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A RECONSIDERATION OF PRICES USING THE BALASSA-SAMUELSON THEORY: EVIDENCE FROM JAPAN

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ABSTRACT

This paper theoretically and empirically reevaluates price policy associated with deflation using the Balassa-Samuelson theory (Balassa (1964), Samuelson (1964)). The theoretical model developed in this paper shows the relative price level (or real exchange rate) between two countries is explained by the relative wage rate and the relative labor productivity between two countries. The empirical results confirm that relative wage rate has more impact on relative price, compared to the relative labor productivity. Since the convergence of price levels in the long run is confirmed in this paper, the theory developed implies that the tendency of nominal appreciation (depreciation) of a country's currency causes declining (increasing) nominal wages and price levels in the long run under a free market economy. To raise the price level, it is necessary to raise labor productivity which causes a rise in the nominal wage rate in the longer run and which eventually results in a rise in the price level. The policy implication is that operating an effective price policy is difficult for countries experiencing deflation.

JEL: E31, E58, F39

KEYWORDS: Price Level, Inflation, Deflation, Inflation Targeting, Nominal Wage Targeting, the Balassa-Samuelson Hypothesis

INTRODUCTION

Japan has experienced deflation for two decades. Not every economist agrees with the effectiveness of inflation targeting. The aim of this paper is to reevaluate price policy associated with deflation. This paper theoretically and empirically investigates the price mechanism by developing the Balassa-Samuelson theory (Balassa (1964), Samuelson (1964), Fukao (2008), Oguro (2012)). The Balassa-Samuelson (BS) theory was originally intended to explain real exchange rate appreciation in countries experiencing rapid economic growth. This is caused by differential productivity growth in a tradable sector which is growing fast and in a non-tradable sector which is relatively stable. As a consequence, the BS theory explains the tendency for relative prices (real exchange rates) to be higher in more developed and higher income countries compared to less developed and lower income countries. Thus, the theory has been played a key role in studies of real exchange rate determination in the long run.

This paper first confirms the convergence of prices over time. The theoretical model developed shows the relative price level (or real exchange rate) between two countries is explained by relative wage rate and relative labor productivity between two countries. The model implies that a rise (decline) in the relative wage rate and/or a decline (rise) in the relative labor productivity result(s) in a rise (decline) in relative prices. Empirical analysis provides support for the theoretical model presented in this paper. The empirical results confirm the relative wage rate has more impact on the relative price level (or real exchange rate) compared to the relative labor productivity. Since convergence of price levels in the long run is confirmed in this paper, the theory implies the tendency of nominal appreciation (depreciation) of a country's currency can cause declining (increasing) nominal wages and price levels in the long run under the economy that allows the market to decide everything. To raise the price level, it is necessary to raise labor productivity which causes a rise in the nominal wage rate in the long run and eventually results in a rise in the price level. The results are not optimistic for Japan. The policy implication is that operating an effective price policy is not easy and takes time for countries experiencing deflation and very low interest rates. The remainder of the paper is organized as follows. The next section refers to previous studies which are related to this paper. In the following section, we discuss the data and methodology. The theoretical model is developed and presented in this section. Then, the empirical results are presented and discussed. The paper closes with some concluding comments.

LITERATURE REVIEW

As noted earlier, the Balassa-Samuelson theory has been a key theory in the field of real exchange rate determination. A series of earlier works on real exchange rates and prices are based on the Balassa-Samuelson (BS) theory. There have also been studies that include and/or refer to Japan. Several earlier works, at least to some extent, confirm the BS hypothesis. In an early study, Hsieh (1982) studied Germany and Japan which estimated real exchange rates based on the BS hypothesis. Hsieh's (1982) data covered years from mid 1950s through mid 1970s. Marston (1987) discussed the Yen's real appreciation against the U.S. dollar from the mid 1970s to mid 1980s based on the productivity growth of tradable goods and non-tradable goods in Japan and the U.S. using the BS theory. The results confirmed the BS hypothesis. Rogoff (1992) concludes that correlation between labor productivity differentials and the real exchange rates is only for very long periods based on the studies on the yen/dollar exchange rates from 1975 to 1990. His investigation also includes the effects of government spending shocks and capital market liberalization on the real exchange rate. Asea and Mendoza (1994) found correlation between labor productivity differentials and relative price differentials for OECD countries. Canzoneri et al. (1999) investigated the BS hypothesis using 1970-1993 OECD panel data and cointegration techniques. The results confirmed the correlation between relative labor productivities and relative prices in the long run. Chinn (2000) investigates real exchange rates in East Asian countries including Japan based on the productivity-based model. Results show consistency with the BS hypothesis.

Earlier studies, however, put an emphasis on skeptical aspects of the BS hypothesis. Ito, Isard, and Symansky (1999), Drine and Rault (2003), and Thomas and King (2004) emphasize the findings on East Asian countries that do not follow the BS hypothesis. Bordo et al. (2017) investigated the effect of productivity on the real exchange rates for 14 countries, including Japan, from 1880 to 1997. The results are not consistent with the traditional BS theory, although they are consistent with the modern versions of the BS theory. Obstfeld (2009) argues the Yen's value, Japan's bubble, and subsequent stagnation from 1985 to 2008 using the BS theory. His findings show that the Japan's real exchange rate is inversely related to the predictions based on the BS hypothesis both in the short and long run.

This paper is the first investigation that develops the BS theory, and theoretically shows real exchange rates can be explained by relative wage and/or relative labor productivity. Additionally, this paper empirically finds that relative wage better explains real exchange rates compared to relative labor productivity. Thus, it is crucial to raise nominal wages to overcome deflation. However, apparently it is not easy to politically raise nominal wages and no countries have adopted nominal wage targeting. Tobin (1980) and Bean (1983) argue the effectiveness of nominal income targeting in the context of pursuing target growth rates. Phelps (1978) and Aoki (2001) note that higher prices can be ensured by consequent higher wages backed up by loose monetary policy.

DATA AND METHODOLOGY

Data Analysis: The Convergence of Price Levels in the Long Run

This section verifies the convergence of price levels based on the Balassa-Samuelson hypothesis in the long run. The Balassa-Samuelson theory explains the positive correlation between income levels and price levels (Balassa (1964), Samuelson (1964)). Following Fukao (2012) and Oguro (2012), data from the Penn World Table 9.0 (Feenstra et al. (2015)) are used for the analysis. The investigation period is from 1985 to 2015. The total number of countries investigated is 178, but the number of countries reported in the data slightly varies from year to year. The data used as the income level, ln(rGDPw), is the natural logarithm of the output-side real GDP at constant 2011 PPPs (in mil. 2011 USD) divided by the number of persons engaged (in mils). The data used as the price level, ln(p), is the natural logarithm of the price level of country i (the country i's price level of output-side real GDP at current PPPs (in mil. 2011USD, PPP/nominal exchange rate)) over the price level of USA in 2011 which equals 1.

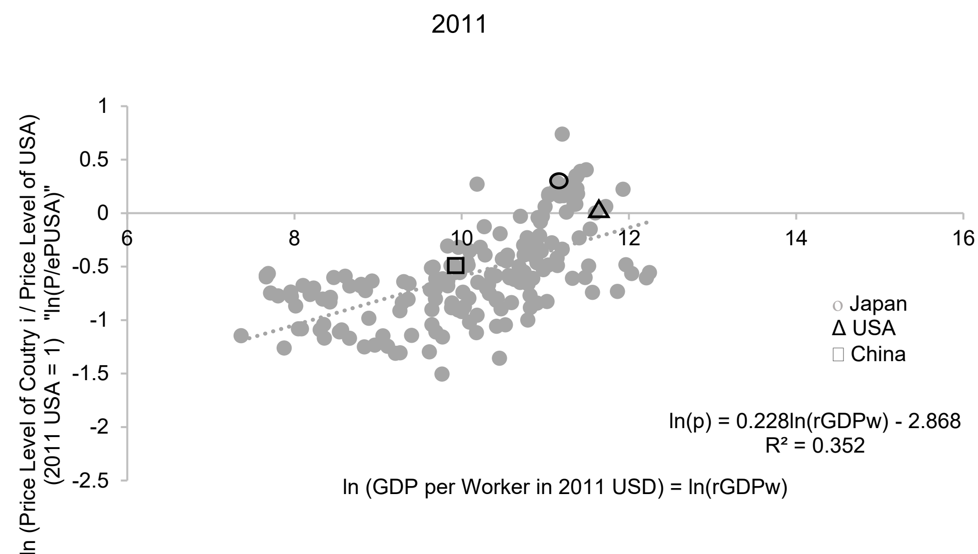
Figures 1 to 3 are simple plots of income levels and price levels in 1995, 2011, and 2014, respectively. In the years 1995 and 2011, the value of the yen to the US dollar drastically appreciated (in comparison with other years). A comparison of Figures 1, 2, and 3 reveal the convergence of price levels in the long run. Figure 4 depicts a decline in the sample standard deviation of ln(p) and the relative price levels (ln(price level of country i / price level of USA)), for 168 countries which are constantly reported in the Penn World Table 9.0 (Feenstra et al. (2015)). Figure 4 supports the existence of price convergence. The number of countries included in Figures 1 to 3 is slightly different since each figure uses all data available in the Penn World Table 9.0 (Feenstra et al. (2015)) as shown in Table 1. Table 1 shows the sample standard deviation of ln(p), the relative price levels, for all available data, and implicitly shows that the change in the number of data reported for each year could be an obstacle to convergence.

Table 2 shows results of OLS and Fixed Effects tests of the Balassa-Samuelson Hypothesis for the data used in Figures 1 to 3. Based on the Breusch-Pagan Lagrange multiplier test and the Hausman test, the fixed effects model is selected for the panel estimation from 1985 to 2015. All estimated coefficients for the income level, ln(rGDPw), are statistically significant, and thus the Balassa-Samuelson Hypothesis is confirmed for the three figures. For the years 1985 to 2015, according to the fixed effects model, a one percent increase in income level results in a 0.136 percent increase in relative price level. Japan's price levels in the three years, 1995, 2011, and 2014 (marked with a circle in Figures 1 to 3) can be recognized as relatively high. This is because Japan's price level in each year is above each regression line. As a whole, Figures 1 to 4 and Table 1 provide support for the convergence in price levels in the long run.

Figure 1: The Positive Correlation between Income Levels and Price Levels in 1995

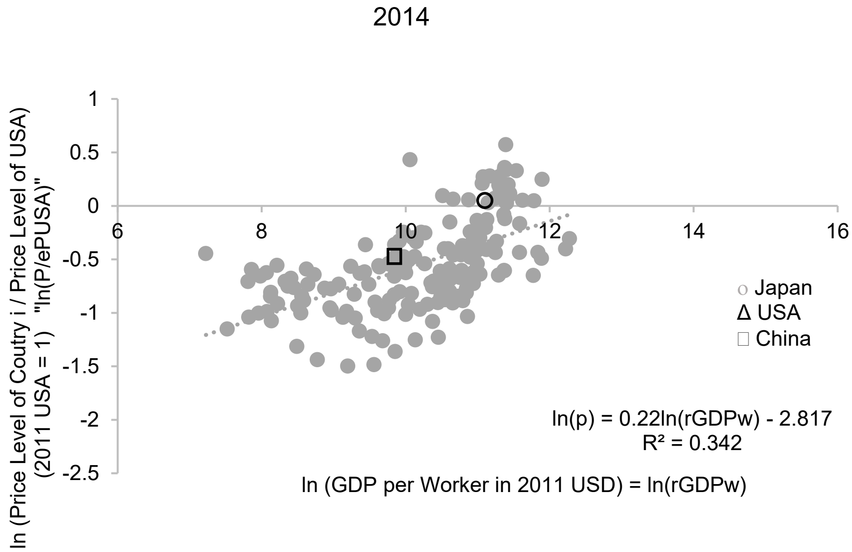
This figure shows the positive correlation between income levels and price levels in 1995. Figures 1 to 3 reveal the convergence of the price levels in the long run. Income and price level data are obtained from the Penn World Table 9.0 (Feenstra et al. (2015))

Figure 2: The Positive Correlation between Income Levels and Price Levels in 2011



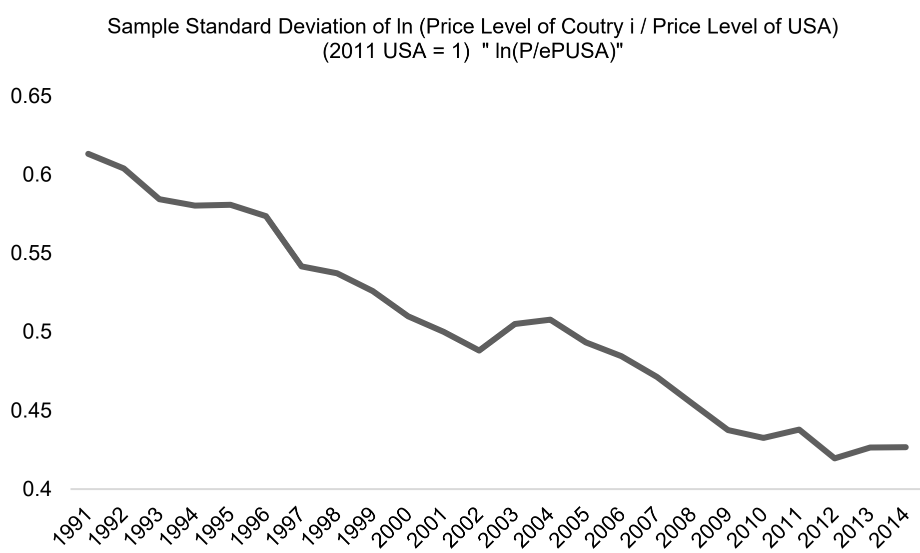
This figure shows the positive correlation between income levels and price levels in 2011. Figures 1 to 3 reveal the convergence of the price levels in the long run. Income and price level data are obtained from the Penn World Table 9.0 (Feenstra et al. (2015))

Figure 3: The Positive Correlation between Income Levels and Price Levels in 2014



This figure shows the positive correlation between income levels and price levels in 2014. Figures 1 to 3 reveal the convergence of the price levels in the long run. Income and price level data are obtained from the Penn World Table 9.0 (Feenstra et al. (2015))

Figure 4: Sample Standard Deviation of the Relative Price Levels



This figure depicts a decline in the sample standard deviation, and strongly supports the existence of price convergence. The data are the author's calculation from the Penn World Table 9.0 (Feenstra et al. (2015)) database.

Table 1: Sample Standard Deviation of the Relative Price Levels

Sample standard deviation (all available data, ( ): number of samples)	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
	0.480	0.495	0.507	0.497	0.597	0.616	0.613	0.600	0.619	0.594	0.592	0.565	0.656	0.552	0.540
	(145)	(145)	(145)	(147)	(170)	(174)	(174)	(174)	(174)	(174)	(174)	(174)	(174)	(173)	(173)
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	
	0.544	0.541	0.631	0.627	0.539	0.530	0.535	0.481	0.469	0.459	0.469	0.496	0.454	0.535	
	(175)	(174)	(173)	(173)	(173)	(173)	(173)	(171)	(169)	(169)	(169)	(169)	(169)	(169)	
Sample standard deviation (168 countries)						**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
						0.613	0.604	0.584	0.580	0.581	0.574	0.542	0.537	0.526	0.510
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	
	0.500	0.488	0.505	0.508	0.493	0.485	0.471	0.454	0.438	0.433	0.438	0.420	0.426	0.427	

This table is the author's calculation and depicts a decline in the sample standard deviation for 168 countries which are constantly reported in the Penn World Table9.0 (Feenstra et al. (2015)).

Table 2: Results of OLS and Fixed Effects to Test the Balassa-Samuelson Hypothesis

	Dependent Variable: Ln (P) = Ln (P/Ep^{usa})				
	OLS	**OLS**	**OLS**	**OLS**	**Fixed Effects**
ln rGDPw	0.259 ***	0.228 ***	0.223 ***	0.250 ***	0.136 **
	(8.33)	(9.52)	(9.31)	(43.57)	(2.17)
cons	-3.421 ***	-2.867 ***	-2.817 ***	-3.309 ***	-2.201 ***
	(-11.32)	(-11.78)	(-11.50)	(-58.55)	(-3.57)
R^2 adj.	0.283	0.348	0.338	0.274	
R^2 within					0.026
between					0.332
overall					0.274
Number of observations	174	169	169	5029	5029
Number of countries (groups)					178
Year(s)	1995	2011	2014	1985~2014	1985~2014

*This table shows the results of the OLS and fixed effects estimation of the data used in Figures 1 to 3 (Penn World Table9.0 (Feenstra et al. (2015))). For the years from 1985 to 2014, a one percent increase in the income level results in a 0.136 percent increase in the price level relative to the price level of USA based on the fixed effects model. *** and ** indicate significance at the 1 and 5 percent levels respectively. T-values are reported in parentheses. The fixed effects model adopts heteroskedasticity-robust estimation. Based on the Breusch-Pagan Lagrange multiplier test and the Hausman test, the fixed effects model is selected for the panel estimation from 1985 to 2014.*

Theoretical Model for Empirical Analysis

The original Balassa-Samuelson theory (Balassa (1964), Samuelson (1964)) is a key theory of real exchange rate determination in the long run. As one of the contributions of this paper, the B-S theory (Balassa (1964), Samuelson (1964), Fukao (2008) and Oguro (2012)) is developed to show the relative price levels (or real exchange rate) between two countries is explained by the relative wage rate and/or the relative labor productivity. The outcome can be obtained by including some additional assumptions to the B-S theory. This section starts by reconsidering each Balassa-Samuelson assumption. The theory consists of two countries, home and foreign (*) countries, and two sectors, tradable (T) and non-tradable (N) sectors.

Assumption 1: The law of one price holds for tradable goods.

$$P_T = e \cdot P_T^* \tag{1}$$

Assumption 2: The real wage rate is equal to the labor productivity.

$$\frac{W_T}{P_T} = \frac{Q_T}{L_T} \qquad \frac{W_T^*}{P_T^*} = \frac{Q_T^*}{L_T^*} \tag{2}$$

$$\frac{W_N}{P_N} = \frac{Q_N}{L_N} \qquad \frac{W_N^*}{P_N^*} = \frac{Q_N^*}{L_N^*} \tag{2'}$$

T: tradable goods,
N: non-tradable goods, *: foreign country,
e: nominal exchange rate between two countries,
W: nominal wage rate, P: price, Q: output, L: the number of hours worked

Assumption 3: The perfect mobility of labor is assumed only within a country (and not across countries). Thus, the wage rates between the two sectors will be equalized in both countries.

$$W_T = W_N = W \qquad W_T^* = W_N^* = W^* \tag{3}$$

Assumption 4: The price level of each countries is determined as the geometric mean of the tradable goods price and the non-tradable goods price in each country.

$$P = (P_T)^\alpha \cdot (P_N)^{1-\alpha} \qquad P^* = (P_T^*)^\beta \cdot (P_N^*)^{1-\beta} \tag{4}$$
$$0 < \alpha, \beta < 1$$

Using Equations (2), (2)', and (4), the relative price level (= real exchange rate) between home and foreign counties can be written as follows.

$$\frac{P}{e \cdot P^*} = \frac{\left[\frac{W_T}{\left(\frac{Q_T}{L_T}\right)}\right]^\alpha \cdot \left[\frac{W_N}{\left(\frac{Q_N}{L_N}\right)}\right]^{1-\alpha}}{e \cdot \left[\frac{W_T^*}{\left(\frac{Q_T^*}{L_T^*}\right)}\right]^\beta \cdot \left[\frac{W_N^*}{\left(\frac{Q_N^*}{L_N^*}\right)}\right]^{1-\beta}} \tag{5}$$

Equation (5) can be simplified as Equation (7) under Assumption 3) (Equation (3)) and with the additional assumption, Equation (6). Equation (6) defines that the labor productivity of each country is the geometric mean of the labor productivity of the tradable goods sector and the non-tradable goods sector in each country.

$$\frac{Q}{L} = \left(\frac{Q_T}{L_T}\right)^\alpha \cdot \left(\frac{Q_N}{L_N}\right)^{1-\alpha} \qquad \frac{Q^*}{L^*} = \left(\frac{Q_T^*}{L_T^*}\right)^\beta \cdot \left(\frac{Q_N^*}{L_N^*}\right)^{1-\beta} \tag{6}$$

$$\frac{P}{e \cdot P^*} = \frac{W}{e \cdot W^*} \cdot \frac{\left(\frac{Q^*}{L^*}\right)}{\left(\frac{Q}{L}\right)} \tag{7}$$

Equation (7) shows the relative price level (or real exchange rate) (P/eP*) between two countries is explained by the relative wage rate (W/eW*) and the relative labor productivity((Q*/L*)/(Q/L)). A rise (decline) in the home country's relative wage rate, and/or a decline (rise) in the home country's relative labor productivity cause(s) a rise (decline) in the home country's relative price level (= an appreciation (a depreciation) of the home country's real exchange rate). In the empirical analysis, the log linearized version of Equation (7), Equation (8), is estimated to assess the determinants of the relative price level.

$$ln\left(\frac{P}{e \cdot P^*}\right)_{i,t} = \propto + \beta \cdot ln\left(\frac{W}{e \cdot W^*}\right)_{i,t} + \gamma \cdot ln\left[\frac{\left(\frac{Q^*}{L^*}\right)}{\left(\frac{Q}{L}\right)}\right]_{i,t} + \varepsilon_{i,t} \tag{8}$$

$\propto$: constant、$\varepsilon_{i,t}$: error term

Data for Checking Theoretical Model and for Empirical Analysis

Before running regressions, the equalization of wage rate within a country (Assumption 3)) and theoretical model derived in the previous section (Equation (7)) are tested using data. To conduct the test for Japan and USA, it is necessary to have overall nominal wage rate in Japan (W) and in USA (W*). In addition, it is necessary to obtain the nominal wage rate for tradable goods sector in Japan (Wm) and in USA (Wm*). Manufacturing industry is treated as the tradable goods sector. To obtain the wage rate data for longer years, we use data from both EUKLEMS database released in November 2009 and OECD index database. The OECD data are connected to the EUKLEMS data using the EUKLEMS 2006 data value as the base. The availability of EUKLEMS data is until 2006 for Japan, and until 2007 for USA. Using both EUKLEMS and OECD data, it is possible to obtain data from 1973 to 2015 for Japan, and from 1977 to 2015 for USA.

Wage rate data is calculated from EUKLEMS database as the compensation of employees (national currency basis, in millions) over the total hours worked by employees (millions). OECD provides index data of labour compensation per hour worked, which are used as the wage rate data in this paper. To check the equalization of wage rate in Japan and in USA (Assumption 3)) Figure 5 depicts the nominal wage rate for the manufacturing industry divided by the overall nominal wage rate in Japan (Wm/W) and in USA (Wm*/W*). Figure 5 confirms the tendency of wage equalization especially in Japan. Figure 6 shows the nominal wage rates taken from both EUKLEMS and OECD database in Japan and in USA from 1985 to 2015. Nominal exchange rate data are obtained from IMF. For Japan, the wage rate in yen, which is mostly constant, and that in US dollar, which fluctuates, are drawn. The US nominal wage rate in USD is constantly increasing. As a whole, it is possible to predict from Figure 6 that the fluctuations are mainly caused by nominal exchange rates.

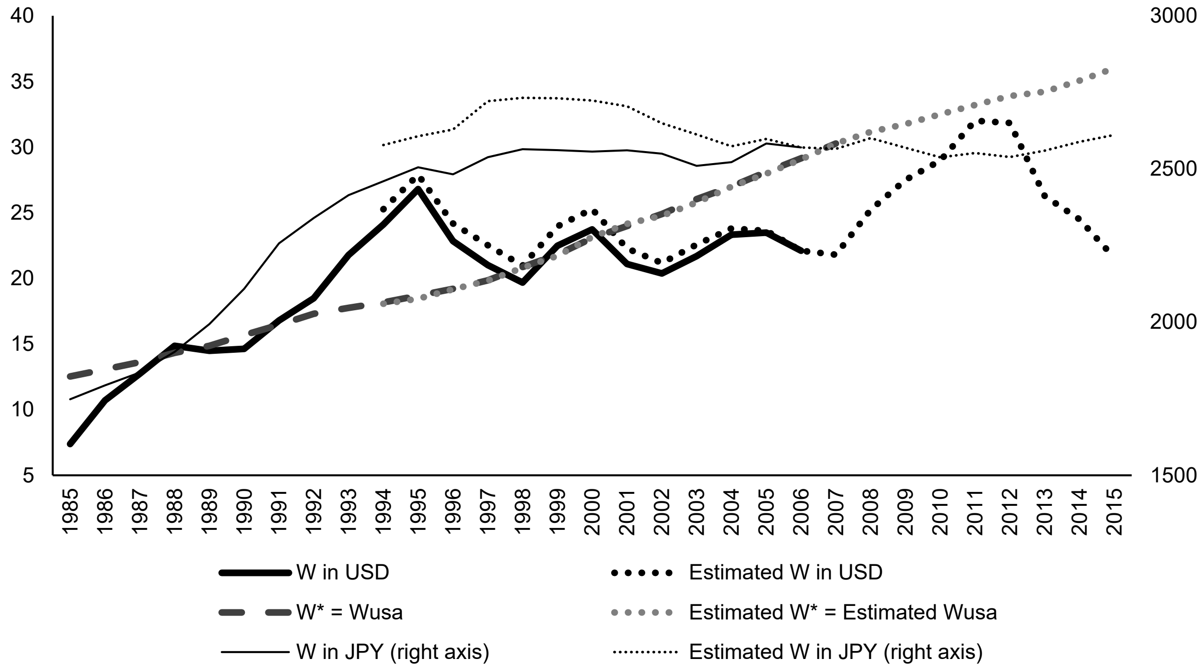
Before running regressions, the accuracy of Equation (7), which is derived in this paper as one of the contributions, is tested by Japan and US data as shown in Figure 7. In other words, the test is done to check whether or not a rise (decline) in a country's relative price level (= an appreciation (a depreciation) of a country's real exchange rate) is caused by a rise (decline) in a country's relative wage rate, and/or a decline (rise) in a country's relative labor productivity. The relative wage rate (W/eW*) and the relative labor productivity ((Q*/L*)/(Q/L)) are calculated from OECD index data. The relative price level (P/eP*) is calculated from the Penn World Table (PWT)9.0 (Feenstra et al. (2015)) data and the IMF nominal exchange rate data. The dataset covers the period from 1985 to 2015. Looking at Figure 7, it seems that the relative price level (= real exchange rate) between Japan and USA is mostly explained by the relative nominal wage rate between the two countries. Based on this result it seems the accuracy of Equation (7) is confirmed.

In the empirical analysis, the dataset is created from OECD and the Penn World Table (PWT)9.0 (Feenstra et al. (2015)) database in the same way as Figure 7. However, when running regressions, the dataset contains 33 countries excluding the base country, USA: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Japan, Korea, Latvia, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom, Lithuania, South Africa. The dataset covers the period from 1999 to 2014. The base year is 2011. Table 3 shows summary statistics of the panel dataset, which is used for the empirical analysis. The panel is unbalanced, and the number of the observations in regressions equals 478. The relative price level (P/ePUSA) is the dependent variable, and the relative wage rate (W/eWUSA) and relative labor productivity (QUSA/LUSA)/(Q/L) are explanatory variables.

Figure 5: Nominal Wage Rate for Manufacturing Industry (Wm) / Nominal Wage Rate for All Industries (W) in Japan and USA (*)

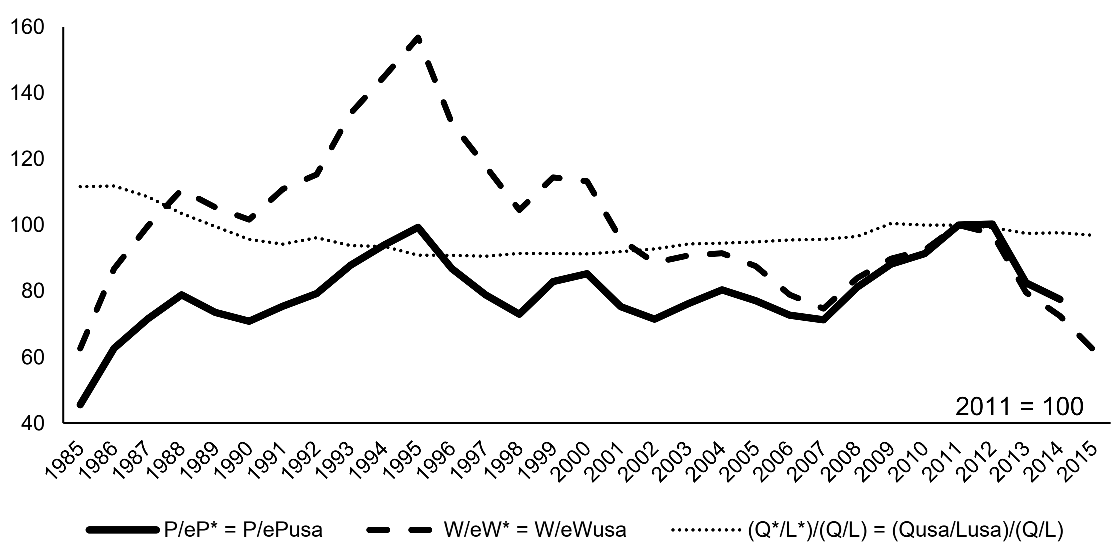
This figure depicts the nominal wage rate for manufacturing industry divided by the overall nominal wage rate in Japan (Wm/W) and in USA (Wm/W*). This figure shows the tendency of wage equalization in Japan and USA. The data are the author's calculation from EUKLEMS and OECD dataset.*

Figure 6: Nominal Wage Rates in Japan and USA



This shows the nominal wage rates taken from both EUKLEMS and OECD database in Japan and in USA from 1985 to 2015. Nominal exchange rate data are obtained from IMF. This figure shows the nominal wage rate in Japan in yen, which is mostly constant, and that in US dollar, which fluctuates. It seems that the price and wage rate fluctuations are mainly caused by nominal exchange rates.

Figure 7: Checking Equation (7) by Japan and US data



This figure shows the relative price level (= real exchange rate) between Japan and USA is mostly explained by the relative nominal wage rate between the two countries. The accuracy of Equation (7) is confirmed. The relative wage rate (W/eW) and the relative labor productivity ((Q*/L*)/(Q/L)) are calculated from OECD index data. The relative price level (P/eP*) is calculated from the Penn World Table (PWT)9.0 (Feenstra et al. (2015)) data and the IMF nominal exchange rate data. The dataset covers the period from 1985 to 2015.*

Table 3: Summary Statistics

	P/eP^{USA} USA in 2011 = 100	W/eW^{USA} Base year 2011 = 100	$(Q^{USA}/L^{USA})/(Q/L)$ Base year 2011 = 100
Min	26.77	36.30	80.57
Max	208.94	127.34	146.10
Average	87.98	86.66	99.88
Standard deviation	31.22	16.46	9.53
Number of observations	528	478	525
Number of countries	33		
Time frame	1999~2014		

This table is the summary statistics of the data used to estimate Equation (8). The relative wage rate (W/eWUSA) and the relative labor productivity ((QUSA/LUSA)/(Q/L)) are calculated from OECD index data. The relative price level (P/ePUSA) is calculated from the Penn World Table (PWT)9.0 (Feenstra et al. (2015)) data and the IMF nominal exchange rate data. The dataset contains 33 countries excluding the base country, USA. The dataset covers the period from 1999 to 2014. The number of the observations in regressions equals 478.

EMPIRICAL RESULTS

The empirical model adopts the log linearized version of Equation (7), Equation (8):

$$ln\left(\frac{P}{e\cdot P^*}\right)_{i,t} = \propto + \beta\cdot ln\left(\frac{W}{e\cdot W^*}\right)_{i,t} + \gamma\cdot ln\left[\frac{\left(\frac{Q^*}{L^*}\right)}{\left(\frac{Q}{L}\right)}\right]_{i,t} + \varepsilon_{i,t} \quad (8)$$

$\propto$: constant、$\varepsilon_{i,t}$: error term

For the empirical analysis, this paper constructs the unbalanced panel dataset which consists of 33 countries for the years from 1999 to 2014. Due to the start of the Euro in 1999, the period of investigation is limited to data after 1999. USA is defined as a foreign (*) country and the base country throughout the empirical analysis. Table 4 shows the result of the panel fixed effects robust estimation of Equation (8).

Table 4: Results of Panel Regression of Equation (8)

Dependent Variable: ln ($P_i/e\cdot P_{USA}$)				
	Fixed Effects		**2SLS IV**	
ln (W_i/eW_{usa})	1.180	***	1.162	***
	(27.95)		(60.54)	
ln [(Q_{USA}/L_{USA})/(Q_i/L_i)]	0.869	***	0.845	***
	(5.43)		(14.86)	
Constant	-9.404	***	-9.204	***
	(-10.82)		(-30.83)	
R^2 within	0.912		0.920	
between	0.018		0.008	
overall	0.330		0.307	
Number of observations	478		444	
Number of countries	33		33	
Time frame	1999~2014		1999~2014	

This table shows the regression estimates of Equation (8):

$$ln\left(\frac{P}{e\cdot P^*}\right)_{i,t} = \propto + \beta\cdot ln\left(\frac{W}{e\cdot W^*}\right)_{i,t} + \gamma\cdot ln\left[\frac{\left(\frac{Q^*}{L^*}\right)}{\left(\frac{Q}{L}\right)}\right]_{i,t} + \varepsilon_{i,t}$$

*Relative price level (P/ePUSA) is the dependent variable, and the relative wage rate (W/eWUSA) and relative labor productivity (QUSA/LUSA)/(Q/L) are explanatory variables. *** indicates significance at the 1 percent level. Numbers in parentheses are T values using heteroskedasticity robust standard errors for fixed effects model and Z values for 2SLS IV estimation. Instrument variable is ln(Wi/eWUSA)t-1.*

Table 4 also shows the result of the estimation with instrument variable in the last column in order to check the endogeneity problem. In the instrument variable (IV) estimation, relative wage term is instrumented by its one-year lagged term. However, the result of the IV estimation is similar to that of the fixed effects estimation and is with much larger standard deviations. All estimated coefficients in Table 4 are statistically significant at the one percent level. According to the fixed effects estimation, a one percent increase in the relative wage results in a 1.18 percent increase in the relative price level, and a one percent increase in the foreign country's relative productivity results in a 0.869 percent increase in the relative price level.

Table 5 indicates the result of panel regression of equation (8) with country dummy variables. The result reveals each country's situation. Japan, who has been experiencing deflation for two decades, has the smallest impact of the relative wage on the relative price level among 33 countries. A one percent increase in the relative wage causes only a 0.481 percent increase in the relative price level in Japan. To sum up, the results of the estimations of Equation (8) confirm that relative wage rate has more impact on relative price level (or real exchange rate) than the relative labor productivity.

Since the convergence of price levels in the long run is confirmed in the earlier section (See Figures 1 to 4, and Table 1 for the details.), Equation (7) implies that when the nominal appreciation (depreciation) of a country's currency occurs, it would be possible to cause the tendency of the declining (increasing) nominal wage and price level in the long run under the economy that allows the market to decide everything. Unfortunately, the nominal wage targeting seems not to be practical. According to the theoretical model depicted by Equation (7), a rise (decline) in relative labor productivity results in a decline (rise) in the relative price. However, the theoretical model also implies that a rise in labor productivity causes a rise in the nominal wage rate in the longer run, which eventually results in a rise in the price level (Equations (2) and (2)'). The estimation of Japan Productivity Center (2017) confirms that a rise in productivity causes a rise in prices with a rise in wages, whereas it causes a decline in prices without a rise in wages.

CONCLUDING COMMENTS

The goal of this paper is to theoretically and empirically reevaluate the effective price policy as a method to deal with deflation using the Balassa-Samuelson theory (Balassa (1964), Samuelson (1964)). The model developed in this paper shows the relative price level (or real exchange rate) between two countries is explained by the relative wage rate and the relative labor productivity between two countries. The empirical analysis of 33 countries from 1999 to 2014 provides support for the theoretical model presented in this paper. The empirical results confirm that relative wage rate has more impact on relative price level (or real exchange rate) than relative labor productivity. Since the convergence of the price levels in the long run is confirmed by the data analysis for 178 countries in this paper, the theory developed implies that the tendency of the nominal appreciation (depreciation) of a country's currency can cause declining (increasing) nominal wages and price levels in the long run under a free market economy. It seems that nominal wage targeting is not practical, but the theoretical model implies that a rise in the labor productivity causes a rise in the nominal wage rate in the longer run, which eventually results in a rise in the price level. The policy implication of the results is that operating an effective price policy is difficult for countries experiencing deflation such as Japan. The limitations of the investigation in this paper is that the results rely on the Balassa-Samuelson Hypothesis, which requires many assumptions. Development of investigation methods to relax the assumptions is left for future research.

Table 5: Results of Panel Regression of Equation (8) with Country Dummy Variables

Dependent Variable	**Ln (P_i/Ep_{usa})**	**Number of Obs.**	**478**
		Number of countries	33
ln (W_i/eW_{usa})	1.128 ***		
	(69.03)	R^2 within	0.942
ln [(Q_{USA}/L_{USA})/(Q_i/L_i)]	0.859 ***	between	1.000
	(3.35)	overall	0.978
-	Estimated Coefficient of ln (W_i/eW_{usa}) + [ln (W_i/eW_{usa}) × D]	Significance of Dummy Variable at: *** 1%, ** 5%, * 10%	
Australia	1.226 **		
Austria	1.427 ***	***	
Belgium	1.429 ***	**	
Canada	1.405 ***	**	
Czech Republic	1.144		
Denmark	1.082	***	
Estonia	0.799 ***	***	
Finland	1.273 ***		
France	1.261 *		
Germany	1.340 ***		
Greece	1.227 ***		
Hungary	1.191		
Ireland	0.946 ***	***	
Israel	1.578 ***	***	
Italy	1.173		
Japan	0.481 ***	***	
Korea	1.460 **	**	
Latvia	1.100		
Luxembourg	1.778 ***	***	
Mexico	0.572 ***	***	
Netherlands	1.294 **		
New Zealand	1.185 ***	***	
Norway	0.736 ***	***	
Poland	1.470 ***	***	
Portugal	1.265 **		
Slovakia	0.974 ***	***	
Slovenia	1.221		
Spain	1.123		
Sweden	1.380 ***	***	
Switzerland	0.874 ***	***	
United Kingdom	1.263 ***	***	
Lithuania	1.202		
South Africa	(omitted)		

This table shows the regression estimates of Equation (8) with country dummy variables:

$$ln\left(\frac{P}{e \cdot P^*}\right)_{i,t} = \propto + \beta \cdot ln\left(\frac{W}{e \cdot W^*}\right)_{i,t} + \gamma \cdot ln\left[\frac{\left(\frac{Q^*}{L^*}\right)}{\left(\frac{Q}{L}\right)}\right]_{i,t} + \varepsilon_{i,t}$$

*Relative price level (P/ePUSA) is the dependent variable, and the relative wage rate (W/eWUSA) and relative labor productivity (QUSA/LUSA)/(Q/L) are explanatory variables. *** and ** indicate significance at the 1 and 5 percent levels respectively.*

REFERENCES

Aoki, Kosuke (2001) "Optimal monetary policy responses to relative-price changes," *Journal of Monetary Economics*, vol. 48(1), pages 55-80.

Asea, Patrick K. and Enrique G Mendoza (1994) "The Balassa-Samuelson Model: A General-Equilibrium Appraisal," *Review of International Economics*, vol. 2(3), pages 244-267.

Balassa, Bela (1964) "The Purchasing-Power Parity Doctrine: A Reappraisal," *Journal of Political Economy*, vol. 72: pp 584-596.

Bean, Charles R. (1983) "Targeting Nominal Income: An Appraisal," *Economic Journal*, Vol. 93(372), 806-819.

Bordo, Michael D., Ehsan U. Choudhri, Giorgio Fazio, and Ronald MacDonald (2017) "The real exchange rate in the long run: Balassa-Samuelson effects reconsidered," *Journal of International Money and Finance*, vol. 75(C), pages 69-92.

Canzoneri, Matthew B., Robert E. Cumby, and Behzad Diba (1999) "Relative Labor Productivity and the Real Exchange Rate in the Long Run: Evidence for a Panel of OECD Countries," *Journal of International Economics*, vol. 47(2), pages 245-266.

Chinn, Menzie (2000) "The Usual Suspects? Productivity and Demand Shocks and Asia-Pacific Real Exchange Rates," *Review of International Economics*, 8, 20-43.

Drine, Imed and Christophe Rault (2004) "Does the Balassa-Samuelson Hypothesis Hold for Asian Countries? An Empirical Analysis using Panel Data and Cointegration Tests," *Applied Econometrics and International Development*, vol. 4(4).

Feenstra, Robert C., Robert Inklaar, and Marcel P. Timmer (2015) "The Next Generation of the Penn World Table," *American Economic Review*, 105(10): pp 3150-3182.

Fukao, Kyoji (2008) Comments on "The Yen and Japan's Economy, 1985-2007," by Maurice Obstfeld, unpublished.

Fukao, Kyoji (2012) "*Ushinawareta 20 Nen*" *to Nihon Keizai* ("*The Lost Two Decades*" *and Japanese Economy*), Nihon Keizai Shimbun.

Hsieh, David A. (1982) "The Determination of the Real Exchange Rate: The productivity approach," *Journal of International Economics*, vol. 12(3-4), pages 355-362.

Ito, Takatoshi and Peter Isard, and Steven Symansky (1999) "Economic Growth and Real Exchange Rate: An Overview of the Balassa-Samuelson Hypothesis in Asia," In T. Ito and A. O. Krueger, eds., *Changes in Exchange Rates in Rapidly Developing Countries*, Chicago: University of Chicago Press.

Japan Productivity Center (2017) "Seisansei oyobi Chingin to Bukka, Shohi ni kansuru Suikei (The Estimations of Productivity, Wages, Prices, and Consumption)," June, 2017.

Marston, Richard C. (1987) "Real exchange rates and productivity growth in the United States and Japan," In S. W. Arndt and J. D. Richardson, eds., *Real-Financial Linkages among Open Economies*, Cambridge: MIT Press.

Obstfeld, Maurice (2009) "Time of Troubles: The Yen and Japan's Economy, 1985-2008," *NBER Working Papers* 14816.

Oguro, Yoko (2012) "Nihon Yen wa Honto ni Takasugirunoka? (Is Japanese Yen Really Too Expensive?)," *Meikai Economic Review*, 25 (1): pp 28-45.

Phelps, E. S. (1968) "Money-Wage Dynamics and Labor-Market Equilibrium," *Journal of Political Economy*, Vol. 76, 678-711.

Rogoff, Kenneth (1992) "Traded goods consumption smoothing and the random walk behavior of the real exchange rate," *Monetary and Economic Studies*, 10: 1-29.

Samuelson, Paul A. (1964) "Theoretical Notes on Trade Problems," *Review of Economics and Statistics*, vol. 46, no. 2: pp 145-154.

Thomas, Alastair and Alan King (2008) "The Balassa-Samuelson Hypothesis in the Asia-Pacific Region Revisited," *Review of International Economics*, vol. 16(1), pages 127-141.

Tobin, James (1980) "Stabilization Policy Ten Years After," *Brookings Papers on Economic Activity*, Vol. 11(1, Tenth), 19-90.

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