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CAN PRODUCTIVITY INCREASES IN THE DISTRIBUTION SECTOR HELP EXPLAIN TENDENCY OF THE TURKISH LIRA TO APPRECIATE?

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Abstract

The Balassa-Samuelson (B-S) hypothesis relies on the productivity differentials between tradable and non-tradable sectors to explain deviations in purchasing power parity. Within this framework, the relative productivity differences in tradable vis-à-vis non-tradable sectors between two countries will determine the long-run changes in the real exchange rate. However, Lopcu, Burgaç and Dülger, (2012) found that the relationship between the real effective exchange rate and productivity is not supported for the post 2001 era in Turkey. By testing the cointegration relationship between the real effective exchange rate, relative productivity differentials, real interest rate differentials and net foreign assets, using recently developed techniques with multiple structural breaks, the authors reported that support could not be found for the standard B-S hypothesis between Turkey and 27 countries of the European Union (EU-27), particularly after 2001.

MacDonald and Ricci (2005) investigated the long run impact of the distribution sector on the real exchange rate and found that increases in productivity and product market competition of the distribution sector vis-à-vis the rest of the world lead to appreciation of the domestic currency. Although the distribution sector typically would be considered part of the non-tradable sector, they indicated that the use of services from the distribution sector in the tradable sector could be a potential explanation for the appreciation of the real exchange rate. In particular, they pointed out that if the distribution sector plays a bigger role in delivering goods in the tradable sector rather than to consumers, this would tend to reduce the price of tradable goods, raising relative wages and, hence lead to the appreciation of the real exchange rate. Thus, in this study, following MacDonald and Ricci, we include the distribution sector in the analysis to determine whether the tendency of the Turkish lira to appreciate could be explained by the B-S hypothesis taking into account the potential productivity increases in the distribution sector for the post-financial liberalization era.

Keywords: Balassa-Samuelson Hypothesis, Real Effective Exchange Rate, Relative Productivity Differentials, Distribution Sector, Cointegration, Multiple Structural Breaks
Jel Code: C22, F31

I. Introduction

The Balassa-Samuelson (B-S) hypothesis relies on the productivity differentials between tradable and non-tradable sectors to explain deviations in purchasing power parity. Empirical studies on the B-S hypothesis typically use data to determine the effect of relative productivity differentials of tradable versus non-tradable sectors between the home country and the rest of the world, including the distribution sector as a part of the non-tradable sector. However, Devereux (1999), Burstein et al. (2000) and MacDonald and Ricci (2001, 2005) emphasized the importance of the distribution sector in determining the real exchange rate.

"The distribution sector's influence on the real exchange rate (*Rer*) through the non-tradable sector stems from the observation that arbitrage in the goods market occurs not at the consumer level but at the producer level. Even abstracting from transportation costs and market pricing and even if global market integration equalizes prices at the producer level, consumer prices for the same good may still differ across countries" (MacDonald and Ricci, 2005, p.30).

The importance of the distribution sector productivity on the real exchange rate is studied by very few authors. Lee and Tang (2003) analyzed the link between productivity and the real exchange rate for 12 OECD countries. They assessed the relative importance of the distribution sector by dividing the non-tradable sector into retail and the rest. The results showed that the productivity of the distribution sector has a significant effect on the real exchange rate. An increase in productivity of the distribution sector tends to reduce the relative price of tradable goods which leads to real appreciation. MacDonald and Wojcik (2004) tested the exchange rate behavior of four EU accession countries using a panel dynamic ordinary least squares (DOLS) estimator so as to investigate the importance of demand and supply effects on real exchange rates. In addition, they examined the role of distribution sector productivity in the real exchange rate dynamics. The authors found that the distribution sector has an independent effect on the real exchange rate. MacDonald and Ricci (2005) examined the long run impact of the distribution sector on the real exchange rate using the total factor productivity. They found that increases in productivity and product market competition of the distribution sector vis-à-vis the rest of the world lead to appreciation of the domestic currency. Camarero (2008) investigated the role of productivity in the behavior of the real exchange rate for a group of OECD countries for the period of 1970-1998, using the pooled mean group estimation method (PMGE). The study stressed the relevance of dividing sectoral productivity in term of tradable, non-tradable and distribution sectors. Econometric results from the study indicated that an increase in distribution sector productivity depreciates the domestic currency. Petrovic (2012) analyzed both standard and modified versions of the B-S hypothesis for Serbia using Johansen and Engle-Granger cointegration tests for the period 2004:01-2010:12. The modified version of the B-S model differs from the standard B-S model since the effect of the distribution sector is separately analyzed. The results provided no evidence in favor of the modified B-S hypothesis.

The main purpose of this paper is to determine the importance of the distribution sector influence on the real exchange rate for Turkey. We test the cointegration relationship between the real effective exchange rate, relative productivity differentials, relative productivity differentials in the distribution sector, real interest rate differentials and the net foreign assets for the 1990:Q1-2011:Q2 period, using recently developed co-integration techniques with multiple structural breaks.

The remaining of the paper is organized as follows. Section two presents theoretical issues. In section three, the data and the empirical methodology are discussed. Section four presents the empirical findings and section five concludes.

II. Theoretical Issues

There are several possible theoretical explanations for the real exchange rate movements in the literature. One of the most important models of long-run deviations from the purchasing power parity (PPP) was developed by Balassa (1964) and Samuelson (1964). They explained that relative productivity differences across countries cause the real exchange rate to deviate from the PPP in the long run. A rapid productivity increase in the tradable sector vis-à-vis the non-tradable sector in the home country in relation to the rest of the world will cause the aggregate price level to increase faster and consequently cause the home currency to appreciate. Most of the studies related to the B-S hypothesis have used data including the distribution sector within the non-tradable sector to determine the effect of the relative productivity of tradable versus non-tradable sector. The distribution sector plays an important role in industrial activity both in terms of value added and employment that might account for a large component of prices (MacDonald and Ricci, 2005; MacDonald, 2007; Burstein et al., 2000). MacDonald and Ricci (2001, 2005) and MacDonald (2007) introduced the distribution sector into variants of the B-S model in empirical analysis.

"Real exchange rate will appreciate with the relative productivity of distribution sector, if this sector plays a bigger role in delivering goods in the tradable industry rather than to consumers. This is because the productivity of the distribution sector has two effects: on the one hand, it tends to lower the price of tradables, thus raising the relative wage and appreciating the *Rer*; on the other hand, it lowers the consumer price of tradables, depreciating the *Rer*" (MacDonald, 2007, p. 88; MacDonald and Ricci, 2005, p. 35). Given this framework, we study two variants of the B-S hypothesis using net foreign assets and real interest rate differentials as explanatory variables in addition to relative productivity differentials of tradable versus non-tradable sectors between Turkey and the EU-27 and the relative productivity of the Turkish distribution sector with respect to the EU-27.

Letting *Reer* denote the real effective exchange rate,

Model 1: $Reer_t = cons + \beta_1 d\_Prod_t + \beta_2 d\_Prodd + \beta_3 Nfa_t + u_t$

Model 2: $Reer_t = cons + \beta_1 d\_Prod_t + \beta_2 d\_Prodd_t + \beta_3 d\_Rir_t + u_t$

where *d_Prod* stands for relative productivity differentials in a standard B-S sense; *d_Prodd* and *d_Rir* denote differentials of the distribution sector productivity and the real interest rate between Turkey and the EU-27 respectively, and *Nfa* is net foreign assets of the home country, Turkey.

III. Data and Econometric Methodology

Data

The data set covers the period from 1990:Q1 to 2011:Q2. We take the EU-27 as the benchmark foreign country. Manufacturing represents the tradable sector; the non-tradable sector includes construction, community, social and personal services while the distribution sector is wholesale and retail trade. Average labor productivity is used as a proxy for the productivity variable suggested by the theoretical model. Hence, in order to compute productivity in the tradable and the distribution sectors, total output is divided by the employment level in the relevant sector. In calculating the productivity for the non-tradable sector as a whole, a weight is needed for each sub-sector productivity. To calculate the weights, we total the output for all non-tradable sub-sectors separately. Then, we calculate the percentage of the total output attributed to each sub-sector by dividing the total output for each sub-sector into the grand total of output for the broad category of the non-tradable sector. All the sectoral output and employment series for the EU-27 as well as the sectoral output series for Turkey are obtained from the statistical office of the European Union (Eurostat). The employment series for Turkey is from the Turkish Statistical Institute (Turkstat) and the Central Bank of the Republic of Turkey (CBRT). The output and employment series for each sub-sector are seasonally adjusted using X-12, before the average productivity for each sub-sector is calculated.

The dependent variable in our study is the logarithm of the consumer price index (CPI) based real effective exchange rate (*Reer*)[4] obtained from the Eurostat. An increase in the *Reer* of Turkey corresponds to an appreciation of the Turkish Lira (TL). The net foreign assets series for Turkey is computed by the difference in the total foreign assets minus the liabilities to non-residents divided by the Gross Domestic Product (GDP), and from the CBRT. Real interest rate differentials *(d_Rir*) are proxied by the real interest rate differentials between Turkey and the G-7. The annual percentage rate (APR) on three month treasury bills (TB) and the CPI based inflation series are used to compute the *Rir*. Both the TB rates and CPI series for Turkey are from the Undersecretariat of the Treasury, while the TB rates and the CPI based inflation series for the G-7 are from the International Financial Statistics (IFS). For Turkey the inflation series is calculated by the authors using the Turkish CPI series. All variables are converted in natural logarithms, except net foreign assets and real interest rate differentials.

Econometric Methodology

As a first step, we start by investigating the order of integration of the real exchange rate and its determinants using the *ADF* and *KPSS* tests. Next, the stability of the relationship between the real exchange rate and its determinants are assessed using the tests proposed by Kejriwal and Perron (2010) involving non-stationary but cointegrated variables with multiple structural changes of unknown timing in regression models. The global minimization procedure for the break fractions is the same as in Bai and Perron (1998, 2003). It is obtained via an algorithm, using the principle of dynamic-programming. Nevertheless, the distributions of the break fraction estimates and the *Sub-Wald* test statistics, *Sub-F*, are different from the ones in Bai and Perron (1998, 2003) due to the nonstationarity of the time series. If the Kejriwal-Perron tests corroborate the existence of structural breaks, then whether the variables are indeed cointegrated needs to be verified, as these tests can reject the null of stability when the regression is purely a spurious one (Kejriwal, 2008). So, cointegration tests following Kejriwal (2008), which are based on the extension of the one-break cointegration tests developed by Arai and Kurozumi (2007) (A-K henceforth) with a null of cointegration, are performed. Because our series seem to exhibit a trend, we include a deterministic trend in the unit root as well as cointegration tests. Hence, our model is a regime and trend shift model.

[4] The *Reer* is calculated as the sum of the nominal rate and the trade weighted price or cost deflator. The *Reer* attempts to show movements in prices or the production cost of domestically produced goods relative to prices or the production cost of goods produced by competitor countries when expressed in common currency. Competitors here for Turkey correspond to the EU-27.

Finally, we estimate the model with breaks to investigate how the relationship between the real exchange rate and its determinants may have altered over time[5]. To deal with potential simultaneity bias, we use the Dynamic Ordinary Least Squares (*DOLS*), adding the leads and lags of the first differences of the regressors.

IV. Empirical Results

Table 1 presents the *ADF* and *KPSS* unit root tests. According to the results, the real effective exchange rate is stationary at 5% but not at a 1% significance level, using Model A of the *ADF* test. The other *ADF* statistics as well as the *KPSS* tests show that the real effective exchange rate is nonstationary. For the other variables, the *ADF* tests cannot reject the null of non-stationary at least at the 1% significance while the *KPSS* tests reject the null of stationarity at least at the 10% level. Both the *ADF* and *KPSS* tests, on the other hand, indicate that the first differences of all the variables in Table 1 are stationary.[6] Hence, we conclude that the variables used in the study are integrated order of one, I (1).

Table 1. ADF and KPSS Unit Root Tests

		ADF							KPSS	
	Model A			Model B			Model C			
Variables	k	τ_τ	ϕ_3	k	τ_μ	ϕ_1	K	τ	η_μ	η_τ
Reer	1	-3.60^{*}	6.58^{*}	2	-1.61	11.36^{**}	4	0.49	1.06^{**}	0.25^{**}
d_Prod	1	-2.89	4.49	1	-2.57	3.32	1	-2.55^{*}	0.93^{**}	0.15^{*}
d_Prodd	8	-1.19	1.01	8	-1.43	1.03	8	-0.35	0.53^{*}	0.23^{**}
Nfa	1	$-3.25^{\#}$	5.30	2	-0.88	1.28	2	-0.51	1.44^{**}	$0.11^{\#}$
d_Rir	5	-3.00	4.99	5	$-2.87^{\#}$	$4.14^{\#}$	5	-1.41	0.18	0.19^{*}
Critical (**)	1%	-4.06	8.73		-3.50	6.70		-2.59	0.74	0.21
Values (*)	5%	-3.46	6.49		-2.89	4.71		-1.95	0.46	0.14
(#)	10%	-3.15	5.47		-2.58	3.86		-1.61	0.34	0.11

Model A: constant and linear trend, Model B: constant, Model C: none. *k* denotes number of lags.
Lags are selected by *t* test for *ADF*. Bandwidth length for *KPSS* is k: $T^{(1/3)}$

The second step is to assess the stability of the long-run relationship between the real exchange rate and the relative productivity differences, relative productivity in the distribution sector and the other variables. We use *Sub-F*, *UDmax* and sequential tests proposed in Kejriwal and Perron (2010) as well as information criteria to determine whether breaks exist in the long-run relationship. Specifically, we first test the null hypothesis of no structural change in the long-run relationship, using *Sub-F* and *UDmax* tests. The number of breaks is

[5] For a detailed discussion of the econometric methodology see Lopcu, Burgaç and Dülger (2012) and the references cited therein.
[6] Unit root tests for the first differences are not reported for the sake of conserving space.

then selected by a sequential procedure and the information criteria following Kejriwal (2008).

Table 2. Kejriwal-Perron Tests for Multiple Structural Breaks (Regime and Trend Shift Model)

y_t={Reer$_t$} z_t={ d_Prod$_t$, d_Prodd$_t$, Nfa$_t$ } q=5 m=4, e=0.15, x_t=0, p=6

Sub F_T(1)	***Sub F_T(2)***	***Sub F_T(3)***	***Sub F_T(4)***	***UD Max***	*LWZ*	*BIC*
16.58*	12.81#	9.13	8.56	16.58#	1	2

SEQ_T (2 | 1)	***SEQ_T (3 | 2)***	***SEQ_T (4 | 3)***
17.10**	16.12	11.94

Break Dates	
$\hat{T}_1$	$\hat{T}_2$
1994:Q1	2000:Q2

Table 3. Kejriwal-Perron Tests for Multiple Structural Breaks (Regime and Trend Shift Model)

y_t={Reer$_t$} z_t={ d_Prod$_t$, d_Prodd$_t$, d_Rir$_t$ } q=5 m=4, e=0.15, x_t=0, p=6

Sub F_T(1)	***Sub F_T(2)***	***Sub F_T(3)***	***Sub F_T(4)***	***UD Max***	*LWZ*	*BIC*
20.19*	12.63#	11.39#	17.34**	20.19*	1	2

SEQ_T (2 | 1)	***SEQ_T (3 | 2)***	***SEQ_T (4 | 3)***
19.99*	11.57	11.08

Break Dates	
$\hat{T}_1$	$\hat{T}_2$
1994:Q1	1999:Q3

Critical values are from Tables 1 and 3 of Kejriwal and Perron (2010), **, *, #, denote significance levels at 1%, 5% and 10%, respectively. **q**: number of regressors whose coefficients are allowed to change ; **m**: Number of maximum breaks allowed; **e**: Trimming percentage; **x**: Number of I (0) variables. **p:** number of first differenced regressors.

$$y_t = c_i + \delta_i t + z_t^{'}\beta_i + \sum_{j=-l_T}^{l_T} \Delta z_{t-j}^{'}\Pi_j + u_t^*$$

The results for Model 1 and 2 are reported in Tables 2 and 3. For both models, overall the tests as well as information criteria offer evidence in favor of the presence of breaks. In particular, all *Sub-F*, *UDmax*, and the sequential procedure tests as well as the *BIC* and *LWZ* information criteria suggest the existence of structural break(s). The break dates selected by the sequential procedure are 1994:Q1 and 2000:Q2 for Model 1 in Table 2 and 1994:Q1 and 1999:Q3 for Model 2 in Table 3. It is important to point out that endogenously selected break dates coincide with the periods of crises and/or policy changes in Turkey, 1994 and 2000-2001.

Table 4 presents the results for Arai-Kurozumi-Kejriwal (A-K-K) cointegration tests with multiple structural breaks. For all the tests, the regression representation is the regime and trend shift model, and the tests with multiple breaks are based on the augmented version of the A-K framework. Turning to the two-break A-K-K test, we cannot reject the null of cointegration even at the 10% significance level for both models. Critical values for multiple breaks are generated by the authors, modifying the programs developed for Kejriwal (2008).

Table 4. Arai-Kurozumi-Kejriwal Cointegration Tests with Multiple Structural Breaks (Regime and Trend Shift Model)

y_t={*Reer*$_t$}	$\tilde{V}_2(\hat{\lambda})$	$\hat{\lambda}_1$	$\hat{\lambda}_2$	$\hat{T}_1$	$\hat{T}_2$
z_t ={ *d_Prod*$_t$, *d_Prodd*$_t$, *Nfa*$_t$ }	0.018	0.19	0.49	1994:Q1	2000:Q2
** %1	0.039				
* %5	0.028				
# %10	0.024				
z_t ={ *d_Prod*$_t$, *d_Prodd*$_t$, *d_Rir*$_t$ }	0.023	0.19	0.49	1994:Q1	1999:Q3
** %1	0.039				
* %5	0.028				
# %10	0.024				

Critical values are obtained by simulations using 100 steps and 2500 replications.

$$y_t = c_i + \delta_i t + z_t'\beta_i + \sum_{j=-l_T}^{l_T} \Delta z_{t-j}' \Pi_j + u_t^*$$

As the final step, we estimate both models for which there is evidence of cointegration, and compare the coefficients for the sub periods to see how the cointegration relationship may have changed over time. Tables 5 and 6 show estimated regressions with the regime and trend shift model. The estimated slope coefficients are denoted by $\varphi_{11}, \varphi_{12}, \ldots, \varphi_{21}, \ldots \varphi_{33}$ in the tables. As an example, in Table 5 for Model 1—z_t={ *d_Prod*$_t$, *d_Prodd*$_t$, *Nfa*$_t$ }—φ_{11}-φ_{12}- φ_{13} show the estimated impact of *d_Prod*, *d_Prodd*, and *Nfa* on *Reer* respectively in the first regime.

The results in Table 5 indicate that while the coefficient on relative productivity differentials is not significant in any of the regimes, the coefficient on relative productivity differentials in the distribution sector is positive and significant, and thereby is consistent with the B-S hypothesis before the structural break in 1994. However, in the second regime (1994-2000), none of the explanatory variables are successful in explaining changes in the *Reer*. Nevertheless, after 2000, the effect of relative productivity differentials in the distribution sector is again important in determining the *Reer*. In particular, a 1% point increase in relative productivity differentials in the distribution sector appreciates the *Reer* 1.64% and 0.92% over the sub-periods 1990-1994 and 2000-2011, respectively. The coefficient of *Nfa*, on the other hand, has a correct sign and is significant in the first and third regimes but not in the second regime (1994-2000).

Table 5. Estimated Regressions with Multiple Structural Breaks (Regime and Trend Shift Model)

yt={Reert} zt ={ d_Prodt , d_Proddt , Nfat }				
	Coefficient	Std.Errs.	T-Stats	P-Value
c_1	5.25	0.19	33.07	0.00
δ_1	-0.01	0.00	-2.76	0.00
φ_{11}	-0.15	0.24	-0.64	0.52
φ_{12}	1.64	0.45	3.61	0.00
φ_{13}	1.42	0.50	2.79	0.00
c_2	3.99	0.07	53.12	0.00
δ_2	0.01	0.00	2.88	0.00
φ_{21}	0.09	0.15	0.60	0.55
φ_{22}	-0.12	0.17	-0.68	0.50
φ_{23}	0.38	0.39	0.99	0.32
c_3	5.22	0.20	25.57	0.00
δ_3	0.00	0.00	-1.38	0.17
φ_{31}	0.14	0.09	1.63	0.11
φ_{32}	0.92	0.21	4.17	0.00
φ_{33}	0.69	0.18	3.74	0.00

$$y_t = c_i + \delta_i t + z_t' \beta_i + \sum_{j=-l_T}^{l_T} \Delta z_{t-j}' \Pi_j + u_t^*$$

Table 6 shows the estimated regressions Model 2. According to the estimated results, the effect of a 1% point increase in relative productivity differentials in the distribution sector appreciates the *Reer* 1.33% and 0.75% in the first and third regimes over the sub-periods 1990-1994 and 1999-2011, respectively. The coefficient of *d_Rir* is positive and significant in the period before 1994 and the period after 2000s. The coefficient on relative productivity differentials, on the other hand, is again not significant at all in any of the sub-periods. The trend coefficient in both Tables 5 and 6 is significant and circa 0.01 in magnitude in the first two regimes, though the sign becomes positive in the second regime, indicating the tendency of the TL first to depreciate between 1990-1994 and, then, to appreciate after 1994 through 1999-2000.

Table 6. Estimated Regressions with Multiple Structural Breaks (Regime and Trend Shift Model)

y_t={*Reer*$_t$}	z_t ={ *d_Prod*$_t$, *d_Prodd*$_t$, *d_Rir*$_t$ }			
	Coefficient	**Std.Errs.**	**T-Stats**	**P-Value**
c_1	**5.14**	0.16	32.77	0.00
δ_1	**-0.01**	0.00	-2.72	0.01
φ_{11}	-0.28	0.25	-0.11	0.91
φ_{12}	**1.33**	0.44	2.98	0.00
φ_{13}	**1.41**	0.49	2.87	0.01
c_2	**4.12**	0.08	35.35	0.00
δ_2	**0.01**	0.00	3.89	0.00
φ_{21}	-0.06	0.17	-0.35	0.72
φ_{22}	0.09	0.17	0.37	0.71
φ_{23}	0.27	0.39	0.69	0.49
c_3	**4.95**	0.17	29.73	0.00
δ_3	0.00	0.00	0.70	0.48
φ_{31}	0.06	0.07	0.76	0.44
φ_{32}	**0.75**	0.20	3.65	0.00
φ_{33}	**0.39**	0.13	2.90	0.00

$$y_t = c_i + \delta_i t + z_t^{'}\beta_i + \sum_{j=-l_T}^{l_T} \Delta z_{t-j}^{'} \Pi_j + u_t^*$$

V. Conclusion

Given the span of the dataset and the econometric techniques employed, the results show that relative productivity changes in the distribution sector have a potentially important role in explaining changes in the real effective exchange rate. On the contrary, relative productivity differentials are found to have no significant effect on the *Reer* in either model. Overall results suggest that an increase in relative productivity differentials in the distribution sector leads to an appreciation of the real exchange rate in the long run, similar to the effects that *Nfa* and *d_Rir* have.

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