issues related to ownership rights on tourist land (i.e. court disputes and inertia of public administration). Additional burden to investors is the issue of concession fees as well as unresolved joint ownership issues in the community. It is clear therefore that a serious investor can only be attracted by the location of the hotel complex.

Although the study has shown that state-owned enterprises show much poorer performance in relation to both private firms and mixed enterprises, from the political point of view, privatisation should probably be postponed to a future period. Namely, the present crisis, just like the past one during which most hotels were privatised in Croatia, implies necessarily a decrease in the inflow of capital to the state budget. Moreover, unemployment rate in Croatia at present is 21.9%, so that privatisation will only contribute to further increases in unemployment rate. From

the economic point of view, on the other hand, privatisation should be completed as soon as possible because its prolongation will result in the accumulation of more losses and perhaps even in bankruptcy. In conclusion, we believe that both economic and political aims of privatisation should be harmonised and that the problem of privatisation should be solved by non-political appointments of managers in state-owned enterprises. Naturally, owners should clearly define goals that managers would then try to accomplish. If these aims are not accomplished, managers should be dismissed which would in turn invigorate the managers' labour market. Along with necessary investments, this would lead to further decreases in costs and increases in quality and competitiveness of these enterprises. Let us conclude by saying that the worst solution would be to keep the present situation intact as this only apparently solves the problem of unemployment in some regions, but continually contributes to the poor quality of the tourism offer of the entire country, which only produces negative effects in the long run.

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