Vol 4, No 1, January - June 2019, pp: 19 - 34

**Faculty Publications**
ISSN: 3008-1017
Title DOI: https://doi.org/10.62458/021024

# Dollarization and the Perception of ASEAN Currency in Cambodia

**Siphat Lim***

## Abstract

The Kalman filter was employed on one observed equation and two state space equations to predict the proportional coefficients which were used to estimate the amount of US Dollar circulation outside banks in Cambodia. The degree of dollarization was high as measure by $DR_4$ indicator bounded in the range between 86 percent and 91 percent from 2010 to 2017. But as compare to GDP, the amount of US Dollar in circulation was rather low aim to the increase in foreign currency deposits. The result of survey from 530 respondents indicated that most of the people's income earned in US Dollar and which turned into the purchase of goods and services in the markets were mainly conducted in US Dollar. Not many people known about the present of the South East Asia Central Bank (SEACEN), but surprising result had revealed that 72.64 percent of the respondents chose ASEAN currency, while 27.36 percent chose US Dollar.

***Keywords*:** Kalman filter, Dollarization, $DR_4$, SEACEN and ASEAN Currency.

* Siphat Lim, PhD
CamEd Business School
Email: lsiphat@cam-ed.com

## 1. Introduction

Cambodia's economy has been dollarized for more than two decades since 1993. Foreign currency, especially US Dollar is used alongside with the Cambodian currency –Riel, for three roles, particularly unit of measurement, medium of exchange and store of value. Although the supply of Riel has been increased between 20% and 30%, dollarized rate measured by the ratio of foreign currency deposit (FCD) to broad money (M2), FCD/M2, remains high, in a range of between 95% and 98% from 2010 and 2017.

US Dollar is widespread nationwide in the daily lifestyle of Cambodians, particularly urban areas in Phnom Penh and other provinces that have high economic and commercial activities. Furthermore, roughly 90% of loans from the commercial banks are issued in US Dollar. In fact, the Royal Government of Cambodia has always adopted the de-dollarization policy in promoting the uses of the national currency–Riel. Key policies utilized by the government are payments of tax and utility in Khmer Riel; recently, supermarkets and stores are required to quote the goods and services in Riel. Meanwhile, the National Bank of Cambodia, as the currency regulator, has maintained the inflation rate of an average 4.5% per year in the last five years and the exchange rate of approximately KHR4,000 per US Dollar, under the pressure of high dollarization. The purpose of this study is to forecast the volume of US Dollar circulation outside banking system in the Cambodian economy by utilizing econometric model and Kalman filter via using observed variables to predict unobserved variables; the forecast period is between January 2010 and December 2017. In addition to empirical study, this research also studies the behavior and understanding among the Cambodian people regarding dollarization and ASEAN currency that is likely to be created by the Southeast Asia Central Bank (SEACEN) in the future. A survey is conducted in Phnom Penh city only over 530 respondents.

## 2. Literature Review

Two main factors drive dollarization in a number of countries, namely price stabilization and economic growth (Reinhart, Rogoff, & Savastano, 2003) and (Galinda & Leiderman, 2005).

Additionally, the level of income could be a key application in measuring dollarization. There is a question regarding if income is the factor driving dollarization in Cambodia. Those whose income is more than $1,000 per month generally hold or save more foreign currency than those who earn less than $100 per month. This study also found that the provinces surrounding Phnom Penh mostly reserve more foreign currency. Furthermore, the salary of workers in private sector, especially factory workers that total approximately 400,000 people and their total combined income is circa 30% of GDP in 2012 (Reza & Chan, 2014). The study above also identified the correlation between level of dollarization and income of Cambodians. The higher their income is, the more they save in foreign currency.

In addition to stabilization of price and economic growth, the persistence of dollarization is associated with interactive economic activities, which is explained as network externalities (Valev, 2010). These activities have occurred from the fact that most commercial transactions by Cambodians that are done in foreign currency. Apart from Reza and Chan solely focusing on the level of income and the holding and saving in foreign currency to determine the level of dollarization, the research from Japan International Cooperation Agency Research Institute (JICA-RI) studied the behaviors of income, expense, saving and borrowing among population and companies in Cambodia. According to the survey in 25 provinces with a total of 2,273 households participating in the study, the finding concluded that the income is not only in US Dollar but also Thai Bath and Vietnamese Dong, together representing roughly 32% of total income, whilst income in Khmer Riel accounts for circa 62%. In contrast, the use of foreign currency in daily expense is approximately 11%, which is relatively low if compared to the level of dollarization determined by FCD/M2. Moreover, the research finding concluded that Cambodian families prefer to save in Khmer Riel than US Dollar (Odajima, 2017).

Aside from studying the behavior of economic agents on a microeconomic level, the macroeconomic level models are used to predict dollarization level. Zamaroczy and Sa (2002) adopted Kalman filter comprising two state space equations and a single observed equation. This study utilized the monthly data between January 1995 and December 2001; however, the Gross Domestic Product (GDP) data was not accurate and the estimation of dollarization could be biased (Zamaroczy & Sa, 2002). As the GDP data is improving, Lim (2011) used the same application by analyzing the data between January 1995 and December 2010. The dollarization level, represented by $DR_4$, was determined by the ratio between the combination of FCD with US Dollar circulating in the Cambodia economy and M2. During the studied period, the level of dollarization stayed in the region between 94% and 95.5% (Lim, 2011).

## 3. Methodology

### 3.1. Econometric Model for Estimating Cash US Dollar outside Banks

The state space representative, Kalman filter, with one observed equation or signal equation and two state space equations are constructed. The proportionality coefficient *k* and velocity *V* are called state space variables and GDP, M2, Consumer Price Index (CPI), and Nominal Exchange Rate (NEX), between January 1995 and December 2017, are called observed variables. The parameters of the state space representative can be determined by maximum likelihood estimation method. The unobserved variables, *k* and *V*, can be generated from the estimated parameter of the Kalman filter. Based on *k* and *V*, cash U.S. dollar circulations outside bank are also revealed.

The quantity theory of money is applied as the main idea in the estimation of the amount of cash U.S. dollar circulated outside banks in Cambodia. This can be seen as follow:

$$M_t V_t = P_t Q_t \quad (1)$$

$M_t$ : money circulated in the economy
$V_t$ : velocity of money
$P_t$ : price level
$Q_t$ : number of transactions.

Due to the existence of the currency substitute, the money circulated in the economy consists of two components which are:

${}^{R}M_{R,t}$ : domestic currency Riels in circulation (cash and checks) and

${}^{D}M_{R,t}$ : dollars in circulation (cash only) which is converted into Riels.

Then,

$$M_t = {}^{R}M_{R,t} + {}^{D}M_{R,t} = (1 + k_t)\,{}^{R}M_{R,t}, \text{ with } k_t > 0 \quad (2)$$

$k_t$ : proportionality coefficient between Riels and U.S. dollars in circulation.

Thereafter, the equation (1) can be written as:

$$(1 + k_t)\,{}^{R}M_{R,t} V_t = P_t Q_t \quad (3)$$

$P_t Q_t$ is proxied by nominal GDP and the velocity of U.S. dollars and Riels are assumed to be the same. We can derive new equation:

$$(1 + k_t)\,{}^{R}M_{R,t} V_t = GDP_t \quad (4)$$

Taking logs of this equation, we obtain:

$$\log({}^{R}M_{R,t}) = \log(GDP_t) - \log(V_t) - \log(1 + k_t) \quad (5)$$

This equation can be called the observation or signal equation. There are two unknown parameters, $V_t$ and $k_t$. The main purpose of this equation is to determine $k_t$ which can be used to estimate ${}^{D}M_{R,t}$.

The following assumptions are developed for the two unobserved variables, $V_t$ and $k_t$.

The velocity of money, $V_t$, evolves over time according to three factors:

1. changes in inflation, as measured by the consumer price index;
2. changes in the level of the exchange rate and
3. disturbance term.

Based on these assumptions, we can generate following equation:

$$\log(V_{t+1}) = \phi_1 \log(V_t) + \phi_2 \Delta \log(CPI_{t+1}) + \phi_3 \Delta \log(NEX_{t+1}) + \mu_{t+1} \quad (6)$$

The proportionality coefficient between Riels and U.S. dollars circulated outside banks, $k_t$, evolves over time according to two factors:

4. the level of the exchange rate; and
5. disturbance term.

Another equation can be generated:

$$\log(1 + k_{t+1}) = \phi_4 \log(1 + k_t) + \phi_5 \log(NEX_{t+1}) + \upsilon_{t+1} \quad (7)$$

*CPI* : consumer price index, including all items
*NEX* : nominal exchange rate, Riels per U.S. dollar

$\Delta$ : difference term

$\phi_1, \phi_2, \phi_3, \phi_4, \phi_5$ : parameters to be estimated

$\mu, \upsilon$ : disturbance terms or stochastic shocks.

Equation (6) and (7) are called state space equations. Now, there are three equations: one observation or signal equation, and two state space equations. The parameters can be estimated by the Kalman filter. The log likelihood function of a smoothed estimate is employed in order to get the estimated parameters.

For simplicity the equation (5), (6), and (7) can be written in the matrices form as follows:

$$\begin{pmatrix} \log V_{t+1} \\ \log(1+k_{t+1}) \end{pmatrix} = \begin{pmatrix} \phi_1 \\ \phi_4 \end{pmatrix} \begin{pmatrix} \log V_t \\ \log(1+k_t) \end{pmatrix} + \begin{pmatrix} \phi_2 & \phi_3 & 0 \\ 0 & 0 & \phi_5 \end{pmatrix} \begin{pmatrix} \Delta \log CPI_{t+1} \\ \Delta \log NEX_{t+1} \\ \log NEX_{t+1} \end{pmatrix} + \begin{pmatrix} u_{t+1} \\ \upsilon_{t+1} \end{pmatrix} \quad (8)$$

$$\log {}^{R}M_{R,t} = \log GDP_t + \begin{pmatrix} -1 & -1 \end{pmatrix} \begin{pmatrix} \log V_t \\ \log(1+k_t) \end{pmatrix} \quad (9)$$

Changing notation, we get

$$\xi_{t+1} = F\xi_t + A' x_{t+1} + v_{t+1} \quad (10)$$

$$y_t = a' z_t + H' \xi_t \quad (11)$$

where

$$\xi_{t+1} = \begin{pmatrix} \log V_{t+1} \\ \log(1+k_{t+1}) \end{pmatrix}, \quad F = \begin{pmatrix} \phi_1 \\ \phi_4 \end{pmatrix}, \quad \xi_t = \begin{pmatrix} \log V_t \\ \log(1+k_t) \end{pmatrix}, \quad A' = \begin{pmatrix} \phi_2 & \phi_3 & 0 \\ 0 & 0 & \phi_5 \end{pmatrix},$$

$$x_{t+1} = \begin{pmatrix} \Delta \log CPI_{t+1} \\ \Delta \log NEX_{t+1} \\ \log NEX_{t+1} \end{pmatrix}, \quad v_{t+1} = \begin{pmatrix} u_{t+1} \\ \upsilon_{t+1} \end{pmatrix}, \quad y_t = \log {}^{R}M_{R,t}, \quad a' = 1, \quad z_t = \log GDP_t, \text{ and}$$

$$H' = \begin{pmatrix} -1 & -1 \end{pmatrix}.$$

The (r x 1) vector $v_t$

$$E(v_t v'_\tau) = \begin{cases} Q & \text{for t} = \tau \\ 0 & \text{otherwise} \end{cases}$$

where Q is (r x r) matrix.

The initial value of the state vector $\xi_1$ is needed. We assume that $\xi_1$ is uncorrelated with any realizations of $v_t$

$$E(v_t \xi_1') = 0 \quad \text{for } t = 1,2, \ldots, T$$

The analyst is presumed to have observed $y_1, y_2, \ldots, y_T, x_1, x_2, \ldots, x_T, z_1, z_2, \ldots, z_T$.
The Kalman filter is motivated here as an algorithm for calculating linear least squares forecasts of the state vector on the basis of data observed through date *t*,

$$\hat{\xi}_{t+1|t} \equiv \hat{E}(\xi_{t+1} \mid \Psi_t)$$

where

$$\Psi_t = (y'_t, y'_{t-1}, \ldots, y'_1, x'_t, x'_{t-1}, \ldots, x'_1, z'_t, z'_{t-1}, \ldots, z'_1)' \quad (12)$$

and $\hat{E}(\xi_{t+1} \mid \Psi_t)$ denotes the linear project of $\hat{\xi}_{t+1}$ on $\Psi_t$ and a constant. The Kalman filter calculates these forecasts recursively, generating $\hat{\xi}_{1|0}, \hat{\xi}_{2|1}, \ldots, \hat{\xi}_{T|T-1}$ in succession. Associated with each of these forecasts is a mean squared error (*MSE*) matrix, represented by the following (r x r) matrix:

$$P_{t+1|t} \equiv E\left[\left(\xi_{t+1} - \hat{\xi}_{t+1|t}\right)\left(\xi_{t+1} - \hat{\xi}_{t+1|t}\right)'\right] \quad (13)$$

The recursive begin with $\hat{\xi}_{1|0}$ which denotes a forecast of $\xi_1$ based on no observations of y, x, or z. This is just the unconditional mean of $\xi_1$,

$$\hat{\xi}_{1|0} \equiv E(\xi_1),$$

with associated *MSE*

$$P_{1|0} = E\left\{[\xi_1 - E(\xi_1)][\xi_1 - E(\xi_1)]'\right\}. \quad (14)$$

The unconditional mean of $\xi_t$ can be found by taking expectation of both side of equation (10), producing

$$E(\xi_{t+1}) = FE(\xi_t) + A'E(x_{t+1}) \quad (15)$$

***Forecasting*** $y_t$

Noted that we assume that $x_t$ contains no information about $\xi_t$ beyond that contained in $\Psi_{t-1}$,

$$\hat{E}(\xi_t \mid x_t, \Psi_{t-1}) = \hat{E}(\xi_t \mid \Psi_{t-1}) = \hat{\xi}_{t|t-1} \quad (16)$$

Next consider forecasting the value of $y_t$:

$$\hat{y}_{t|t-1} \equiv \hat{E}(y_t \mid z_t, \Psi_{t-1})$$

Notice from (11) that

$$\hat{E}(y_t \mid z_t, \xi_t) = A'z_t + H'\xi_t,$$

from the law of iterated projections,

$$\hat{y}_{t|t-1} = A'z_t + H' \cdot E(\xi_t \mid z_t, \Psi_{t-1}) = A'z_t + H'\hat{\xi}_{t|t-1} \quad (17)$$

from (11) the error of this forecast is

$$y_t - \hat{y}_{t|t-1} = A'z_t + H'\xi_t - A'z_t - H'\hat{\xi}_{t\}t-1} = H'(\xi_t - \hat{\xi}_{t|t-1}) \quad (18)$$

with *MSE*

$$E\left[\left(y_t - \hat{y}_{t|t-1}\right)\left(y_t - \hat{y}_{t|t-1}\right)'\right] = E\left[H'\left(\xi_t - \hat{\xi}_{t|t-1}\right)\left(\xi_t - \hat{\xi}_{t|t-1}\right)'H\right] = H'P_{t|t-1}H \quad (19)$$

***Using the Kalman Filter to evaluate the log likelihood function***

$$y_t \mid z_t, \Psi_{t-1} \sim N\left(\left(A'z_t + H'\hat{\xi}_{t|t-1}\right), \left(H'P_{t|t-1}H\right)\right), \quad (20)$$

That is

$$L = -\frac{T}{2}\log 2\pi - \frac{1}{2}\sum_{t=1}^{T}\log\left|H' P_{t|t-1} H\right| - \frac{1}{2}\sum_{t=1}^{T}\left(y_t - A' z_t - H'\hat{\xi}_{t|t-1}\right) \times \left(H' P_{t|t-1} H\right)^{-1}.\left(y_t - A' z_t - H'\hat{\xi}_{t|t-1}\right) \quad (21)$$

or *t = 1, 2, …, T.*

***Forecasting State Space Vector***

The Kalman filter is motivated as an algorithm for calculating a forecast of the state vector $\xi_t$ as a linear function of previous observations. Based on a full set of observed data, the value of $\xi_t$ can be forecasted. Such a procedure is called the smoothed estimates of $\xi_t$, denoted

$$\hat{\xi}_{t|T} = \hat{E}(\xi_t \mid \Psi_t)$$

The *MSE* of this smoothed estimate is denoted

$$P_{t|\tau} = E\left[\left(\xi_t - \hat{\xi}_{t|T}\right)\left(\xi_t - \hat{\xi}_{t|T}\right)'\right]$$

In general, $P_{t|\tau}$ denote the *MSE* of an estimate of $\xi_t$ that is based on observation of y, x, and z through date $\tau$. We produce here the key equations for the Kalman filter:

$$\hat{\xi}_{t|t} = \hat{\xi}_{t|t-1} + P_{t|t-1} H (H' P_{t|t-1} H)^{-1}\left(y_t - A' z_t - H'\hat{\xi}_{t|t-1}\right) \quad (22)$$

$$\hat{\xi}_{t+1|t} = F\hat{\xi}_{t|t} + A'\hat{x}_{t+1|t} \quad (23)$$

$$P_{t|t} = P_{t|t-1} - P_{t|t-1} H (H' P_{t|t-1} H)^{-1} H' P_{t|t-1} \quad (24)$$

$$P_{t+1|t} = F P_{t|t} F' + Q \quad (25)$$

Consider the estimate of $\xi_t$ based on observation through date *t*, $\hat{\xi}_{t|t}$. Suppose we were subsequently told the true value of $\xi_{t+1}$. From the formula for updating a linear projection, the new estimate of $\xi_t$ could be expressed as

$$\hat{E}(\xi_t \mid \xi_{t+1}, \Psi_t) = \hat{\xi}_{t|t} + \left\{E\left[\left(\xi_t - \hat{\xi}_{t|t}\right)\left(\xi_{t+1} - \hat{\xi}_{t+1|t}\right)'\right]\right\}\left\{E\left[\left(\xi_{t+1} - \hat{\xi}_{t+1|t}\right)\left(\xi_{t+1} - \hat{\xi}_{t+1|t}\right)'\right]\right\}^{-1} \times \left(\xi_{t+1} - \hat{\xi}_{t+1|t}\right). \quad (26)$$

The first term in the product on the right side of (26) can be written

$$E\left[\left(\xi_t - \hat{\xi}_{t|t}\right)\left(\xi_{t+1} - \hat{\xi}_{t+1|t}\right)'\right] = E\left[\left(\xi_t - \hat{\xi}_{t|t}\right)\left(F\xi_t + v_{t+1} - F\hat{\xi}_{t|t}\right)'\right]$$

Furthermore, $v_{t+1}$ is uncorrelated with $\xi_t$ and $\hat{\xi}_{t|t}$. Thus,

$$E\left[\left(\xi_t - \hat{\xi}_{t|t}\right)\left(\xi_{t+1} - \hat{\xi}_{t+1|t}\right)'\right] = E\left[\left(\xi_t - \hat{\xi}_{t|t}\right)\left(\xi_t - \hat{\xi}_{t|t}\right)' F'\right] = P_{t|t} F' \quad (27)$$

Substituting (27) and the definition of $P_{t+1|t}$ into (26) produce

$$\hat{E}(\xi_t \mid \xi_{t+1}, \Psi_t) = \hat{\xi}_{t|t} + P_{t|t} F' P_{t+1|t}^{-1}\left(\xi_{t+1} - \hat{\xi}_{t+1|t}\right), \text{ or} \quad (28)$$

$$\hat{\xi}_{t/T} = \hat{\xi}_{t|t} + P_{t|t}F'P_{t+1|t}^{-1}\left(\xi_{t+1} - \hat{\xi}_{t+1|t}\right). \quad (29)$$

The period of the study is covering from January 1995 to December 2017. The broad money is collected from the National Bank of Cambodia. The consumer price indexes are collected from the International Financial Statistics (IFS) of the International Monetary Funds (IMF). Yearly GDP data are also extracted from the IFS. Monthly data of GDP are derived from cubic interpolation.

### 3.2. Research Design

In addition to the econometric model, in order to forecast the circulations of US dollar currency outside the banking system, a survey is utilized in this study to understand the perspective of Cambodians on dollarization and their prospective on ASEAN Currency that is likely to happen in the future.

Before the survey is officially sent out, thirty people are randomly selected to test the questionnaire. During the questionnaire is being completed, time control is used to observe the length of time required to complete the form. In the meanwhile, doubts regarding the questions within the questionnaire are raised by the thirty people will be recorded and used in helping to improve the quality of the questionnaire. Upon the amendments of the survey form is completed, the survey process is started. The sample size for this study is 530 observations and the survey is conducted only in Phnom Penh city.

## 4. Research Result

After using the Maximum Likelihood method (BFGS/Marquardt steps) on a Kalman filter that has one observed or signal equation and has two state space equations, as well as monthly data from January 1995 until December 2017, the five parameters of this model are found as show in the following table:

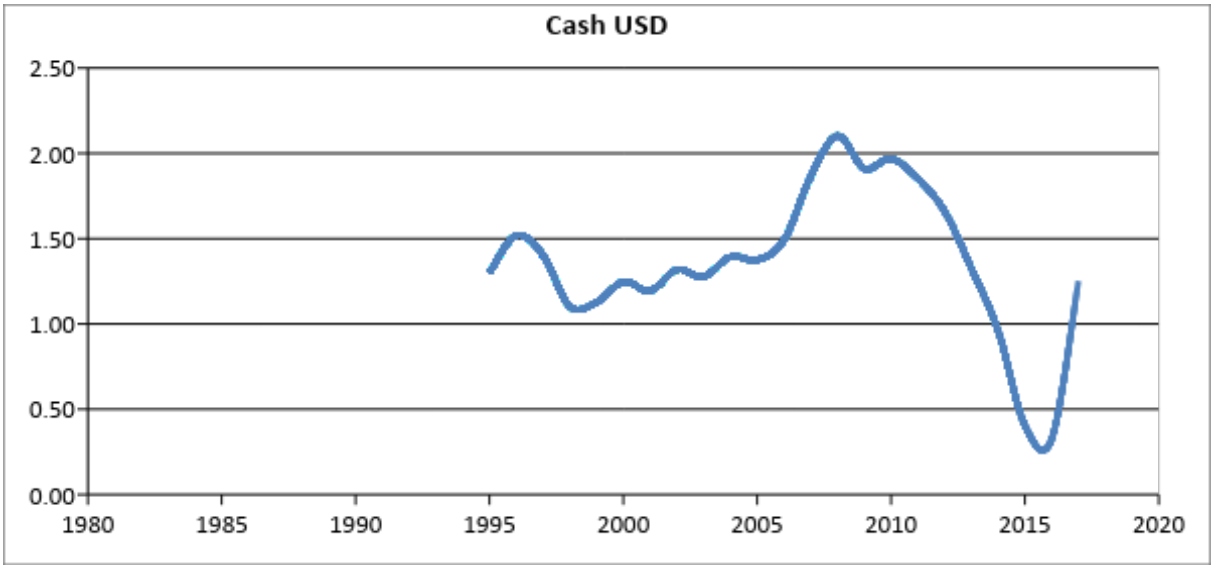
Sspace: KALMAN
Method: Maximum likelihood (BFGS / Marquardt steps)
Sample (adjusted): 1995M02 2017M12
Included observations: 275 after adjustments
User prior mean: SVEC0
Convergence achieved after 1 iteration
Coefficient covariance computed using outer product of gradients

| | Coefficient | Std. Error | z-Statistic | Prob. |
|---|---|---|---|---|
| C(1) | 0.996380 | 7.918620 | 0.125828 | 0.8999 |
| C(2) | 0.125957 | 418.2822 | 0.000301 | 0.9998 |
| C(3) | 0.052555 | 279.3852 | 0.000188 | 0.9998 |
| C(4) | 0.996380 | 7.174350 | 0.138881 | 0.8895 |
| C(5) | -0.000588 | 2.226367 | -0.000264 | 0.9998 |

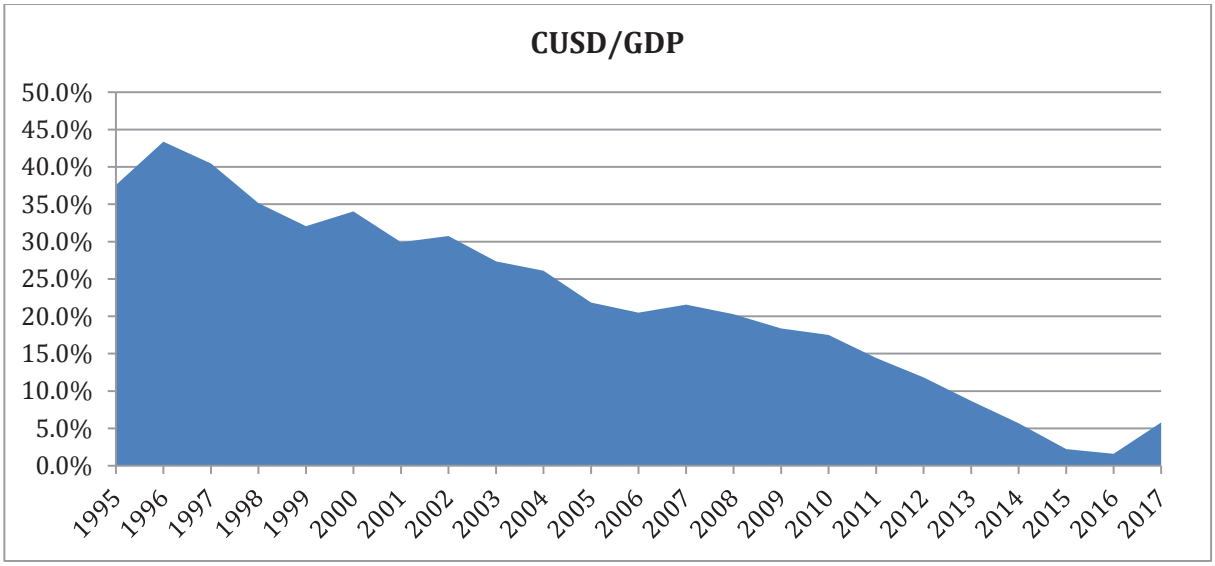
| | Final State | Root MSE | z-Statistic | Prob. |
|---|---|---|---|---|
| SV1 | 1.126318 | 260.9760 | 0.004316 | 0.9966 |
| SV2 | -0.919354 | 260.9760 | -0.003523 | 0.9972 |

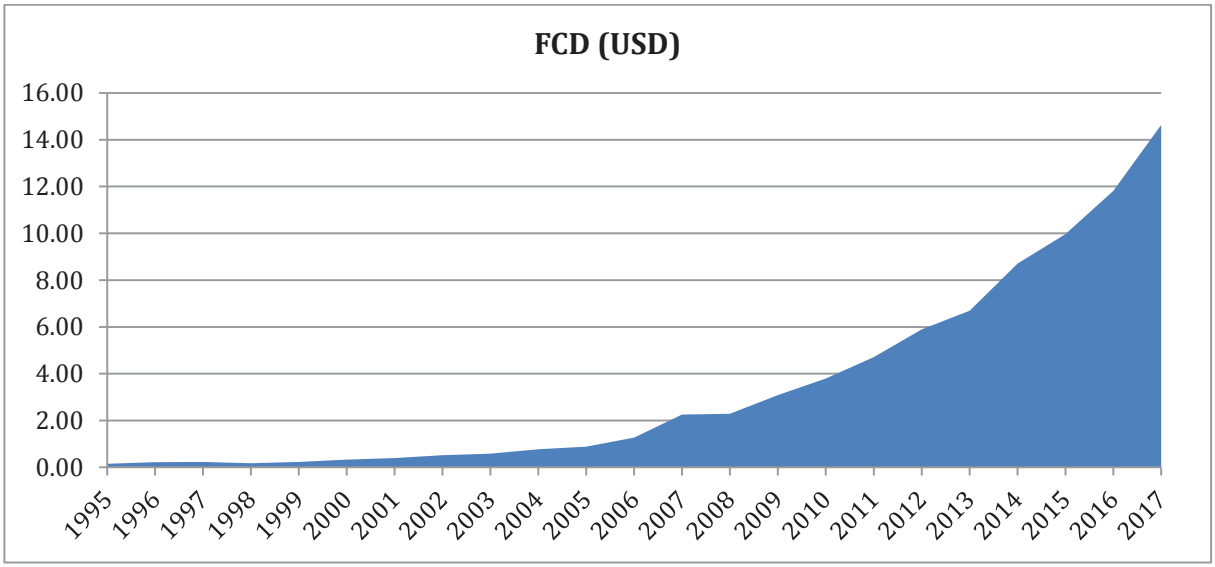
| | | | |
|---|---|---|---|
| Log likelihood | -354.9814 | Akaike info criterion | 2.618047 |
| Parameters | 5 | Schwarz criterion | 2.683806 |
| Diffuse priors | 2 | Hannan-Quinn criter. | 2.644438 |

The above results will be used to predict the values of k, known as the proportionality coefficient between the Riel and the US Dollar, and the value of V called Velocity is also predicted. Between 1995 and 2006, US Dollars were circulating outside the banking system in the Cambodian economy ranging from $1.2 billion to $1.5 billion, on average about 31.6 percent of GDP but between 2007 and 2010, the US Dollar in circulation rose to $2.1 billion, this could be caused by the global financial crisis, which led to less confident by the people toward banking system; thus, people hold more of cash US Dollar on hand, but since 2011 the US Dollar in circulation has dropped from $1.85 billion in 2011 to $324 million in 2016 due to the increase in confidence as well as the use of the banking system. But due to uncertainties in Cambodian politics, US Dollar in circulation has risen to $ 1.25 billion in 2017.



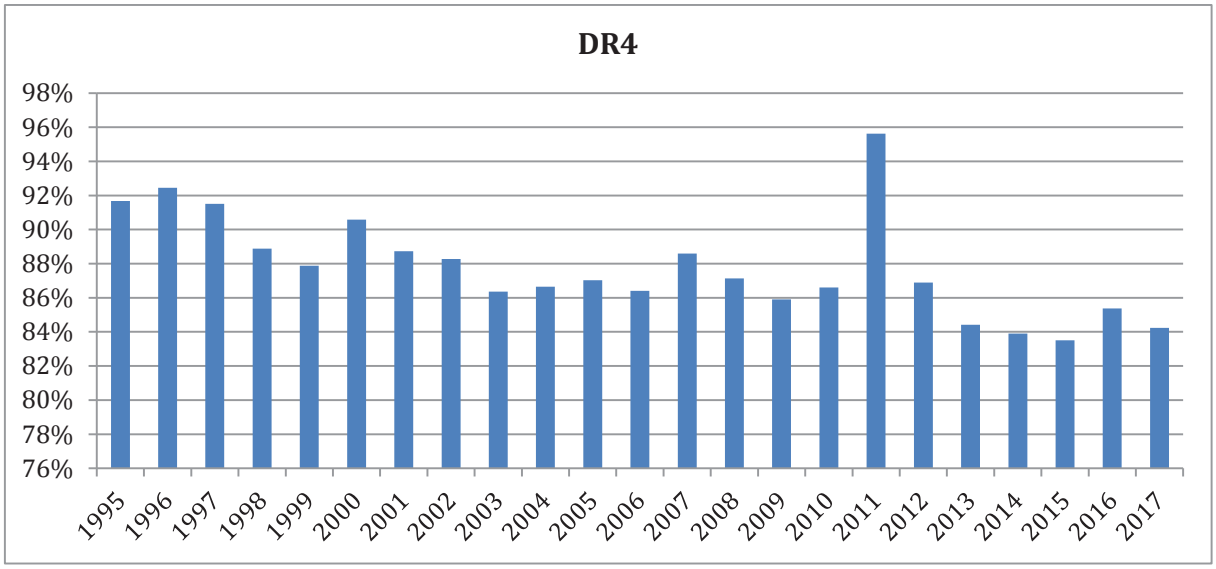

In the last two to three years, the ratio of US Dollar in circulation to GDP was 2.2%, 1.6% and 5.8% in 2015, 2016 and 2017, respectively. The decline in cash US Dollar in circulation can be explained by the increase in foreign currency deposits that continue to grow every year. As of the end of 2017, the amount of foreign currency deposits reached $ 14.82 billion.




Whereas the level of dollarization as measured by the divided between the US Dollar in circulation plus foreign currency deposits by broad money plus US Dollar in circulation which is known as DR4, from 1995 to 2009, is high between 86% and 91%

During the same period, the results were slightly different compared to studies conducted by Zamaroczy and Sa (2002), as well as Lim (2011). The level of dollarized as measured by DR4, is about 86% between 2010 and 2017.



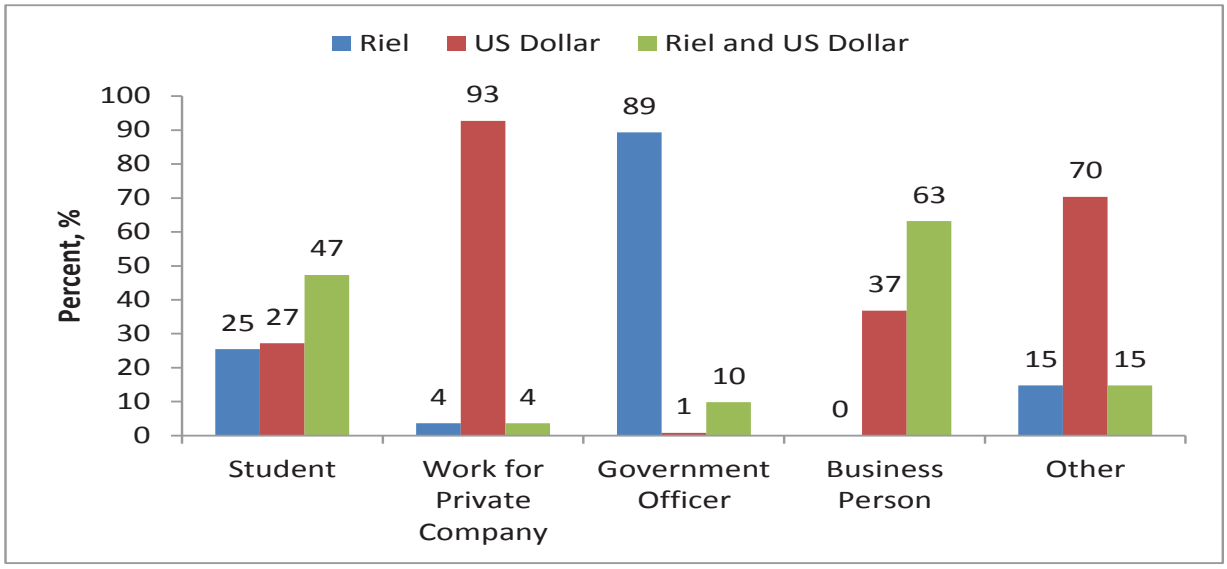

As noted above, the surveys were conducted only in Phnom Penh, with 530 respondents, 53.2% of female and 46.8% of males. Survey participants were divided into five groups, 42.3% is student, 26% works for private company, 23% is government officer, 3.6% is business person, and 5.1% is other and earnings are divided into 5 groups as well, 34.5% has income lower or equal to $ 200, the largest amount is 39.8% has income between $ 200 and $ 500, and 13.6%, 5.7%, 6.4% between $ 500 and $ 800, between $ 800 and $ 1,100 and more than $ 1,100, respectively.

| Sex | Frequency | Percent |
|---|---|---|
| Male | 248 | 46.8 |
| Female | 282 | 53.2 |
| Total | 530 | 100 |

| Occupation | Frequency | Percent |
|---|---|---|
| Student | 224 | 42.3 |
| Work for Private Company | 138 | 26 |
| Government Officer | 122 | 23 |
| Business Person | 19 | 3.6 |
| Other | 27 | 5.1 |
| Total | 530 | 100 |

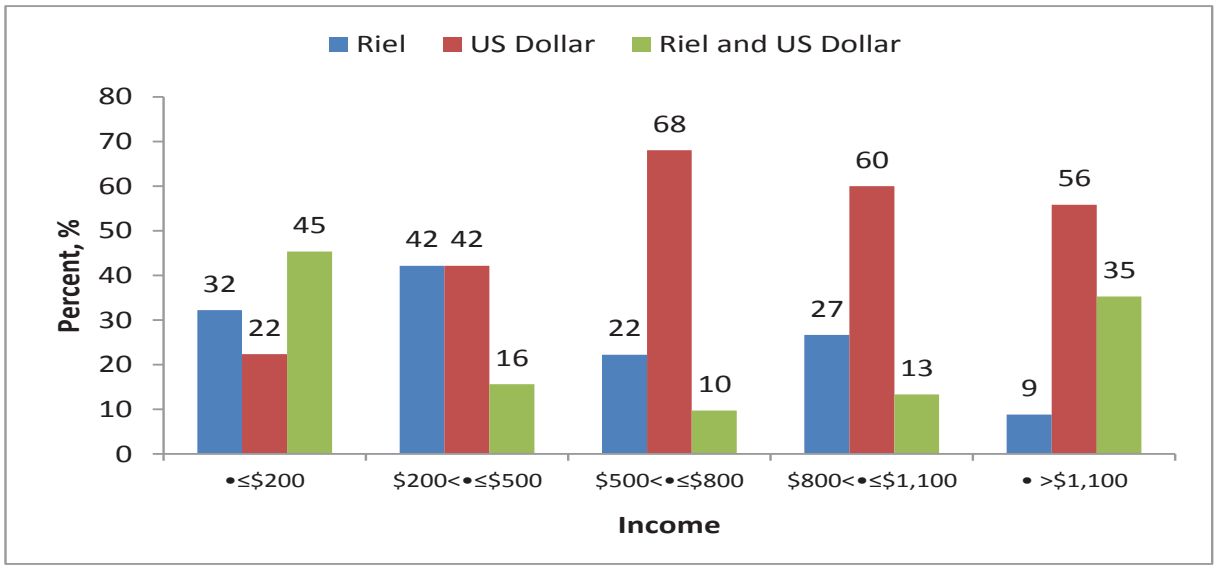
The income of the respondents were 40.8% received in US Dollars, the result is similar to previous research which was conducted by Reza and Chan (2014). The income earned in Riel was about 33%, while received in both Riel and US Dollar was 26.2%.

Those who earn income in Riel mostly are civil servants while those who earn income in US Dollar are work for private company. The results are not surprising given that the government pays salaries to civil servants in Riel and almost all private companies pay salary to employees in US Dollars.




The study found that the occupation has a relationship with income received by different currency because the value of Chi-square is $\chi^2(8df) = 410.04$ and the p-value is 0.00 lower than significant level of 1%. In addition, according to the value of Phi, $\emptyset$ = 0.88 the relationship of these two variables is high.

Of course, the higher the level of income, the higher the US Dollar earned, compared to the Riel. Those with income between $500 and $800 were 68% earning in US Dollars, but only 22% received in Riel and 10% received both Riel and US Dollar. Those with income ranged from $800 to $1,100 of which 27%, 60%, and 13% earned in Riels, in US Dollars, in Riels and in US Dollars, respectively. In addition, those with income more than $1,100 received income in Riel are only 9%, but received in US Dollar is 56%, while received in both Riel and US Dollar is 35%. For those who have income less than $200, mostly received in Riel which is 32%, 22% received in US Dollar and 45% received in both Riel and US Dollar. But for those who earn between $200 and $500, 42% earned in Riel which the same as the one who earned in US Dollar, and 16% earned in both Riel and US Dollar.

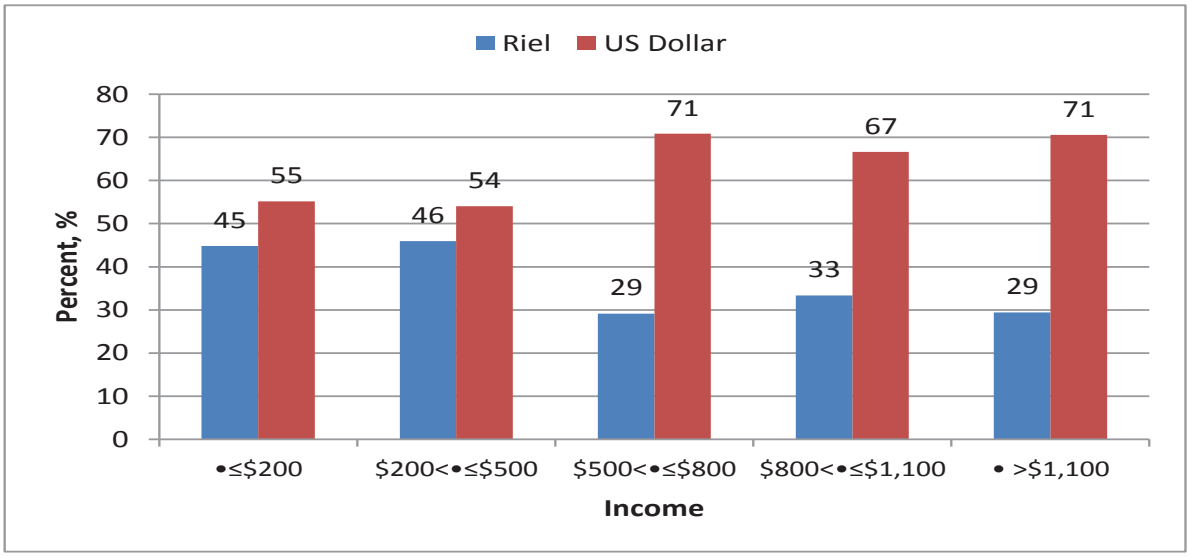


Based on the result of $\chi^2$(8df) = 92.356 and p-value = 0.000 and with significant level of 1% shows the relationship between income levels with the type of currency obtained, although the relationship between the two variables is moderate, according to Phi, $\emptyset$ = 0.417.

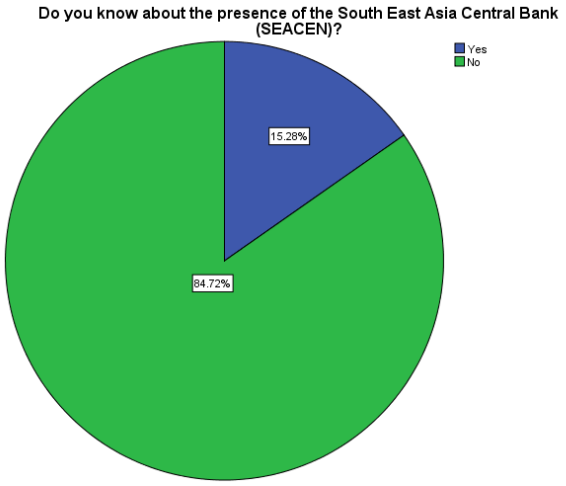
| | | What currency of your income do you earn? | | | |
|---|---|---|---|---|---|
| | | Riel | US Dollar | Riel and US Dollar | Total |
| When buying products or services, what currency do you always use? | Riel | 109 | 58 | 53 | 220 |
| | US Dollar | 66 | 158 | 86 | 310 |
| Total | | 175 | 216 | 139 | 530 |

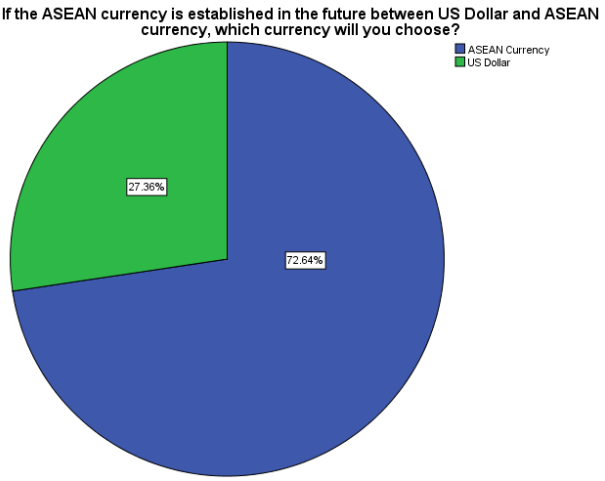
The matching between those who earned and spent in Riel is found to be 62% (109/175) and the mismatch is 38% (66/175) among those earned in Riel but spent in US Dollar. But the matching between those who earned and spent in US Dollar is found to be 73% (158/216), while the mismatch is found to be only 27% (58/216).

When buying goods or services 58% of the people always use US Dollar and 42% use Riel. In addition, in each income group, all spent in US dollars more than Riel especially high income people 71%, 61% and 71% the income range between $500 and $800, between $800 and $1,100 and more than $1,100, respectively. This may be the exchange rate which set by the store owners is not appropriate as compare to the exchange rate which is determined by the market since 79.43% of the respondents had agree the unfairness of the exchange rate quoted in the store if customers choose to pay in Riel.

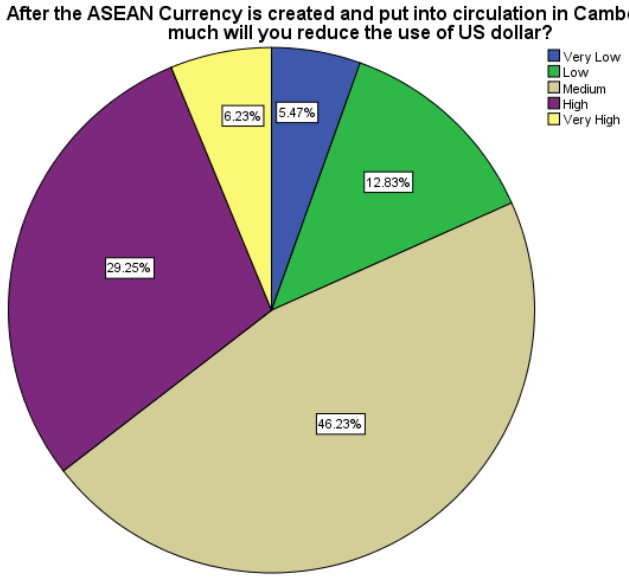



More than 52.26% of those who earned income in Riel will convert the income earned into US Dollar more than 30%, but only 36.42% of the people who earned income in US Dollar will convert the income earned into Riel more than 30%. This result could be concluded that people prefer to hold US Dollar than Riel because using US Dollar for daily life and business is easier than in using Riel.




About 84.72% of Cambodian people do not know the present of the South East Asia Central Bank (SEACEN). But when asking to choose between the ASEAN Currency and the US Dollar, 72.64% of the people decided to choose ASEAN Currency, while 27.36% decided to choose US Dollar.




If the ASEAN Currency is created and put into circulation in Cambodia, 29.25% of the people highly reduce the use of US Dollar and 6.23% will reduce in a very high level, while 46.23%, 12.83% and 5.47% will reduce in medium, low and very low, respectively.

## 5. Conclusion

Dollarization remained high in Cambodia, with an average of 86% between 2010 and 2017 as measured by DR4. However, the ratio of US Dollar in circulation outside banks to GDP is low: 2.2 percent in 2015, 1.6 percent in 2016 and 5.8 percent in 2017. This could be explained by a surge in foreign currency deposits as of 2017, about $14.82 billion due to public confidence as well as the use of banking service increased.

The results of the survey showed that most people's income was earned in US dollars, especially those who work for private companies as well as those who income was high. Since the price of goods and services in the supermarket is determined mainly in US Dollars with the exchange rate set by the market owner is not appropriate and fair as compare to the market exchange rate, so most people exchange the earned income in Riel into US dollars and make payments for goods and services purchased in US Dollars. The same reason has also been made for those who income earned in US Dollar tend to exchange small amount of money into Riel, thus prefer to hold more of US Dollar. This research result can be a signal of Network Externality as explained by Valev in 2010.

To facilitate payment of purchases of goods and services in supermarkets or stores in Riel, the mechanism to determine the exchange rate should be initiated by the Royal Government of Cambodia in which the National Bank of Cambodia plays an important role as the monetary authority to ensure fairness for buyers and sellers when the Riel is used to pay for goods and services. When the fair and appropriate exchange rate is determined, this can be used as a strategy to promote the use of Riel and to reduce the use of US dollar as well as reducing level of dollarization. Moreover, this strategy might have convinced the person who receives income in Riel does not have to convert to US Dollar and the payment directly is done in the Riel.

Only a small number of Cambodians know about the presence of the South East Asia Central Bank, but if the ASEAN currency is created, 72.64% chose the ASEAN currency and only 27.36% chose the US dollar. At the same time, reducing the use of the US dollar would be more likely if the ASEAN currency is established.

## References

Galinda, A., & Leiderman, L. (2005). Living with Dollarization and the Route to Dedollarization. *IDB Working Paper*.

Lim, S. (2011). *Dollarization and the Effectiveness of Monetary Policy in Cambodia.* Bangkok, Thailand: Thailand Research Fund.

Odajima, K. (2017). *Dollarization in Cambodia: Behavior of Households and Enterprises in a Highly Dollarized Environment.* Tokyo, Japan: JICA Research Institute.

Reinhart, C., Rogoff, R., & Savastano, M. (2003). Addicted to Dollar. *NBER Working Paper*.

Reza, S. Y., & Chan, N. (2014). Factors behind Foreign Currency Holding by Households in Cambodia. *CAMA Working Paper*.

Valev, N. (2010). The Hysteresis of Currency Substitution: Currency Risk vs. Network Externalities. *Journal of International Money and Finance*, 224-235.

Zamaroczy, D. M., & Sa, S. (2002). *Macroeconomic Adjustment in a Highly Dollarized Economy.* Washington DC: International Monetary Fund.