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BALASSA–SAMUELSON EFFECT IN IRAN

Abstract:

Deviations from purchasing power parity because a deviation of productivity is Balassa–Samuelson effect. The Balassa–Samuelson effect depends on inter-country differences in the relative productivity of the tradable and non-tradable sectors. According to this hypothesis, Imai (2010) make a model and measurement Balassa–Samuelson effect in Japan during 1970-1955 when exchange rate in Japan is fixed. In this paper we measurement Balassa–Samuelson effect in Iran economic. The result shows that Balassa–Samuelson effect in Iran is -2.1. Then devaluation of the national currency in Iran according to Balassa–Samuelson effect would be equal to 2.1 in annual, while devaluation of the national currency in Iran 13% in a year.

Keywords:

Balassa–Samuelson effect; purchasing power parity; productivity gap; tradable and non-tradable sectors

JEL Classification: D24, E31, F31

1. Introduction

The gap productivity in tradable goods between two countries is a factor of fluctuations real exchange rate and it is called Balassa–Samuelson effect (1964). The Base of BS (Balassa–Samuelson effect) idea was inflation gap between U.S. and Japan in 1960 decade. They are looking for how many of inflation gap between U.S. and Japan is Due to the productivity gap between tradable goods in two countries. If total factor productivity in tradable goods in country A is more than country B, increase value of the national currency will occur in country A and deviation of Purchasing Power Parity (PPP) in this country.

This effect explains that why the nontradable price goods in lower productivity country is less than another country? This difference of price makes a deviation of PPP. For example annual average inflation rate during 1955-1970 in Japan was 5.4 percent. In the same period annual average inflation rate in U.S. was 2.6 percent. The gap of inflation rate between Japan and U.S. is 2.8 percent (Imai 2010), then real exchange rate appreciation of the Japanese yen. When we assume that there are two goods in the economy, tradable and nontradable and labor is factor of production. If productivity of tradable goods in Japan more than U.S., then the tradable goods price in Japan is less than U.S. but it is not true because tradable goods is mobility between countries and has a unit price in all countries. Base of profit maximization condition that is $W = MP_L.P$, when MP_L increase and P is not change in tradable sector, then W of tradable and nontradable sector will be increased, because labor is mobility between tradable and nontradable sector. The Result is increasing price of nontradable goods in Japan while the nontradable price in U.S. is constant. This difference price of nontradable sector between Japan and U.S. is explained deviation of PPP in Japan.

In this paper we estimated BS effect in Iran. Total factor Productivity in Iran is less than U.S. then Part of deviation PPP in Iran is productivity gap between Iran and trade partner’s countries.

2. Literature Review of Balassa–Samuelson Effect

We assume two countries 1 and 2, two sectors tradable and nontradable and define following notation:

$MPL_{n,1}$: Productivity of nontradable good in country 1.

$MPL_{n,2}$: Productivity of nontradable good in country 2.

W_1 : Wage rate in country 1.

W_2 : Wage rate in country 2.

$P_{n,1}$ And $P_{n,2}$: price of nontradable goods in 1 and 2 countries.

$P_{t,1}$ And $P_{t,2}$: price of tradable goods in 1 and 2 countries.

Assumptions:

1. Same productivity in two countries and equal to unit:

$$MPL_{n,1} = MPL_{n,2} = 1 \qquad (1)$$

2. Labor is full mobility between tradable and nontradable within country.

3. Unit Price Law in tradable sector: $P_{t,1} = P_{t,2} = P_t$

Now we can write for country 1:

$$W_1 = P_{n,1} \times MPL_{n,1} = P_{n,1} \times 1 = P_{n,1} \qquad (2)$$

$$W_1 = P_{t,1} \times MPL_{t,1} = P_t \times MPL_{t,1} \qquad (3)$$

And for country 2:

$$W_2 = P_{n,2} \times MPL_{n,2} = P_{n,2} \times 1 = P_{n,2} \qquad (4)$$

$$W_2 = P_{t,2} \times MPL_{t,2} = P_t \times MPL_{t,2} \qquad (5)$$

Then

$$W_1 = P_{n,1} = P_t \times MPL_{t,1} \qquad (6)$$

$$W_2 = P_{n,2} = P_t \times MPL_{t,2} \qquad (7)$$

Divided Eq.6 to Eq.7

$$\frac{P_{n,1}}{P_{n,2}} = \frac{MPL_{t,1}}{MPl_{t,2}} \qquad (8)$$

Now if $MPL_{t,1} > MPL_{t,2}$ then $P_{n,1} > P_{n,2}$ and it is BS effect. In other words, higher nontradable price in country 1 is Due to higher productivity in tradable goods in country 1. This is one of the causes of PPP deviations. When productivity in tradable sector Increases, wage is increase and labor will move to tradable sector. Then nontradable wage increase up to equilibrium in two sectors. In this situation, price of nontradabe good increases and we have deviation of PPP (Hamano 2012).

3. Decomposition of Level price and PPP

We have derived equation to account for Iran long-term inflation rate relative to U.S inflation. (P) is geometric mean of index price for tradable price level (P_T) and nontradable price level (P_N) in Iran.

$$P = P_N^{\beta} P_T^{(1-\beta)} \qquad (9)$$

β denotes the nominal GDP share of nontradables in Iran.

And for U.S

$$EP^* = EP_N^{*\gamma} P_T^{*(1-\gamma)} \qquad (10)$$

γ denotes the nominal GDP share of nontradables in U.S.

Eq. (10) show that a price level in Foreign country (the U.S.), that we have a derived with currency home country (Iran) and E is nominal exchange rate.

When divided Eq. (9) to Eq. (10)[1]

[1] . Real exchange rate has two definitions, first $\frac{EP^*}{P}$ and second $\frac{P}{EP^*}$ we used second definition.

$$\frac{P}{EP^*} = \frac{P_N^{\beta} P_T^{(1-\beta)}}{EP_N^{*\gamma} P_T^{*(1-\gamma)}} = \frac{\left(\frac{P_N}{P_T}\right)^{\beta} P_T}{\left(\frac{P_N^*}{P_T^*}\right)^{\gamma} EP_T^*} \qquad (11)$$

With LOG and differential from Eq. (11)

$$\hat{P} - \hat{E} - \hat{P}^* = \beta\left[\hat{P}_N - \hat{P}_T\right] - \gamma\left[\hat{P}_N^* - \hat{P}_T^*\right] + \left[\hat{P}_T - \hat{E} - \hat{P}_T^*\right] \qquad (12)$$

Denote of ($\wedge$) is growth rate. The Eq. (12) is Decomposition of real exchange rate to three components. If regime of exchange rate is fixed, we can remove $\hat{E}$ from right and left side of Eq. (12).

$$\hat{P} - \hat{P}^* = \beta\left[\hat{P}_N - \hat{P}_T\right] - \gamma\left[\hat{P}_N^* - \hat{P}_T^*\right] + \left[\hat{P}_T - \hat{P}_T^*\right] \qquad (13)$$

The difference of first of two terms of right hand side in Eq. (13) is BS effects. For calculate BS effect, we need to change this two terms of right hand side to productivity index. We do it and summery of them is following:

$$\beta\left[\hat{P}_N - \hat{P}_T\right] = \beta\left[\left(\frac{\alpha_N}{\alpha_T}\right)\hat{A}_T - \hat{A}_N\right] + \mathrm{I}_b \qquad (14)$$

$$\gamma\left[\hat{P}_N^* - \hat{P}_T^*\right] = \gamma\left[\left(\frac{\alpha_N^*}{\alpha_T^*}\right)\hat{A}_T^* - \hat{A}_N^*\right] + \Pi_b \qquad (15)$$

When A_T is total factor productivity (TFP) of tradable sector, A_N total factor productivity (TFP) of nontradable sector, α_T production elasticity of labor of tradable sector and star is denoted for foreign country. (I_b) and (Π_b) are demand disturbances in economy for home and foreign respectively.

With replace Eqs. (14) and (15) in Eq. (13) we have

$$\hat{P} - \hat{P}^* = \beta\left[\left(\frac{\alpha_N}{\alpha_T}\right)\hat{A}_T - \hat{A}_N\right] - \gamma\left[\left(\frac{\alpha_N^*}{\alpha_T^*}\right)\hat{A}_T^* - \hat{A}_N^*\right] + \left[\mathrm{I}_b - \Pi_b\right] + \left[\hat{P}_T - \hat{P}_T^*\right] \qquad (16)$$

Now the difference of first of two terms of right hand side in Eq. (16) is BS effects. The $[I_b - \Pi_b]$ is difference of demand disturbances between home and foreign economy. And finally term that is $\left[\hat{P}_T - \hat{P}_T^*\right]$, part of PPP deviation due to tradable goods price deferent between home and foreign countries. We expect this term to be zero, if isn't, because the international market is not full competition or price at short run is rigidity (Rogoff 1996).

In Eq. (16) when TFP growth rate of nontradable sector is constant for two countries and TFP growth rate of tradable sector in home to be more than foreign country $\left(\hat{A}_T > \hat{A}_T^*\right)$, then inflation rate in home to be more than foreign country $\left(\hat{P} > \hat{P}^*\right)$. In other word real exchange rate to be increases or real appreciated in currency of home country. Therefore the root of deviation PPP (real appreciated in currency of home country) is due to difference TFP growth rate of tradable sector in two countries (Harrod 1939).

4. Data

Nominal exchange rate (Rials/ U.S. $) in Iran is reported by central bank of Iran (Table 1). In this paper we choose 2002-2011 time periods for our study. The annual average growth rate of nominal exchange rate (Rials/ U.S. $) in this period is 3.6 percent, But annual average growth rate of domestic price is 15.8 percent, and then we can assume that the growth rate of nominal exchange rate is fixed.

Table 1 Growth rate of nominal exchange rate (Rials/ U.S. $) in Iran (2002-2011)

year	Growth rate of Rials/ U.S. $
2002	**-**
2003	4.1
2004	5.3
2005	3.5
2006	1.9
2007	0.9
2008	3.1
2009	3.6
2010	4.2
2011	6.1
annual average growth rate of nominal exchange rate (2002-	3.6

2011)

We have four assumptions for calculate BS effect in this study:

1- Nominal exchange rate is constant.
2- Proxy for tradable and nontradable sectors is industrial and service sector in both Iran and U.S.
3- WPI (wholesale price index) consider for price in industrial sector, because share of tradable goods in WPI is more than CPI (Consumer price index). In the other hand share of services in CPI is more than WPI, then we consider CPI for service sector. In addition inflation rate calculate with CPI in both countries (Table 2).
4- γ and β denotes the share of nontradable sector of GDP in U.S (The Iran) is 0.7 and 0.5 respectively.

5. Estimation of Inflation Gap between Iran and U.S

In this section we estimate right hand side of Eq. (13) and comparing it to left hand side. If two side to be equality, we can calculate BS effect. The right hand side of Eq. (13) has three components, which we can see in following.

$$\hat{P} - \hat{P}^* = \underbrace{\beta\left[\hat{P}_N - \hat{P}_T\right]}_{\text{I}} - \underbrace{\gamma\left[\hat{P}_N^* - \hat{P}_T^*\right]}_{\text{II}} + \underbrace{\left[\hat{P}_T - \hat{P}_T^*\right]}_{\text{III}} \qquad (13)$$

$$\hat{P} - \hat{P}^* = \text{I} - \text{II} + \text{III} \qquad (17)$$

To calculate the left-hand side of Eq. (13), we need to inflation rate in Iran and U.S. ($\hat{P}$ and $\hat{P}^*$) That exist in the Central Bank of Iran and World Bank (Table 2). To calculate the right-hand side, we need to annual growth rate of tradable sector (industrial sector) and nontradable sector (service) in Iran and U.S.[$\left(\hat{P}_T\right)$, $\left(\hat{P}_N\right)$ $\left(\hat{P}_T^*\right)$ $\left(\hat{P}_N^*\right)$].

Table 2 Right and Left Hand Estimate of Eq. (13)

Year	Iran					U.S							Right Hand	Left Hand
	$\hat{P}$	$\hat{P}_N$	$\hat{P}_T$	β	I	$\hat{P}^*$	$\hat{P}_N^*$	$\hat{P}_T^*$	γ	II	I–II	III	I – II + III	$\hat{P} - \hat{P}^*$
2002	14.3	16.3	9.9	0.5	3.2	1.6	2.4	-0.7	0.7	2.1	1.0	10.6	11.6	12.7
2003	16.5	20.6	10.9	0.5	4.8	2.3	4.1	2.6	0.7	1.0	3.8	8.3	12.1	14.2
2004	14.8	18.6	14.8	0.5	1.9	2.7	3.1	4.3	0.7	-0.8	2.7	10.5	13.2	12.1
2005	13.4	12.7	8.2	0.5	2.2	3.4	4.1	5.5	0.7	-0.9	3.2	2.7	5.9	10.0
2006	11.9	14.4	11.4	0.5	1.5	3.2	4.2	4	0.7	0.1	1.3	7.4	8.7	8.7
2007	17.2	19.8	13.1	0.5	3.3	2.9	2.8	3.8	0.7	-0.7	4.0	9.3	13.3	14.3
2008	25.5	25.9	22.3	0.5	1.8	3.8	4.7	8	0.7	-2.2	4.1	14.3	18.4	21.7
2009	13.5	14.3	3.0	0.5	5.6	-0.3	1.7	-5	0.7	4.7	0.9	8.0	8.9	13.8
2010	10.1	10.6	22.0	0.5	-5.7	0.3	2.2	5	0.7	-1.9	-3.7	17.0	13.3	9.8
2011	20.6	14.7	54.3	0.5	-19.8	1.6	2.2	7.9	0.7	-3.9	-15.8	46.4	30.6	19
(2002-2011 Average	15.8	16.8	17.0	0.5	-0.1	2.2	3.1	3.5	0.7	-0.2	0.1	13.5	13.6	13.6

6. BS Effect Estimation in Iran

The gap of inflation rate between Iran and U.S. is decomposition to three components in Eq. (16).

$$\hat{P} - \hat{P}^* = \underbrace{\beta\left[\left(\frac{\alpha_N}{\alpha_T}\right)\hat{A}_T - \hat{A}_N\right] - \gamma\left[\left(\frac{\alpha_N^*}{\alpha_T^*}\right)\hat{A}_T^* - \hat{A}_N^*\right]}_{(1)} + \underbrace{\left[\mathrm{I}_b - \prod_b\right]}_{(2)} + \underbrace{\left[\hat{P}_T - \hat{P}_T^*\right]}_{(3)} \qquad (16)$$

$$\hat{P} - \hat{P}^* = (1) + (2) + (3) \qquad (18)$$

We have left hand side of Eq. (16) in Table 2. In this section the right hand side of Eq. (16) is estimated. For this purpose we need TFP growth rate of tradable and nontradable in Iran ($\hat{A}_N, \hat{A}_T$) and U.S (star symbol *), α_N and α_T denotes share of labor factor of GDP in nontradable and tradable sector. We assume that relative α_N is equal to unit. In other word the share of labor factor of GDP in nontradable sector is equal to tradable sector for two countries:

$$\frac{\alpha_N^*}{\alpha_T^*} = \frac{\alpha_N}{\alpha_T} = 1$$

The first term in right hand side in Eq. (18) is BS effect. Table 3 shows that The BS effect is -2.1 in Iranian economies during 2002-2011. Table 3 shows that the right hand side of Eq. (16) is equal to left hand side and it is 13.6 percent, therefore the Decomposition of gap inflation between Iran and U.S. with Eq. (16) is true.

Table 3- Estimation Balassa–Samuelson Effect's in Iran by Decomposition inflation Gap between Iran and U.S

Year	Iran				U.S				Components of RHS[2]			RHS Eq. (16)	LHS[3] Eq.(16)
	$\hat{A}_N$	$\hat{A}_T$	β	I_b	$\hat{A}_N^*$	$\hat{A}_T^*$	γ	II_b	(1)	(2)	(3)	(1)+(2)+(3)	$\hat{P} - \hat{P}^*$
2002	-0.1	7.6	0.5	-0.6	0.7	6.8	0.7	-2.1	-0.4	1.5	10.6	11.7	12.7
2003	-0.6	4.7	0.5	2.1	1.2	6.4	0.7	-2.6	-0.9	4.7	8.3	12.1	14.2
2004	1.7	-1.4	0.5	3.4	1.7	7.7	0.7	-5.0	-5.7	8.4	10.5	13.2	12.1
2005	1.3	1.3	0.5	2.2	2.0	3.2	0.7	-1.7	-0.8	3.9	2.7	5.8	10.0
2006	2.8	2.0	0.5	1.9	0.2	3.4	0.7	-2.1	-2.6	4.0	7.4	8.8	8.7
2007	2.6	-0.7	0.5	4.9	0.1	3.9	0.7	-3.3	-4.3	8.3	9.3	13.3	14.3
2008	1.3	2.2	0.5	1.3	-0.9	-5.4	0.7	0.9	3.6	0.4	14.3	18.3	21.7
2009	1.5	1.3	0.5	5.7	-2.3	-3.4	0.7	5.4	0.6	0.2	8.0	8.9	13.8
2010	1.9	0.8	0.5	-5.1	3.4	12.1	0.7	-7.9	-6.6	2.8	17.0	13.2	9.8
2011	1.9	1.1	0.5	-19.4	1.0	5.7	0.7	-7.1	-3.6	-12.2	46.4	30.5	19.0
2002-2011 Average	1.4	1.9	0.5	-0.3	0.7	4.0	0.7	-2.5	-2.1	2.2	13.5	13.6	13.6

[1] Right hand side
[1] Left hand side

7. Conclusion

According to Purchasing Power Party (PPP), Law of Unit Price and assuming no transportation costs for tradable goods, the price of them in all countries is same, but nontradable goods have a different price in any countries. The Balassa–Samuelson indicated that the different price of nontradable goods due to productivity different in tradable goods between two countries. Then a part of inflation gap or deviation of PPP (condition of fix exchange rate), due to productivity gap of tradable goods in two countries. Note that the inflation gap between two countries due to several factors and one of them is Balassa–Samuelson Effect.

This paper estimated BS effect in Iran with comparing inflation rate of Iran and U.S. during 2002-2011, that is nominal exchange rate (Rials/ U.S. $) fixed. According to Emai (2010) the gap of inflation rate between two countries to be decomposition of productivity gap of tradable and nontradable goods in two countries, and then we estimate BS effect. We assumed the industrial and service sectors are a proxy for tradable and nontradable sectors. The result shows that, BS effect in Iranian economies is -2.1 percent during 2002-2011. This means that, the real devaluation of Iranian Rials as a 2.1 percent during 2002-2011 is reasonable, while the fact in Iranian economies show that, not only real devaluation of Iranian Rials but also Iranians Rials against U.S.$ real appreciation during 2002-2011 about 13.6 percent (annual average gap inflation rate between Iran and U.S.). In other word, when annual average inflation rate of U.S. at same period is 2.2 percent and BS effect -2.1 percent, then annual average inflation rate of Iran 0.1 percent is reasonable in same period of time.

Final result of this paper is that, the higher inflation rate in Iran than to other countries (the deviation of PPP in Iran) is not due to productivity gap between Iran and other countries such as U.S.

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