EQUILIBRIUM EXCHANGE RATE IN A DEVELOPING ECONOMY

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CONTENTS

ABSTRACT[1]

This research attempts modelling equilibrium real exchange rate for Albanian currency. For high-growth economies, factors like Balassa-Samuelson effect and terms of trade, referring to internal and external equilibrium in an economy, play a substantial role in guiding equilibrium RER. This research relies on a BEER approach to model a long-run relationship between RER, a Balassa-Samuelson term, terms of trade and net foreign assets, as well as real interest rate differential, sticking to few variables considering that the sample of 13 years is critically small for the method used. Behavioural Equilibrium Exchange Rate (BEER) approach is a statistical model that offers a feasible alternative to equilibrium exchange rate, though at the disadvantage of lacking the macroeconomic balance normative. Findings suggest that terms of trade and relative prices have the greatest impact to relatively affect real exchange rate, while real interest rate differential and net foreign assets have only a marginal effect. Also, it is real exchange rate and relative price ratio that adjust to restore equilibrium, once the system is subject to a shock.

Key words: Equilibrium exchange rate, BEER, Balassa-Samuelson, cointegration

[1] A similar and longer version of this work was written as a thesis for qualification in MSc in Economics and Finance at Durham University, UK.

1. INTRODUCTION

There is high uncertainty with regard to analyzing any economic or financial variable. Social or individual behaviour is part of the process making analysis rather less reliable than otherwise. Analyzing exchange rate is quite a challenge on its own, as it carries the properties of any macro variable as well as the uncertainty of any financial one. The modern foundations of exchange rate determination is generally attributed to Cassell's (1928) theory on Purchasing Power Parity (hereby PPP). While the notion of PPP has not been unknown to economists, it was him who laid down a theoretical framework of exchange rate modelling, stating that prices across countries should be equal when expressed in same currency.

Stricter exchange rate regimes have had the advantage of minimal uncertainty once an initial exchange rate was set. Moving to more flexible regimes in the second half of the previous century pushed the economists to focus on equilibrium benchmarks of exchange rate. Since then, theoretically sound frameworks have been set up to explain exchange rate, mostly based on a macroeconomic perspective. Involvement of trading activity in a seemingly successful macroeconomic model of this financial indicator has rendered these models bound to fail. Yet, analyzing and attempting a fair price of foreign currency, leads to benefits of a closer to equilibrium exchange rate than otherwise.

The aim in this study is to explore relevant factors affecting exchange rate in a transition economy and attempt an equilibrium level conditional on certain assumptions. The approach of a Behavioural Equilibrium Exchange Rate recognizes the importance of relevant phenomena for developing economies, the rising income effect and improving terms of trade, while it is very flexible in terms of data requirements which is a concern in such cases. The work proceeds as follows. Section II deals with the theoretical framework and applications of such approach. Section III covers data and methodological issues. Empirical results and interpretation are summarized in Section IV. The final section concludes.

2. THEORETICAL BACKGROUND AND APPLICATIONS

2.1 LITERATURE REVIEW

There is an underlying assumption that the law of one price, hence the PPP hypothesis, applies on goods frequently traded among countries. Accordingly, the (nominal) exchange rate between two countries should equal the ratio of the price levels prevailing in each country. At the core of PPP theory is the Law of One Price (LOOP)[2]. Mean-reverting PPP (less restrictive) recognizes to a degree the impact of transaction costs, interest rate differentials, interventions, and other factors with a frictional impact on real exchange rate reverting to equilibrium.

It is not surprising for PPP not to hold for countries that are not open to trade. Institutional factors have been thought an impediment to trade and a sensible explanation for its failure. Data series 700 years long on price of grain traded between Holland and England show that volatility of deviations from law of one price is stable (Froot, Kim, & Rogoff, 1995). Obviously institutional factors could not explain the failure of PPP (Roggoff, 1996). Other factors should be accounted when PPP is discussed.

Transportation costs do count for a certain price wedge among countries. Tariffs and non-tariff barriers as well have a toll on prices of the same goods observed in two different countries. Engel and Rogers (1995) analyzed (disaggregated) CPI for 23 cities located in US and Canada, concluding that the relative price of the same good between two cities was a function of distance between them. The "border" effect had an impact equivalent to adding an additional distance varying within 2,500-23,000 miles between two cities on the same side of the border.

Alternatively, failure of PPP has been commonly attributed to sticky prices. Dornbusch (1976) overshooting model showed how

[2] Absolute PPP and LOOP are conceptually the same, though PPP can be applied on multilateral exchange rates, while LOOP is more of a bilateral concept.

the introduction of sticky prices in a monetary model of exchange rate determination could explain large departures from PPP. Due to sticky prices in the goods market the PPP might only hold in the long run. Studies covering the post Breton-Woods period with fluctuating exchange rates focused on monetary models. Frenkel (1978) found support for PPP on hyperinflation data. But in an environment with hyperinflation where prices move upward several times a year, sticky prices are of less relevance for PPP hypothesis. Despite the initial success, studies on data from monetary stable environments rejected PPP (Frenkel, 1981) (Krugman, 1978). Meese & Rogoff (1983) showed that out-of-sample forecasts of monetary models fitted with PPP could hardly, outperform a random walk. Even a 15 percent erosion of deviation from equilibrium every year implied too long a period to claim any success for the mean-reverting PPP (Frankel & Rose, 1995).

In his famous paper on exchange rate, Rogoff (1996) showed that even over long periods, PPP either did not hold or in those cases that it did, it took quite an awful time to do so. He suggested at least three significant modifications to the PPP theory, the Balassa-Samuelson (hereby B-S) effect, trends in current account and public spending role. While not all of them new to the literature, the latter alternatively overlaps with the demand side effect similar to B-S effect.

BALASSA SAMUELSON HYPOTHESIS.

The recognition of real factors in determining the long-term real exchange rate had received increasing attention in earlier literature. The most popular of real determinants is the Balassa-Samuelson effect, a phenomenon initially introduced in literature by Balassa (1964) and Samuelson (1964)[3]. Under certain assumptions, the B-S effect implies that the relatively faster growth of prices in the non-traded goods sector that comes with relatively higher income growth in developing economies, provided that wage equalization across the sectors holds, will cause real exchange rate appreciation.

[3] Appendix III, for technical summary

The literature has been enriched with broad range of approaches to analyzing exchange rate. The most comprehensive framework, the fundamental model (*FEER*) introduces judgment to exogenously set a sustainable capital account level and imposes Internal and External Balance (Williamson, 1983), (Wren-Lewis, 1992). Isard and Faruque (1998) introduce demographic variables in a normative approach to a long-run equilibrium saving-investment (S-I) position, while Stein (1994) uses time preference and capital stock to distinguish between equilibrium S-I position of different countries.

Exchange rate models covered in the literature use PPP theory as a building block. The use of a fundamental approach has a normative sense and requires reliable and sufficiently long data on real and external sector which for many developing economies are not available. A statistical approach to modelling exchange rate that recognizes the importance of real factors is the behavioural equilibrium exchange rate (*BEER*). It has the advantage of combining variables that affect both current and capital account and as such is considered a stock-flow consistent model (Clark & MacDonald, 1999), (Wadhwani, 1999). While it takes into account the UIP and B-S effect, BEER lacks the underlying assumption of macroeconomic equilibrium (as in *FEER*). In this study I proposed *BEER* approach to model a statistical equilibrium of Eur/Lek bilateral exchange rate for Albania.

2.2 MODELLING EXCHANGE RATE (BEER)

The BEER model follows the standard approach of Clark and MacDonald (1999). The starting point is the UIP block as in equation (4.1), written in real terms adjusted with a risk factor[4]:

$$\Delta q^{e}_{t+k} = -(r_t - r_t^*) + \omega_t \qquad (2.1)$$

where RER is foreign currency price per unit of home currency.

Equation (4.1) can be rewritten to sort out actual RER:

$$q_t = q^{e}_{t+k} + (r_t - r_t^*) - \omega_t \qquad (2.2)$$

[4] BEER is generally applied to Real Effective Exchange Rate.

such that,

$$\omega_t = \mu + \lambda_t + \varepsilon_t \tag{2.3}$$

where ω_t is mean-zero random error and λ_t is a time varying component of risk premium. In general it can be set as a positive function of the ratio of domestic to foreign public debt.

$$\lambda_t = f^{+}\left(\frac{fs}{fs*}\right) \tag{2.4}$$

The term q^{e}_{t+k} can be considered as a long-run or systematic component of RER ($\overline{q}_t$) assuming rational expectations. It can be further expressed as a function of several variables hence reconciled with a stock-flow model.

$$\overline{q}_t = f(tot_t, tnt_t, nfa_t) \tag{2.5}$$

Finally, actual RER rate is expressed as a function:

$$q_t = f(r_t - r_t^{*}),\ tot_t, tnt_t, nfa_t, \lambda_t) \tag{2.6}$$

where tot is terms of trade and measures the competitiveness of the economy, tnt is relative price of traded to non-traded goods as a measure of Balassa-Samuelson effect. Provided real exchange rate and other terms are I(1), a cointegration relationship would be helpful in explaining the former. Most importantly, in developing countries tnt is expectedly I(1) due to faster income growth than the world growth rate, and so is real exchange rate.

2.3 APPLICATIONS

Applying equilibrium models in different countries takes into account the objective of the researcher and country specifics. Objectives, though not exhaustive, might consider finding an equilibrium benchmark with a normative perspective, a multilateral equilibrium perspective or estimating the impact of a certain macroeconomic variable on exchange rate.

BEER models reveal the variety of enriching with additional variables to capture special macro effects. Elbadawi (1994) models long-run equilibrium, using terms of trade, a measure of openness, net capital inflows, net government spending and export growth rate. Wadhwani (1999) modifies BEER with unemployment rate, to account for expected current account, or to capture supply side effects as low unemployment make FDI more attractive. The presence of a term capturing the BS-effect is explicitly recognized in the BEER model, though its impact is captured by different variables in other models (MacDonald, 2000).There is a greater application of other fundamental models in advanced countries like *FEER*, NATREX, IEB, as these models are better supported by availability of data.

APPLICATIONS IN DEVELOPING COUNTRIES

Modelling equilibrium exchange rate in a PPP framework in transition economies is more complicated due to specifics related to those countries. Burgess et. al. (2003) and Egert et. al. (2005) raise at least three aspects relevant to the Balassa-Samuelson framework of exchange rate.

First, the failure of PPP even in the tradable sector implicates factors other than B-S effect, like the presence of unusually high transaction costs, initial devaluation (Halpern & Wyplosz, 1997) and tradable inflation differential (Burgess, Fabrizio, & Xiao, 2003)) leading to certain trends not related to B-S effect or any fundamental predicted in standard theory. The correlation between nominal and real exchange rate observed in a floating currency period is interpreted as evidence that real exchange rate in the tradable sector dominates the overall RER movements (Mussa, 1986), (Engle C., 1993)5.

In addition, B-S framework can be extended to capture the role of demand factors on relative price of non-tradables. A model where relative price determination can be modified additionally with capital-labour ratio, suggested by Bhagwati (1984), or demand side factors like government consumption will capture such effects.

[5] Extensive literature and empirical evidence exists for the failure of PPP in the tradable sector as well. Additional factors may be related to home bias and international price discrimination.

It rests on assumption that given higher income elasticity of demand for non-tradable goods, increases in disposable income per capita and rising consumption may fall on non-tradable goods pushing the prices up. Lee et. al. (2008) finds such evidence in panel study for most economies in CEE economies.

Furthermore, literature distinguishes between the B-S effect and Baumol-Bowen effect (Baumol & Bowen, 1965). While the effect is similar, the role of regulated (administered) prices affects RER for reasons related to adjustments with market prices. Even with identical technologies, implying absence of B-S effect, a higher CPI share of services in one country produces significant trend effects in CPI-based real exchange rate. The share of regulated prices in CPI basket varies from 10% to 46 % in CEE during the 90'ies (Egert et. al. (2005)). Not recognizing and dealing with those additional factors may introduce bias (overstate) on B-S effect.

The use of a variety of other fundamental variables is common in empirical work of BEER (see Table I.1, pp 37). In models with panel data higher price controls are significant in explaining for deviation of prices from market value in many transition economies. Lee et. al. (2008) use trade restrictions index as a dummy variable to capture a potential impact on higher domestic prices before trade liberalization took place. Significance of the tradable/non-tradable relative price effect has been documented in almost all developing economies, though results vary hugely across them (Table 2. 1).

Table 2.1 Summary of findings of long-run coefficients in transition countries

		prod	open	nfa	r_diff	tot	fdi	nx	inv	ECM coef-ficient	1/2 life (in quar-ters)
Spain '75-98	Alberola (2003)	-0.42		-0.31						--	
Czech	Melecky & Ko-marek (2008)	-2.17			0.0256		–0.1692			-0.1033	3.89
Poland	Rawdanowicz (2003)	-1.32			-2.221	-1.028				--	
Estonia	Filippozi (2000)	0.443*						1.422	0.778*	--	
Estonia	Hinnossar (2005)	1.71				7.578				--	
Lithuania	Alonso-Gamo (2002)									--	
Lithuania	Vetlov (2002)	-1.91	1.22		0.005					-0.461	1.08
Pooled EEC & Baltic	De Broeck and Sløk (2001)	(-0.4) - (-0.7)								-0.6 (av. annual	
	Frait et al (2006)									ECM coef-ficient	implied 1/2 life (in quar-ters)
Czech		-3.03				-0.84959	-0.08703			-0.44	1.1
Hungary		-2.25	-0.30							-0.64	0.8
Poland		-0.79	0.61							-0.48	1.0
Slovakia		-1.18								-0.28	2.1
Slovenia		-0.21								-0.66	0.8

The employment of a wide range of variables used in equilibrium models, hence of the results for the respective variables, often mirror different countries' experiences with regimes they keep on trade, capital account, exchange rate market, labour markets as well as on goods market. The choice of variables to modify PPP, and possibly their significance, is conditioned by these market imperfections and in turn do affect exchange rate equilibrium differently. Therefore, the wide range of estimates of B-S effect and the unusually high adjustment coefficient of RER to equilibrium might be accommodative to those country-specifics due to short samples of data across the studies. Comparatively, models with panel data find more significant results, possibly due to greater amount of cross-sectional information. They are usually more robust for the same reason. Authors recognized the role of panel data in getting significant results, implying that evidence might be harder to find

in time series data (Bayoumi and MacDonald (1999), MacDonald (1995)). The advantage of time series studies is giving more weight to country specific problems.

3. DATA AND METHODOLOGY

3.1 DATA CONSTRUCTION

Series for this study have been obtained from own calculations or proxies have been built in the absence of original data[6]. For real exchange rate, the conventional measure has been used, obtained by deflating nominal exchange rate expressed as foreign currency per unit of home currency (Eur/Lek), by the inflation differential between home and Euro area.

Tradable / non-tradable ratio (*tnt*) is the difference of home tradable / non-tradable price ratio relative to Euro area as a proxy to capture B-S effect[7]. Terms of trade is the ratio of export price index to import price index measures. Data constructed internally at Bank of Albania. Net foreign assets (*nfa*) of the banking system as a share of GDP are used as proxy for nfa of the economy. Real interest rate differential (r-r^*) is measured by the 1 year treasury bill for Albania and the yield of 1-year Euribor, both deflated by respective CPI. Risk premium. The ratio of public debt as a share of GDP relative to that of Euro area is expected to capture the risk premium effect on real exchange rate. While some data go back until 1995, others are only available starting from 1998 and extend up to first quarter of 2011 (see Appendix II. Data Description)[8].

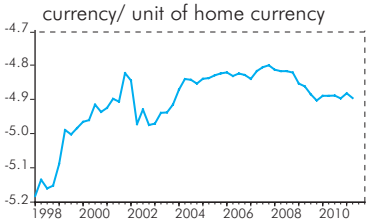
[6] Main sources are www.bankofalbania.org and www.instat.gov.al.

[7] The disadvantage of this measure is that it does not distinguish from effect demand side factors.

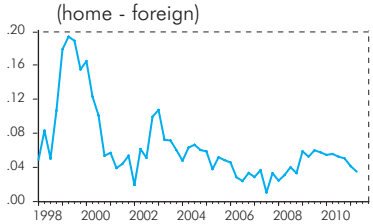
[8] Sources: Bank of Albania website, Institute of Statistics of Albania, Eurostat. Some series are internally constructed for specific use in research work and are not publicly available.

Graph 1. Inspection of main variables

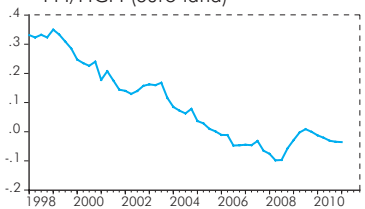
Real exchange rate (log of) foreign currency/ unit of home currency



Real Interest rate differential (home - foreign)

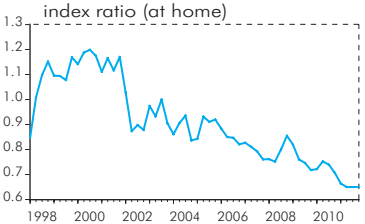


Relative price index: T/NT (home)-PPI/HCPI (euro land)

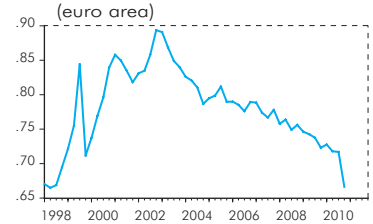


NFA of banking system home

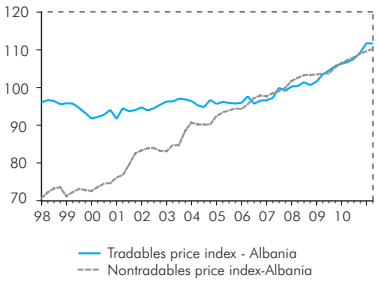
Export Price index over Import Price index ratio (at home)

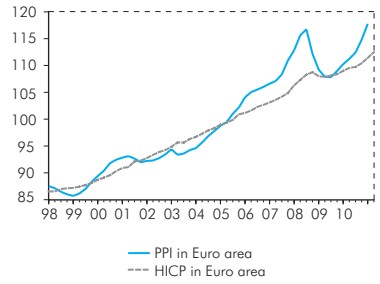


Public debt (home)/public debt (euro area)



Graph 2. Price indices





3.2 METHODOLOGY

3.2.1 DATA PROPERTIES

Econometric analysis involves testing for hypothesis that is consistent with theoretical predictions.To analyse the underlying properties of the processes that generate time series variables at hand is a cornerstone of any sound investigation of an economic or financial relationship. The most useful and meaningful property of a variable from the economic and financial perspective is its potential of mean-reversion, which from a statistical perspective is the property of stationarity.

In economics/finance flow variables are mostly stationary while stock variables are often non-mean reverting. Yet, it is not unusual to find out that certain variables might be stationary in one sample and non-stationary in another. As an example, inflation may turn non-stationary if someone looks at a sample period during 1970-1990, typically a high inflation period in many advanced countries, but it is stationary if the sample period is extended to about 100 years. As Juselius (2006) put it, such property is more statistical than virtue of a certain variable. From a statistical point of view, stationarity conditions the econometric method and the timeframe of the analysis. Besides theoretical expectations or observational judgments, formal test are performed to determine stationarity.

Definition. A stochastic process is defined as (weakly) stationary process if it satisfies three properties, (a) constant mean, (b) constant but finite variance and (c) constant covariance across time[1]. Statistically,

(a) $E[y_t]$ = constant for all t,
(b) Var $[y_t]$ = constant for all t,
(c) Covar $[y_t, y_{t+n}]$ = constant for all t,

[1] (*Harris & Sollis*, 2003).

Considering a simple data-generating process (d.g.p), a variable y_t generated by a first order auto-regressive (AR) process:

$$y_t = p\, y_{t-1} + \varepsilon_t \qquad \varepsilon_t \sim N(0,\sigma^2)$$

the current value of y_t depends on the previous period's value y_{t-1} plus a disturbance term that comprises T random numbers coming from a normal distribution with 0 mean and constant variance σ^2, i.e. identically and independently distributed (hereby i.i.d). The variable y_t will be stationary if abs (p) $<$ 1; kur abs (p) $=$ 1, y_t is nonstationary[2].

[2] When abs (p) $>$ 1, y_t is nonstationary and explosive to $\pm\infty$.

The unit root test consists in running a regression on the first difference of the series to be tested as follows:

$$\Delta y_t = a\Delta y_{t-1} + x'd + \beta_1 \Delta y_{t-1} + \ldots + \beta_q \Delta y_{t-q} + e_t$$

where, *x* represents a "constant" or "constant and trend", and $\alpha = \rho - 1$, while null and alternative hypothesis are: *H0*: $\alpha = 0$ and Ha: $\alpha < 0$. The lagged values of the (Δy_{t-q}) are added to control for serial correlation of the residuals to ensure the latter are white noise. Running the test without those lagged values is only valid for an AR(1) process.

The critical values to test for unit roots are not the usual Student's t-distribution critical values but have been worked out by Dickey & Fuller (1979) and later augmented by McKinnon (1991) (1996), hence the test name Augmented Dickey Fuller (ADF)[9].

3.2.2 COINTEGRATION & JOHANSEN APPROACH

The phenomenon whereby non-stationary variables can be linearly combined into stationary process was called cointegration by Granger (1981) who used the concept to model long-run economic relations. Engle and Granger (1987) jointly developed

[9] Standard tests used in Eviews 6.0.

a statistical theory of testing for cointegration and estimating parameters of linear systems with cointegration. They tested the null hypothesis that the estimated linear relationship between I(1) variables is a cointegrating relationship with stationary errors in the regression, against the alternative of no cointegration with non-stationary errors by an ordinary LS. Obviously, size and power of unit-root tests on errors are critical for robustness of cointegration results. The foundation of Cointegrated-VAR is the Granger Representation Theorem[10].

Besides Engle and Granger method, Johansen (1988) (1991) advanced to a second generation approach from an econometric perspective, nowadays widely applied to model long-run economic relations since its inception. The Johansen Vector Error Correction Mechanism (hereby VECM) representation builds on Engle and Granger wherby:

$$\Delta Z_{i,t} = \sum_{j=1}^{4} \Gamma_{t-j} * \qquad \Delta Z_{i,t-1} + \Pi * Z_{i,t-1} + \Phi d_{i,t} + \varepsilon_{i,t}$$

where, $Z_{i,t}$ is the vector of potentially all "*N*" endogenous variables in the system, is a matrix of short term coefficients (*N x N*) driving the process, $\Gamma_{i,t-j}$ is the matrix of coefficients of the *N* variables in levels that are cointegrated, which is product of speeds of adjustments (α's) and long-run coefficients (β's), Φ is a vector of short run coefficients for deterministic terms in the VAR model that may be equal or different from zero, and $\varepsilon_{i,t}$ is the vector of i.i.d errors terms with mean zero and finite variance.

Johansen contribution lies in two aspects of cointegration in multivariate VAR (hereby CVAR), that are estimation of cointegrating vector (CV) and determination of cointegration rank (CR). Johansen made use of Likelihood Ratio (LR) test statistic, whose asymptotic distribution depends on the deterministic terms in the VAR model, allowing a simultaneous determination of both CR and deterministic terms, a key element to Johansen approach. Second, he derived the ML estimator of β, instead of relying on LS, to determine the cointegration space by reduced rank regression.

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[10] See (1987; Engle & Granger, 1987) for a rigorous proof of Granger Representation Theorem.

Application of Johansen Approach, given non-stationarity of the variables, relies on:

- Determining the unrestricted VAR, ensuring that $\varepsilon_{i,t}$ are white noise.
- Testing for reduced rank of Π matrix and deciding on inclusion of deterministic terms. Testing for cointegration amongst variables in Z_i is done using LR trace test. It tests the null hypothesis that there are at most r distinct CV using the trace statistic:

$$LR_{TR}(r|k) = -T\sum_{i=r+1}^{k} ln\,(1-\lambda_i)$$

  where λ_i is the largest eigenvalue of the Π matrix. Asymptotic critical values are provided by MacKinnon-Haug-Michelis (1999)[11].
- Testing for uniqueness of CV and for weak exogeneity.

Applying Johansen method with macroeconomic variables of transition economies is challenging. Data quality and short periodicity affect test results and lead to biased estimates. While there is no clear answer as to how many observations are needed for the asymptotic results to hold sufficiently well in VECM applications, long series of data are preferred to statistically distinguish between different hypothesis in time series models (Juselius, 2006). Whether a sample is "small" or "big" is not a function of the number of observations only, but also of the informativeness of the sample. Johansen (2002) has developed small sample correction, which might be significant for moderately short series (50-70 observations). Reihnsel and Ahn (1992) simplified a formula for short sample corrections which modifies asymptotic critical values upward by a scaling factor. Eviews 6.0 econometric package uses critical values from MacKinnon-Haug-Michelis (1999).

[11] Critical values of MHM used by Eviews differ from those reported in Johansen & Juselius (1990).

4. TESTS AND EMPIRICAL RESULTS

4.1 DATA PROPERTIES

I used Augmented Dickey Fuller Test (ADF) to check for stationarity in a sample covering 1998- 2010. All the variables were seasonally adjusted. Automatic lag selection with Schwartz Info Criterion (SIC) and 10 lags was chosen.

Unit root tests show the variables included in this study are all non-stationary[12]. For all variables the null hypothesis of no unit root was rejected in levels, but not in first difference. The presence of constant or trend did not change the results of the ADF test. All variables are mean-reverting at first difference and with only a constant, and maximum lag of up to 4. While aware that in different samples one might get different results, graphical inspection shows high persistence in series (Graph 1. pp. 17).

4.2 EMPIRICAL RESULTS

4.2.1 THE VAR MODEL AND TESTS FOR REDUCED RANK OF Õ

Our data are quarterly and an unrestricted VAR model of maximum 5 lags was tested considering that individual unit root tests gave a maximum lag of 3 or 4 for most of the variables. Schwarz-Criterion and Hannan-Quin test suggest lag length of 1 while other tests suggest maximum of 4 or 5.

Residual autocorrelation and normality test of unrestricted-VAR with 1 lag failed only for the first lag, while normality failed due to non-normality of "risk premium" (*lambda*) residuals. Testing with longer lags improves the latter but not the former (results not shown). VAR simulations show that statistical inferences are sensitive to serially-correlated residuals, residual skewness, parameter constancy, but are robust to kurtosis and residualhe teroscedasticity[13]. Size and power of these tests are affected by sample size. With higher lag

[12] Most diagnostic test results not shown due to space limits. They are available upon request.

[13] (Hendry & Juselius, 2000).

length, the unrestricted VAR would still fail one of the above tests as the case showed. Higher lags lose degrees of freedom. It makes those tests and cointegration tests less reliable. For short samples it is suggested not to lose further degrees of freedom. I chose lag one to proceed.

The econometric interpretation of the *BEER* theoretical model is that there is at least one (predictably two if UIP holds separately) long-run relationship between *RER* and the fundamental (non-stationary) variables involved in *BEER*, referred as cointegration. Determination of rank of Π matrix and of number of deterministic terms by Johansen method is done simultaneously. Cointegration test results suggest 1 cointegration equation independently of deterministic terms.

While cointegration tests suggest model 4, unit root tests of the variables suggested no trends in the variables, only constants. Juselius (2006) suggests case 2 is the appropriate specification provided there are no linear trends in the data, unless CVs can be assumed to have a zero mean (suggesting case 1), which is not the case. Unit root tests showed series have only a constant. I chose to proceed with an intercept in the cointegration equation (no trend), but no intercept in the short term dynamics. Clearly cointegration rank does not have to be equivalent to the number of theoretical relations suggested by an economic model (Juselius, 2006). A purely theoretical model would suggest two equilibrium equations, one for the UIP with a risk premium, and the other for the PPP augmented with B-S term and other fundamentals.

4.2.2 ESTIMATION AND IDENTIFICATION

I stick to one equilibrium relation assuming that UIP on its own cannot drive mean reversion within a short time period that could be captured in a small sample. This is later supported by the long-run coefficient of -0.548 percent change in RER for 1 percent change in real interest rate differential. All the long-run equilibrium coefficients are significant as judged by a Student's t-distribution, though not all α-coefficients satisfy the stability condition (Table 4. 1). Diagnostic tests show residual autocorrelation, portmanteau, and non-normality are rejected, while failed test of residual heteroscedasticity.

Table 4.1. Eigenvector decomposition of (unrestricted) long-run matrix ∏

	RER	RR_DIFF	NFA/GDP	TNT	TOT	LAMBDA	CONSTANT
Long Run equilibrium coefficients.							
	1	-0.5484	0.3148	1.2398	-0.5257	-0.528715	5.6488
		[-4.02391]*	[1.33567]	[19.1758]*	[-9.66391]*	[-4.98103]*	
Adjustment coefficients							
	-0.367282	0.11623	-0.005659	-0.25886	0.276248	-0.021861	
	[-2.47995]*	[1.03814]	[-0.10526]	[-2.74134]*	[1.00944]	[-0.15600]	

* t-statistic in square brackets

(I) Restrictions on eigen-vector

Likelihood Ratio (LR) test statistics rejected omission of each of individual β's other than *nfa* implying significance for the long run relationship equation.

Tabela 4.2. Restrictions on long-run coefficients

ho: Testing restriction $\beta(1,k)=0$	rer=0	r_diff =0	nfa/gdp	tnt	tot	lambda
Chi-square(1)	[12.658*]	[10.272*]	[1.6489]	[17.417*]	[19.015*]	[14.547*]

(*) means significance at 5 %

(II) Long-Run weak exogeneity

Weak exogeneity hypothesis is tested with a LR test procedure (Johansen S. , 1995). The null hypothesis here is that a variable of interest has influenced the long run stochastic path of the other variables in the system, while it is not simultaneously influenced by them.

Table 4.3. Testing for weak exogeneity

ho: Testing restriction $\alpha(k,1)=0$	$\alpha_{d(rer)}$ $\chi^2(1)$	$\alpha_{d(r\_diff)}$ $\chi^2(1)$	$\alpha_{d(nfa)}$ $\chi^2(1)$	$\alpha_{d(tnt)}$ $\chi^2(1)$	$\alpha_{d(tot)}$ $\chi^2(1)$	$\alpha_{d(lambda)}$ $\chi^2(1)$
(Chi-square(1)	5.172471	0.979017	0.014521	6.400073	0.20597	0.025266
Critical Value (95 %)	{ 3.841 }	{ 3.841 }	{ 3.841 }	{ 3.841 }	{ 3.841 }	{ 3.841 }

Individual LR tests with a distribution confirm weak exogeneity of 4 variables in the unrestricted VEC model (Table 4. 3). Joint tests confirmed their non-significance, implying that rer and relative tradable/non-traadable price ratios adjust to bring equilibrium when system is exposed to a shock[14].

Table 4.4 Joint test restriction on exogeneity and structural restrictions

	$\chi^2(4)$ test on α- coefficients	$\chi^2(5)$ test on α- coefficients and β of nfa
Joint $\chi^2_{(df)}$ test	[1.5036]	[3.6742]
$\chi^2_{(df)}$ critical	{ 9.488 }	{ 11.070 }

The long-run equation coefficients of macro fundamentals are correctly signed in a restricted CVAR, while proxy for risk premium is not. An increase in non-tradable price index at home, causing tnt to decline would trigger increase (appreciation) of RER, hence negative correlation. The size of 1.16 percent appreciation for any 1 percent increase in non-tradable prices is relatively larger than the pool estimate of around 0.4-0.7 of De Broeck and Sløk (2001), but well in the range of other individual time series findings on Eastern Europe economies (Table 2. 1, pp.14). Also, terms of trade is positively signed. A 10 % increase in export prices would trigger about 4.8 % appreciation to restore equilibrium.

[14] A granger causality test on unrestricted-VEC show exogeneity of rird, nfa and lambda.

Table 4.5. Eigen vector decomposition of long-run matrix Π

Long Run equilibrium coefficients (the β's); t-statistics in brackets						
RER	RR_Dif	NFA / GDP	TNT	TOT	lambda	constant
1.00	-0.451	0.319	1.160	-0.470	-0.497	5.572
	[-3.62325]	[1.48281]	[19.6583]	[-9.45884]	[-5.13270]	
Adjustment speed coefficients (α-coefficients); t-statistics in brackets						
RER	RR_Dif	NFA / GDP	TNT	TOT	lambda	
-0.46691	-	-	-0.31273	-	-	
[-3.04410]	NA	NA	[-3.02576]	NA	NA	

UIP suggests that the domestic currency is expected to depreciate when the domestic interest rate exceeds the foreign interest rate. Hence, an appreciated currency at time t_0, when interest rate differential is positive, is in line with the expectation of depreciation at a future date. Similarly, portfolio allocation theory suggests a positive relationship implying a higher demand for the currency with the higher interest rate. Yet the size of the coefficient is very small, implying 0.45 percent change in RER for every 1 percent increase in real interest rate differential.

Real exchange rate reacts much stronger to a greater coefficient of about 0.5 on relative debt, though with the wrong sign. A higher risk premium should expectedly be associated with a more depreciated currency. Positive sign of relative public debt is against theoretical intuition, which says that increasing risk premium cause depreciation. One possible explanation for the positive sign is that relative public debt might be an indication of the domestic country capacity to borrow, which is inversely related to risk premium. That is as the (unobservable) risk premium declines, the (unobservable) domestic country capacity to borrow goes up. Similarly, RER appreciates due to lower risk premium. As an illustration, back in 1998, domestic public debt was about 38 % while Albania had just moved past the civil turmoil of 1997. In year 2000, when the country had stabilized and country risk premium should have declined, public debt in Albania reached around 61 %. Those figures do not imply that risk premium was higher in year 2000 than in 1998, nor that in 1998 public sector did not need to borrow, but rather that

the public sector capacity to borrow had gone up after 2000 as political risk had declined.

The main view is that the relative debt is inversely correlated to risk premium proxy itself, and so is RER. That makes the endogeneous variable rer positively correlated to relative public debt.

4.3 ECONOMIC INTERPRETATION

At this point it is not clear what the impact of *B-S* effect alone is. The relative price ratio (*tnt)* is a proxy that captures both the *B-S* effect due to relative productivity increases as well as demand side pressures. The latter might be related to the role of public expenditures on non-tradable price index. Alternatively, stable growth of remittances averaging 10-14 % of GDP annually with two-sided impact on both per capita income growth (hence relative productivity) and tnt might count.

Use of relative productivity measure would have made it possible to differentiate the B-S effects from demand side effect of public spending, though the data on employment are quite dubious as around a third of employment is employed in agricultural sector, and data on this sector are hardly reliable[15].

At this stage, current findings suggest two endogenous variables that adjust to bring equilibrium, *rer* and *tnt*. There are two observations open to interpretation here. The α-coefficient for *rer* is quite high (about 0.46), implying a half life less than two quarters, a very fast adjustment mechanism. A tentative explanation for such a high adjustment speed is that the implied equilibrium is a statistical one, not a normative and macroeconomic one. While it is implicitly assumed that the tradable/non-tradable relative price ratio (*tnt*) adjusts to the level consistent with the internal equilibrium of the economy it does not necessarily do so. Rather than to macro-equilibrium it adjusts to a statistical equilibrium the model implies through the cointegration vector.

[15] An attempt to include relative productivity (GDP/employment relative to Euro area) did not give significant results even when other variables included (results not shown).

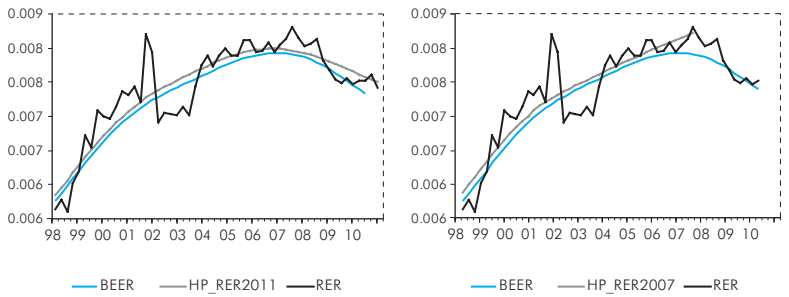
The high adjustment coefficient on tnt might be fitted within such a tentative scenario, which raises the second issue. The relative price ratio (*tnt*) has a high adjustment parameter (about 0.3). Assuming the stochastic trend of this term is dominated by that of domestic non-tradable price index, it can be deducted that RER disequilibrium is corrected quick due to adjustment of non-tradable price index at home rather than nominal ER. For this deduction to hold we would require that non-tradable prices in Albania be rather flexible, such that they can easily go down as well to close the disequilibrium gap. Hence, the Balassa-Samuleson disequilibrium gap to be closed by nominal exchange rate becomes smaller. Such a scenario would hold under rather trivial assumptions. First, that the system reaches real exchange rate equilibrium is no guarantee that the whole economy does. Both variables, real exchange rate and relative price ratio (*tnt*), adjust to their own (statistical) equilibrium simultaneously.

4.3.1 CONSTRUCTING AN EQUILIBRIUM EXCHANGE RATE

It is possible to construct the behavioural equilibrium exchange rate (BEER) using the long run equation. I proceed by finding the potential equilibrium of all variables, except rer. Using long run β's calculate the equilibrium level of rer. Check that the other endogenous variable (*tnt*) is consistent with this equilibrium.

There is an underlying assumption on estimating *BEER*, that HP filtered equilibrium paths for the endogenous variable *tnt* and other explanatory variables are supposedly consistent with an internal equilibrium. This is why BEER is a statistical equilibrium rather than a theoretical or normative one. It may still provide some valuable insight. The BEER estimate is below the actual path during 1999-2001, implying over-appreciation. The depreciation that took place in 2002 has overshot, while it's been close, though above, equilibrium in 2004- 2007Q1 followed by over-appreciation in 2007-2008. The nominal depreciation that took place in 2009 brought RER closer to our equilibrium estimate (Graph 3).

Graph 3. BEER, HP filter of RER as of 2011, as of 2007 and actual RER



For comparative purposes I used HP filtered real exchange rate (HP_RER) against model-derived equilibrium path of real exchange rate (BEER), vis-a-vis actual real exchange rate (RER). While the size of over or under-shooting might need further analysis, the equilibrium path estimated seems to lead the trend.

4.3.2 PROBLEMS WITH BEER MODEL

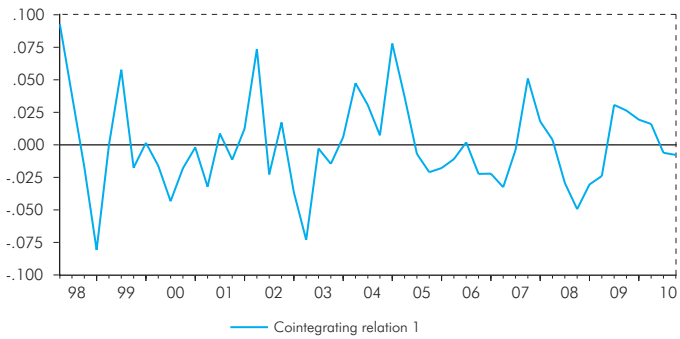
The error-correcting mechanism (ECM) imposes the equilibrium to which it refers to at the beginning of the process and at the end of it, while there is no guarantee the economy has been at equilibrium in those two moments. In 1998, economy was in the process of recovering from the socio-political turmoil of 1997, while in 2010 the economic growth was under its historical average[16].

Additionally, BEER forces equilibrium over the sample period even when indeed for short samples exchange rate has not been close to equilibrium. This is closely related to the "informativeness" degree of the sample discussed by Juselius (2006). With half-life of about 4 years, which is average finding in many studies. the actual (unobserved) macroeconomic error-correcting process will only take place a few times in a 13-years sample. But, Johansen approach recognizes a CV when the relationship is stable with several (many) cuts on the horizontal line, so that ECM will have forced RER

[16] Bank of Albania, (Annual Report 2010).

several times to reach equilibrium (Graph 4). This contradicts the slow mean-reversion (to equilibrium) of real exchange rate that is generally considered throughout the literature.

Graph 4. Cointegration graph for Restricted-CVAR



The case of very short half-life may be that of statistical fit. Both adjustment-coefficients might be capturing the effect of the same variable, which is the change in non-tradable price index[17]. For any 1% decline in tnt term (hence a 1 % increase in domestic non-tradable prices), the real exchange rate increases (appreciates) by 1.16 %. If a shock on any other variable in the cointegrating vector takes place, then it is simultaneously absorbed by the non-tradable price index that partly is captured by adjustment in rer. This scenario fits well with the assumption of very flexible non-tradable prices, which in a small transitional country with a large agricultural sector, and hence grey economy, is very likely.

[17] The ratio of non-tradable goods and services in CPI basket (Albania) has been around 60 %.

5. CONCLUSIONS

This study examines equilibrium exchange rate in Albania. Modelling of equilibrium exchange rate has been built upon the basic framework of Purchasing Power Parity. Behavioural model (BEER) is employed in this research as it copes much better with data shortages and is widely used in time series modelling of exchange rate for developing countries. The most popular indicator relevant to real exchange rate determination is Balassa-Samuelson effect, though demand-side effects due to public spending or other variables may interfere with the former and lead to biased estimates. As both real exchange rate and proxy for B-S effect show non-stationarity, we approached the issue with Johansen method on cointegration. Short samples of data affect the power and size of tests, hence standard BEER model with an UIP block and three other explanatory variables, tradable/non-tradable term, terms of trade and net foreign assets, was employed. Increasing number of variables was avoided as it would lead to unreliable cointegration rank and biased estimates due to short sample of 52 quarters.

One long-run relationship was found. Real exchange rate and relative tradable/non-tradable price ratio (*tnt*), capturing B-S term, were the endogenous terms adjusting respectively by 46 percent and 33 percent every quarter to restore equilibrium. Elasticity of RER towards tradable/non-tradable ratio and terms of trade is respectively 1.16 and 0.47 percent respectively, being main variables determining RER. There is no clear answer what the B-S effect is as the tnt term captures demand-side effect of other factors.

Adjustment speed of RER to equilibrium is rather fast relative to an average half-life of 4 years found in advanced countries. One possible explanation comes from use of relative price ratio, instead of relative productivity, to capture B-S effect and the imposed equilibrium in a short sample. Both these might be overstating the B-S effect and the adjustment speed calling for a careful interpretation of results. This is more of a problem in the case of a transition economy, where other factors may be part of the process, like initial depreciation, trend appreciation and the effect of administered prices. Unless the presence of these factors is specifically recognized in the equation and a larger sample is obtained, the true value of the equilibrium captured by a statistical process should be interpreted carefully.

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APPENDIX I.

Table 1.1. Variables used in Exchange Rate models

STUDY	STUDY	PROD	GOV	OPEN	NFA	RIRD	TOT	INV	FD	PC (S)	RP	FDI	nr i variab
Alberola (2003)	-			-/+									2
Alonso-Gamo et al. (2002)	-			+									2
Avallone and Lahrèche-Révil (1999)	-	-	+			-			-				5
Begg et al. (1999)	-	-	-										3
Beguna (2002)		-	-			-					-		4
Bitans (2002)	-	+	+										3
Bitans and Tillers (2003)	-			-		+							3
Burgess et al. (2003)	-			+									3
Coricelli and Jazbec (2001)	-	-							-				3
Coudert (1999)	-												2
Csajbók (2003)	-	-	-	-	-	-		+					6
Darvas (2001)	-			-	-/+								3
De Broeck and Sløk (2001)	-		+										2
Dobrinsky (2003)	-	-											2
Égert and Lahrèche-Révil (2003)	-												1
Égert and Lommatzsch (2003)	-		+		-			-/+		-			5
Filipozzi (2000)	-						-						2
Fischer (2002)	-	-			-/+	+							4
Frait and Komárek (1999, 2001)	-				+	-			-		-		4
Halpern and Wyplosz (1997)	-	-											2

Hinnosar et al. (2005)	-			-		-							3
IMF (1998)	-	+	-				+						4
Kazaks (2000)	-		+										2
Kim and Korhonen (2002)	-	-	+				-						4
Krajnyák and Zettelmeyer (1998)	-												1
Lommatzsch and Tober (2002b)	-			+	-								3
MacDonald and Wójcik (2002)	-			-/+	-					-			4
Maurin (2001)	-	-			-			+					4
Rahn (2003)	-			-									3
Randveer and Rell (2002)	-					-							2
Rawdanowicz (2003)	-				-	-							3
Rubaszek (2003)				-	-								2
Vetlov (2002)	-		+		+								3
Number of	31	10	4	9	9	7	2	1	2	2	2		
Number of	0	2	7	3	3	2	1	3	0	0	0		
Total number of studies	31	12	11	11	10	9	3	3	2	2	2		

Note: (-) means appreciation of real exchange rate for an increase in the explainign variable.
PROD = productivity (or proxy for it like relative CPI / PPI, or GDP/capita, GDP/employment); GOV = government consumption (% GDP); OPEN = sum of exports and imports (% of GDP); RIRD = real interest differential (or a proxy like foreign interest rate or any world interest rate); TOT = terms of trade (export price / import price); INV =investment (% GDP); FD = foreign debt (% of GDP); PC = private consumption (% of GDP); RP = regulated (administered) prices or proxy for that; FDI = foreign direct investment (% of GDP); S = national savings (% of GFP).
Source: Based on Égert (2003), Melecky and Komarek (2007) updates and own updates.

APPENDIX II.
DATA DESCRIPTION & SOURCES

- *lrer* – log of Real Exchange Rate: log of Eur-Lek exchange rate (foreign currency per unit of domestic currency) multiplied by the ratio of two price indices, for Albania and Euro area. An increasing trend shows appreciation. Data available at http://www.bankofalbania.org/web/Statistika_Hyrje_230_1.php. CPI at www.instat.gov.al. For longer series the Institute of Statistics should be contacted.

- *tnt1* (*al_tnt – eu_tnt*): tradable non-tradable price ratio of Albania relative to euro area.

A decrease in al_tnt would imply a relatively faster increase in non-tradable price index of domestic economy. Hence a negative sign is expected. In some studies the tnt variable is inversely constructed, that is non-tradable to tradable ratio, with an expectation of a positive relationship.

- *al_TNT* (tradable non tradable price ratio) Albania. Ratio of tradable price index to non-tradable price index. A measure of these two price indices is built within Research Department and is available for its internal use (period 1998 Q1 – 2011 Q2).

Tradable and non-tradable price indices for Albania are not publicly available, hence indices constructed for internal purposes cover the period after 1998. Some observations are filled by interpolation or regression with older discontinued data.

- *eu_TNT* (tradable non tradable price ratio) Euro area. Ratio of PPI to HCPI for the Euro area. Both indices are available at ECB website. Periodicity on monthly basis.
  http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database

- *al_nfa*: net foreign assets of the banking system in Albania. Net foreign assets of the banking system as a proxy for nfa of the economy (measured as a ratio of GDP). Available on monthly

basis available at Bank of Albania website:
http://www.bankofalbania.org/web/Statistika_Hyrje_230_1.php?evn=agregate_parent_sel&evb=agregate&Cgroups=16&periudha_id=5

- *Lambda1* (risk premium). Ratio of public debt of Albania and public debt of euro area.
  - al_gdebt: Public debt as a share of GDP Albania. Ratio of public debt (domestic and external) as share of GDP. Available at bank of Albania website on quarterly basis since 2000. The series of public debt is extended back to 1998 by using annual data and interpolated by using the quarterly growth rate of domestic public debt for this period.
  - *eu_gdebt*: Public debt as a share of GDP Euro area – Public debt as a share of GDP for Euro area available on quarterly basis until year 2000 at:
    http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database

Annual data obtained from this website have been used to obtain quarterly data for the years 1998 and 1999 through straight line trends. The series is seasonally adjusted.

- *al_tot1*: Terms of Trade – The ratio of export price index to import price index (in same currency). The two indices have been constructed within Bank of Albania for internal use.

The set of data used in this study is partly constructed by the author or is available for internal purposes within the Bank of Albania.

APPENDIX III.
BOX ON BS EFFECT

Given RER between home and abroad. Real Exchange rate and Relative price of traded goods are:

$$\dot{q} = \dot{s} + \dot{p} - \dot{p}^* \qquad (2.0)$$

$$\dot{q}_T = \dot{s} + \dot{p}_T - \dot{p}^*_T \qquad (2.1)$$

where subscript T stands for tradable goods. By subtracting (2.0) from (2.1), we can write RER as the sum of two countries relative price ($\dot{q}_T$) and the difference of relative prices across economy and the tradable sector observed in each country.

$$\dot{q} = \dot{q}_T + [(\dot{p} - \dot{p}_T) - (\dot{p}^* - \dot{p}^*_T)] \qquad (2.2)$$

Given that the final price is a weighted average of the prices in two sectors:

$$\dot{q} = \dot{q}_T + [(\dot{p} - \dot{p}_T) - (\dot{p}^* - \dot{p}^*_T)] \qquad (2.3)$$

substituting for $\dot{p}$ and $\dot{p}^*$ in (2.2) we get:

$$\dot{q} = \dot{q}_T + (1-\alpha)[(\dot{p}_N - \dot{p}_T) - (\dot{p}^*_N - \dot{p}^*_T)] \qquad (2.4)^1$$

Under certain assumptions[2], , the relative price of non-tradable goods compared to tradable goods (home and abroad), referred to as "internal exchange rate", is:

$$\dot{p}_N - \dot{p}_T = \frac{\mu_N}{\mu_T}\dot{A}_T - \dot{A}_N \qquad (2.5)$$

where, A_i is the change in total factor productivity in respective sectors, and μ_i is labour share of income in each sector ($i=N,T$). For simplicity assume those shares are the same at home and abroad. Equation (2.5) says that the relative price of non-tradable goods (i.e. internal exchange rate) appreciates with relatively

[1] When $\alpha \neq \alpha^*$, then (2.4) is modified with a term $-(\alpha - \alpha^*)(\dot{p}_N - \dot{p}_T)$.

[2] International capital mobility and labour mobility across sectors, but not internationally.

faster productivity gains in the tradable sector $\frac{\mu_N}{\mu_T}\dot{A}_T > \dot{A}_N$.

The effect is further multiplied, the higher the labour shares in non-tradable sector. This result implies that faster productivity growth between tradable goods to non-tradable goods at home relative to abroad, $(\frac{\mu_N}{\mu_T}\dot{A}_T - \dot{A}_N) > (\frac{\mu_N}{\mu_T}\dot{A}^*_T - \dot{A}^*_N)$, cause RER appreciate.

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