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Hard pegs versus intermediate currency arrangements in the Pacific

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Hard Pegs versus Intermediate Currency Arrangements in the Pacific

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Abstract

The 14 Pacific developing member countries (DMCs) of the Asian Development Bank (ADB) have opted for very different exchange rate regimes with varying degrees of flexibility. Whereas several microstates have adopted an external currency as their legal tender, others have decided to use a basket currency and yet others have chosen a managed float. The choice of exchange rate regime can have far reaching economic consequences. In this paper, we first build a simple exchange rate model that illustrates how monetary authorities should best determine the weights of the basket currencies in order to keep fluctuations in gross domestic product (GDP) and in exchange rates to a minimum. We add to the literature by explicitly modeling tourism flows. In the second part of the paper we study the recent developments of the Pacific DMCs in terms of the volatility of their exchange rates, their GDP and their balance of trade. We find that Pacific DMCs with external currencies systematically exhibit lower GDP volatility compared to Pacific DMCs with basket currencies or floats. We conclude that Pacific DMCs with basket currencies or floats seem to have managed their exchange rate with the objective to minimize fluctuations of exchange rates, rather than those of their GDP. Our model therefore provides valuable guidance for those monetary authorities in the Pacific that would like to lower GDP fluctuations.

JEL Classification: F31, F33

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1. INTRODUCTION

The Pacific developing member countries (DMCs) of the Asian Development Bank (ADB) are a heterogeneous group of economies. Their economic development differs strongly; the gross domestic product (GDP) per capita ranges from about \$1,000 in Timor-Leste to more than \$20,000 in the Cook Islands. Similarly, the size of the economies differs dramatically, with a GDP of \$38 million in Tuvalu compared to \$15.468 million in Papua New Guinea (PNG). However, when it comes to optimal exchange rates, the Pacific DMCs are faced with similar challenges.

First, all of the Pacific economies are small and, with the exception of PNG, can be defined as microstates, as they have less than 2 million inhabitants.¹ Second, most of them fall into the category of lower-middle-income countries by the definition of the World Bank.² These factors make it difficult to allocate the necessary financial and technical resources to establish and run a central monetary authority. A third similarity among Pacific economies that limits their exchange rate choice is that they all have very underdeveloped financial markets. Fourth, exchange rate markets in the Pacific are typically shallow and tend to be highly volatile. All these elements make it difficult for countries to choose their optimal exchange rate regime.

Table 1 lists all Pacific DMCs and their exchange rate according to the International Monetary Fund (IMF) *de facto* classification (IMF 2013). Given the constraints explained above, it is not surprising that most Pacific DMCs have exchange regimes that are characterized by a very low degree of flexibility. Eight out of 14 Pacific DMCs use the currency of another country as sole legal tender and have thus given up their monetary control (Table 1). All these Pacific DMCs have a population of less than 150,000, except for Timor-Leste with 1.3 million.

Table 1: Exchange Rate Arrangements in Pacific Developing Member Countries

Pacific DMC	Name of Currency	<i>De facto</i> classification (IMF)	Population	GDP per capita (\$)
Cook Islands	New Zealand dollar	External currency	15,225	21,490
Federated States of Micronesia	US dollar	External currency	102,908	3,057
Fiji	Fiji dollar	Currency basket	863,073	4,652
Kiribati	Australian dollar	External currency	111,117	1,528
Marshall Islands	US dollar	External currency	54,550	3,333
Nauru	Australian dollar	External currency	10,660	7,502
Palau	US dollar	External currency	17,862	13,761
Papua New Guinea	kina	Managed floating	7,570,686	2,043
Samoa	tala	Currency basket	187,372	3,641
Solomon Islands	Solomon Islands dollar	Currency basket	626,247	1,858
Timor-Leste	US dollar	External currency	1,306,000	1,063
Tonga	pa'anga	Currency basket	103,347	4,619
Tuvalu	Australian dollar	External currency	11,099	3,434
Vanuatu	vatu	Managed floating	271,089	2,951

DMC = developing member country; GDP = gross domestic product; IMF = International Monetary Fund.

Note: Population and economic figures are from 2013.

Source: International Monetary Fund (2013); Asian Development Outlook Database (2015).

¹ Countries with fewer than 2 million inhabitants are typically referred to as microstates (Imam 2010).

² For 2013, the World Bank defined lower-middle-income economies as those with a GNI per capita, calculated using the World Bank Atlas method, of more than \$1,036 but less than \$4,085.

Several of the larger Pacific economies maintain exchange rate regimes that offer more flexibility. Four, namely Fiji, Samoa, the Solomon Islands and Tonga, have adopted a currency-basket regime. In a currency-basket regime the weights in the basket typically correspond to the importance of the respective trading or financial partners. Finally, two Pacific economies have an even more flexible regime in place. PNG and Vanuatu apply an exchange rate regime described as “managed floating,” in which the central banks manipulate the exchange rate without having a specific exchange rate path or target.

The objective of this paper is to study the exchange rate choices of the six economies that do not use an external currency. First, we will study how the exchange rate choice has affected the exchange rate and the volatility of economic output. Second, we will examine the weights of external currencies used in the currency baskets and in the other arrangements. Third, we will address whether the exchange rate policies have changed over time, and how they have done this. Finally, we will propose a new theoretical model to calculate the optimal weights for the pegs in a composite.

Our main findings are that the six Pacific DMCs have successfully established exchange rate policies that have kept the volatility of their currencies towards leading international currencies low. For the four Pacific DMCs with currency baskets the low exchange rate volatility translated into fast-changing weights in their currency baskets. Our results indicate that the main exchange rate policy target was thus to keep the volatility low and, to a much lesser extent, to adjust to changing patterns of economic and financial flows. As a consequence of this policy focus on exchange rate volatility, real economic activity played the role of shock absorber. The result was substantially higher levels of GDP volatility compared to the eight Pacific DMCs that use an external currency. We argue that high volatility in economic output should be avoided and propose a new theoretical approach to determine the optimal weights in the currency basket to lower fluctuations of economic output.

The paper is structured as follows: after the literature review, Section 3 presents a simple, theoretical model that allows the optimal weights in the currency basket to be calculated, taking into account not only trade in goods, but also trade in services. Section 4 studies how the exchange rates of the six Pacific DMCs have developed in recent years. We then empirically assess the weights of external currencies for the countries with a currency basket. For PNG and Vanuatu we try to detect whether their exchange rate policies include any element of a peg towards a composite. In Section 5 we look at exchange rate volatility as well as fluctuations of GDP and compare it to the volatility in the eight Pacific DMCs that use foreign legal tenders. Before concluding, Section 6 presents various simulations of optimal shares assuming certain loss functions.

2. LITERATURE REVIEW

The literature on optimal exchange rate policy is vast and has been constantly expanding and developing. As a consequence, recommendations by leading international organizations on optimal exchange rate policy choices for developing countries have also been evolving. In the 1990s it became popular for developing and emerging economies to peg the exchange rate against a strong currency. However, the Asian financial crisis of 1997 showed the risk of such a policy. Sharp reversals of capital inflows triggered the collapse of several Asian currencies and led to sharp economic contraction. After the financial crisis the IMF tended to recommend either fully floating regimes or hard pegs. This became known as bipolar prescription (Ghosh

and Ostry 2009). Intermediate regimes, such as crawling arrangements or managed floats, were not advised since leading economists, such as Obstfeld and Rogoff (1995), argued that they made countries more vulnerable to crisis.

Following the bipolar prescription, many countries did indeed abandon intermediate regimes and adopted more flexible regimes. However, this trend came to an end in 2004 (Ghosh et al. 2014). Increasingly, emerging countries started to fear that a freely floating exchange rate could lead to strong currency volatility, which could be deleterious to economic growth. In addition, IMF research indicated that historically, intermediate exchange rate regimes exhibited the best growth performance (Ghosh and Ostry 2009). Their research into the global financial and economic crisis that began in 2007 also indicated that, for emerging countries in Europe, hard pegs triggered strong declines in economic output and harsh current account reversals. The adequacy of hard pegs to weather economic shocks was thus called into question again.

Today, the majority of countries in the world have an intermediate exchange rate regime in place. Latest research by the IMF suggests that intermediate regimes are more vulnerable to crisis than free floats (Ghosh et al. 2014). However, given that central bankers in developing countries have a preference for at least some control over the exchange rate, Ghosh et al. (2014) recommend managed floats, as they offer almost the same advantages as pure floats.

While at the international level there seems to be a preference for more intermediate regimes, for microstates, such as most of the Pacific DMCs, the choice is less clear. According to Imam (2010) there are several reasons why microstates usually fare better with a fixed exchange rate regime. First, microstates typically lack the necessary institutional infrastructure to operate monetary policy, including the qualified professional staff necessary to manage a central bank. Second, as financial markets are typically underdeveloped in microstates, monetary policy will be largely driven by exchange rate considerations and therefore cannot be used proactively to influence economic activity. Third, the volatility of the exchange rate can be excessive because foreign exchange markets are illiquid. As a result, floating exchange rates in microstates are likely to become *de facto* fixed over time, with the authorities intervening to smooth fluctuations. Fourth, central banks of microstates typically lack credibility, resulting in a “fear of floating” and high levels of dollarization. A hard peg thus allows microstates to import credibility. And finally, microstates are often sufficiently well integrated with the former colonial power or regional partner that they almost naturally form an optimum currency area with them.

These reasons explain why the empirical literature of monetary policy choices in the Pacific DMCs often recommends the adoption of an external currency. For example, Freitag (2011), in his review of the currency and trade experiences of the six Pacific states that issue their own currencies (Fiji, PNG, Samoa, the Solomon Islands, Tonga and Vanuatu), finds that a large and increasing proportion of the trade, and thus the reserves, of these countries is denominated in US dollars. Using gravity model estimation, he suggests that these Pacific states should replace their own currencies with the US dollar as it would substantially stimulate the countries’ trade and accelerate economic growth. In addition, dollarization would reduce transaction costs with East Asia and for most trade in global resources. Furthermore, he argues that the loss of seigniorage would be outweighed by cost savings in operating central banks.

However, as alluded to earlier in the paper, a pegged regime has disadvantages as well as advantages. As Ghosh and Ostry (2009) explain, pegged regimes severely constrain the use of other macroeconomic policies following the logic of the “impossible

trinity.” In addition, pegged regimes are associated with greater susceptibility to currency and financial crises (but countries with floating regimes are not entirely immune). Finally, pegged and intermediate exchange rate regimes impede timely external adjustments.

Despite the arguments against pegged regimes, all Pacific DMCs with a population of less than 150,000 (and Timor-Leste, with a much larger population) have decided to adopt an external currency (see Table 1). For those eight countries the perceived benefits of using an external currency outweigh the expected costs. Assuming their choice as given, one might ask whether the external currency is the optimal one and whether, given the increasing integration with Asia, a switch in the external currency will be necessary in the near future.

The second most prominent exchange rate regime found in the Pacific DMCs is currency baskets. The IMF defines a basket currency as a currency that bases its value on a portfolio of other currencies with different weights (Dutttagupta et al. 2005). The basket is formed from the currencies of major trading or financial partners and weights reflect the geographical distribution of trade, services, or capital flows. A basket currency is sometimes also called soft-peg policy since the value of the currency is pegged on several major currencies instead of just one.

Yoshino et al. (2004) explain the advantages and disadvantages of having a basket currency policy. There are two positive aspects. First, the exchange rate fluctuations are typically lower than a hard-peg since the exchange rate risk is more dispersed. Second, the weights in the basket may be used as an additional policy tool to achieve a given exchange rate objective. Authorities can minimize the deviation from their policy goal by choosing the values for these weights accordingly. This need for frequent, if not constant, readjustment can be positive or negative. It is positive if the composition of the basket moves in the direction targeted by the monetary authorities, since the monetary authorities do not then need to intervene in the market and can save the foreign reserves using minimal effort to stabilize the value of the currency. However, if the movement goes in the opposite direction, then the monetary authorities need to adjust the weights of the currencies in the basket, which can be costly in terms of foregoing foreign reserves. Finally, there is an important caveat. In order to realize the advantages of a currency basket, the country should denominate trade in the different currencies. Even if the effects on the exchange rates are more dispersed, countries will not gain from the basket if their use of currencies in trade is not correspondingly diverse.

For Pacific DMCs with a currency basket the question is whether the weights in the basket reflect the current trade patterns. According to economic theory the external currency of choice should be the currency of the major trade and finance partner. For the Pacific DMCs, financial links with the rest of the world are not well documented. This contrasts with documentation on trade flows. We have therefore chosen to study the flows of trade in goods and services to evaluate the appropriateness of the weights in the currency baskets.

Finally, two countries, PNG and Vanuatu, maintain a managed float. According to Ghosh et al. (2014), managed floats can be as safe as full floats if they guarantee almost full flexibility. This means that the countries not only have to apply a *de jure* managed float, but also *de facto*, otherwise there is an increased probability of a financial crisis.

In summary, the literature on optimal exchange rate regimes has evolved over the past 2 decades and so have the exchange rate choices of countries around the world. Most of the smaller Pacific DMCs have opted for an external currency as legal tender. There

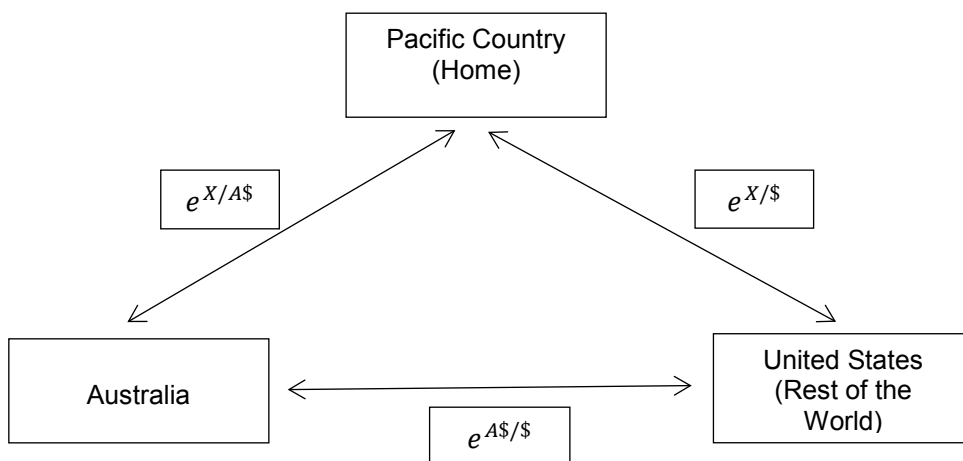
are strong arguments in favor of this choice. The focus of this paper is on the countries that have adopted a more flexible regime, either a currency basket or a managed float. The literature suggests that both intermediate regimes can yield benefits. At the same time they carry risks and are not always easy to implement. In the next section, we propose a simple theoretical model to calculate the optimal basket weights given a loss function of the government that aims to minimize fluctuations of GDP and of exchange rates.

3. THE OPTIMAL BASKET WEIGHTS

Yoshino et al. (2003) argue that managing the shares in the basket currency optimally can help the government to reduce GDP volatility. We build on their model and extend it by explicitly modelling trade in services and by enhancing the loss function (Figure 1). In the end, we are able to propose optimal weights for the basket currencies of Pacific DMCs. Our model also shows that a currency basket, if properly managed, will always yield better outcomes in terms of reducing GDP volatility than an external currency.

For the sake of analytical clarity, we assume that the currency basket contains only two currencies, namely the US dollar and the Australian dollar. The shares of these two currencies in the basket determine the value of the exchange rate of the domestic currency (X) towards all foreign currencies. Furthermore, we assume that there are three countries: the Pacific country, Australia, and the United States (US). The Pacific country is labelled “Home.” We assume that domestic and foreign assets are imperfect substitutes, whereas US and Australian assets are perfect substitutes for domestic investors.

Figure 1: Tripartite Exchange Rate Relationship Chart



Source: Authors.

Let $e^{X/USD}$, $e^{X/AUD}$ and $e^{AUD/USD}$ denote the exchange rate of the Pacific currency against the US dollar, the Pacific currency against the Australian dollar, and the Australian dollar against the US dollar. Because one of the three exchange rates is not independent, the Pacific currency–US dollar exchange rate can be expressed as:

$$e^{X/\$} = e^{X/A\$} + e^{A\$/\$} \tag{1}$$

We assume that the monetary authority would adjust money supply by intervening in the foreign exchange market in order to maintain the value of the basket at a constant

level θ . If v is the weight of the US dollar and $(1 - v)$ is the weight of the Australian dollar in the basket, then the value of the basket can be described as:

$$ve^{X/\$} + (1 - v)e^{X/A\$} = \theta \quad (2)$$

Inserting equation (1) into equation (2) we can rewrite $e^{X/\$}$ and $e^{X/A\$}$ as follow:

$$e^{X/\$} = \theta + (1 - v)e^{A\$/\$} \quad (3)$$

$$e^{X/A\$} = \theta - ve^{A\$/\$} \quad (4)$$

We assume that the main policy objective of Pacific governments when managing their exchange rate policy is to minimize the exchange rate volatility against both the US dollar and the Australian dollar as well as the GDP volatility. The government objective function can be written as follows:

$$\text{Min } w_1(e^{X/\$} - \bar{e}^{X/\$})^2 + w_2(e^{X/A\$} - \bar{e}^{X/A\$})^2 + (1 - w_1 - w_2)(y - \bar{y})^2 \quad (5)$$

where $0 \leq w_1 + w_2 \leq 1$.

w_1 , w_2 , and $(1-w_1-w_2)$ denote the weight that a government can attribute to the stability of the domestic currency to the US dollar–Australian dollar exchange rates, and output stability, respectively.

We further assume that the GDP fluctuations are a function of the deviation of the interest rate (r), of government spending (G), and of the current account (CA) from their initial targets (denotes by \bar{r} , \bar{G} , and \bar{CA} respectively). The fluctuations in the current account come from the fluctuations of the balance of trade and the revenues from tourism. These relationships can be expressed as follows:

$$(y - \bar{y}) = c_0 + c_1(r - \bar{r}) + c_2(G - \bar{G}) + c_3(CA - \bar{CA}) \quad (6)$$

$$(CA - \bar{CA}) = (BT - \bar{BT}) + (TOUR - \bar{TOUR}) \quad (7)$$

where $c_2, c_3 > 0$ and $c_1 < 0$.

In this paper we assume that the fluctuation of the balance of trade is a function of the fluctuation of GDP (that represents the fluctuation of domestic demand and production capability) and of exchange rates in terms of the US dollar and the Australian dollar. The fluctuation of revenues from tourism inflow, however, is a function of exchange rates and demand from the rest of the world. These assumptions take the following mathematical form:

$$(BT - \bar{BT}) = a_0 + a_1(y - \bar{y}) + a_2(e^{X/\$} - \bar{e}^{X/\$}) + a_3(e^{X/A\$} - \bar{e}^{X/A\$}) \quad (8)$$

$$(TOUR - \bar{TOUR}) = b_0 + b_1(e^{X/\$} - \bar{e}^{X/\$}) + b_2(e^{X/A\$} - \bar{e}^{X/A\$}) + b_3(Y_w - \bar{Y}_w) \quad (9)$$

Solving for the first order condition, $\partial L/\partial v = 0$, we obtain the optimal weight of US dollars in the basket as follow:

$$v = [(w_1 + w_2 + (1 - w_1 - w_2)(l^2k^2 + lk^2))e^{A\$/\$}]^{-1} \left[(w_1 + (1 - w_1 - w_2)(a_2 + b_1)(l^2k + lk)) \left(\theta + e^{A\$/\$} - \bar{e}^{\frac{X}{\$}} \right) + (w_2 + (1 - w_1 - w_2)(a_3 + b_2)(l^2k + lk)) \left(\theta - \bar{e}^{\frac{X}{A\$}} \right) + (1 - w_1 - w_2) \frac{(l^2k + lk)}{c_3} (c_0 + c_3(a_0 + b_0) + c_1(r - \bar{r})) + c_2(G - \bar{G}) + c_3b_3(Y_w - \bar{Y}_w) \right] \quad (10)$$

where

$$k = a_2 + a_3 + b_1 + b_2$$

$$l = \frac{c_3}{(1 - c_3a_1)}$$

From equation (10) we know that, other things being equal, the optimal weight of the US dollar in the basket (v) is positively correlated with G , θ and Y_w , and negatively with r and $\bar{e}^{\frac{X}{A\$}}$. It also moves inversely with the movement of the exchange rate $e^{A\$/\$}$. This model suggests that the monetary authority should revise the weight on a more regular basis to avoid GDP fluctuations, as the exchange rate $e^{A\$/\$}$ frequently changes.

4. ESTIMATING *DE FACTO* BASKET WEIGHTS

4.1 Ordinary Least Squares Regressions

In this section, we seek to better understand how monetary policy is undertaken in the six countries in our sample. Countries that have currency baskets do not typically publish any information about which foreign currencies are in the basket, nor their respective weights. This also applies to the four Pacific DMCs with basket currencies. The two other Pacific countries apply a managed float, which means that different tools are used to manage the currency.

Following the methodology introduced by Frankel and Wei (1994) one can estimate the *de facto* weight of the basket currencies or test whether other exchange rate arrangements actually follow basket currencies. The basic idea behind Frankel and Wei (1994) is that, in the case of a perfect basket peg, a simple ordinary least squares (OLS) regression analysis on the daily exchange rates against a numeraire currency will uncover the weights in the basket. In other words, the volatility of the Pacific currencies against the numeraire can be explained by the volatility of one or several potential anchor currencies. The estimation then takes the following form:

$$e_{i,t} = \alpha_i + \sum_{j=1}^N \beta_{i,j} e_{j,t} + u_{i,t} \quad (11)$$

In equation (11), the difference of logged exchange rates of the daily bilateral exchange rates of each Pacific DMC and other currencies in the basket are expressed by e_i and e_j respectively, while N denotes the number of different currencies in the basket.

In our case, we assume that the six Pacific DMCs might use the following currencies in their monetary baskets: the Australian dollar, the euro, the New Zealand dollar, the pound sterling, the US dollar, the won and the yen.³ The Canadian dollar is used as numeraire to measure the volatility of the exchange rates and thereby identify the basket currencies. For this analysis we downloaded the daily exchange rates from USForex and Bloomberg from January 1, 2001 to June 21, 2013.

We were able to download daily exchange rate data towards the Canadian dollar for all currencies of the Pacific DMCs except for the pa'anga. We therefore triangulated the data by using the pa'anga–US dollar and US dollar–Canadian dollar exchange rates. Likewise, there were numerous missing values for the exchange rates of the Solomon Islands dollar–Canadian dollar and tala–Canadian dollar. We thus applied the same approach to proxy the missing values. All data were converted into differenced log forms and smoothened by using the Hodrick–Prescott filter.

In the first attempt, we estimated the weight of each currency by pooling all observations and estimating a simple OLS regression. The results are shown in Table 2. The four countries with basket currencies are listed first. The results suggest that Fiji uses a currency basket that consists mainly of the US dollar, New Zealand dollar, euro, and Australian dollar.⁴ For the Solomon Islands the results indicate that the Solomon Islands dollar was fully pegged against the US dollar, and these results are supported by other studies, such as Wood (2010). For Tonga, the regression suggests that the pa'anga was pegged mainly to the US dollar and, to a lesser extent, (around 20%) to the Australian dollar and New Zealand dollar. According to our estimation, the tala was oriented towards a very similar currency basket, but with a relatively higher weight for the New Zealand dollar and a lower weight for the US dollar. For all four Pacific DMCs with a currency basket, our simple pooled regressions explain more than 50% of the variations.

When we apply the same methodology to the two countries with a managed float arrangement (last two columns), R^2 drops to less than 10%. To uncover the main determinants of managed floats thus requires more analysis. Our regression results seem to show that the Australian dollar, the New Zealand dollar and the US dollar are important points of reference for exchange rate policy in PNG. (In managed floats negative signs in the regression can appear when a country purposely moves against another currency). For Vanuatu, the pound sterling, the yen and particularly the US dollar are the main anchors in terms of exchange rate policies.

³ We did not include the yuan as a possible foreign currency in the basket because during our period of analysis, the yuan was pegged almost 100% to the US dollar (Yoshino et al. 2014). This peg would cause a multi-collinearity problem in our estimation.

⁴ The small, statistically significant, but negative results for pound sterling and the won are difficult to interpret.

Table 2: Estimates of the Currency Weights in the Currency Baskets of Fiji, Papua New Guinea, Samoa, the Solomon Islands, Tonga, and Vanuatu

Variable	Direct Ordinary Least Squares					
	F\$	SI\$	T\$	ST	K	Vt
Constant	0.000** (2.426)	0.000*** (5.315)	0.000** (2.502)	0.000*** (-2.876)	0.000 (-0.763)	0.000 (-0.980)
A\$	0.230*** (9.958)	0.078*** (3.660)	0.179*** (9.129)	0.208*** (20.392)	1.129*** (3.150)	0.184 (1.586)
€	0.235*** (11.053)	-0.059*** (-2.996)	0.003 (0.163)	0.000 (-0.045)	-0.343 (-1.036)	-0.119 (-1.105)
£	-0.041** (-2.002)	-0.017 (-0.868)	0.065*** (3.683)	0.064*** (6.959)	0.598* (1.858)	0.489*** (4.685)
¥	0.022 (1.585)	0.029** (2.219)	-0.009 (-0.770)	0.005 (0.735)	-0.652*** (-3.010)	-0.183*** (-2.608)
W	-0.052*** (-3.334)	0.013 (0.887)	-0.044*** (-3.325)	0.025*** (3.649)	0.699*** (2.874)	0.051 (0.652)
NZ\$	0.302*** (16.222)	-0.026 (-1.518)	0.223*** (14.067)	0.296*** (35.965)	-1.193*** (-4.119)	-0.146 (-1.550)
\$	0.360*** (17.731)	0.984*** (52.439)	0.547*** (31.585)	0.398*** (44.291)	1.492*** (4.729)	0.959*** (9.362)
R ²	0.544	0.696	0.575	0.838	0.024	0.085

\$ = US dollar; A\$ = Australian dollar; € = euro; F\$ = Fiji dollar; K = kina; NZ\$ = New Zealand dollar; £ = pound sterling; SI\$ = Solomon Islands dollar; ST = tala; T\$ = pa'anga; Vt = vatu; W = won; ¥ = yen.

Note: Numbers in parentheses denote t-values; *** significant at 1% level; ** significant at 5% level; * significant at 10% level.

Source: Authors' calculations.

Our results can also be tested through backward OLS. This means that variables that do not enhance the model fit are eliminated stepwise until the most parsimonious model is reached. In addition, we employ a non-negativity constraint by removing variables with negative signs. The estimation results of the backward OLS regressions are listed in Table 3.

Overall, we see that the R²s in the backward OLS approach are very similar to the simple OLS approach, which indicates that we do not lose much information even when eliminating several variables. According to our backward OLS regressions, in all Pacific DMCs, the US dollar plays the most important role in their currency arrangements. In contrast, it seems that the two Asian currencies included, namely the yen and the won, have not gained popularity among the currency baskets of the Pacific DMCs.

Looking in more detail at Fiji, our regressions show that the Australian dollar and the euro take approximately the same share in the basket—each about 21%. The New Zealand dollar has an estimated weight of 29%, whereas the US dollar has a share of about 35% in the basket. In the case of the Solomon Islands, we again find that the currency is almost fully pegged against the US dollar with an estimated share of over 97%. Tonga and Samoa seem to conduct very similar exchange rate policies. The main basket currency appears to be the US dollar in both countries, with Tonga having 53% and Samoa, 40%. The next two currencies with the biggest share are the Australian dollar and the New Zealand dollar. Both countries also seem to have a small

share of pound sterling included, whereas the won is only present in Samoa, with a small percentage share of 3%.

Table 3: Estimates of the Currency Weights in the Currency Baskets of the Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, and Vanuatu

Variable	Backward Ordinary Least Squares					
	F\$	SI\$	T\$	ST	K	Vt
Constant	0.000** (2.094)	0.000*** (5.398)	0.000** (2.366)	0.000*** (-2.905)	0.000 (-0.401)	0.000 (-0.772)
A\$	0.215*** (9.467)	0.031** (2.231)	0.166*** (8.652)	0.208*** (20.541)		
€	0.214*** (12.579)					
£			0.063*** (4.213)	0.065*** (8.396)		0.381*** (4.759)
¥						
W				0.026*** (3.756)	0.512** (2.387)	
NZ\$	0.288*** (15.709)		0.217*** (13.912)	0.296*** (36.272)		
\$	0.349*** (21.812)	0.973*** (75.522)	0.525*** (36.500)	0.401*** (51.456)	0.932*** (4.082)	0.791*** (9.767)
R2	0.541	0.693	0.573	0.838	0.012	0.080

\$ = US dollar; A\$ = Australian dollar; € = euro; F\$ = Fiji dollar; K = kina; NZ\$ = New Zealand dollar; £ = pound sterling; SI\$ = Solomon Islands dollar; ST = tala; T\$ = pa'anga; Vt = vatu; W = won; ¥ = yen.

Note: Numbers in parentheses denote t-values; *** significant at 1% level; ** significant at 5% level; * significant at 10% level.

Source: Authors' calculations.

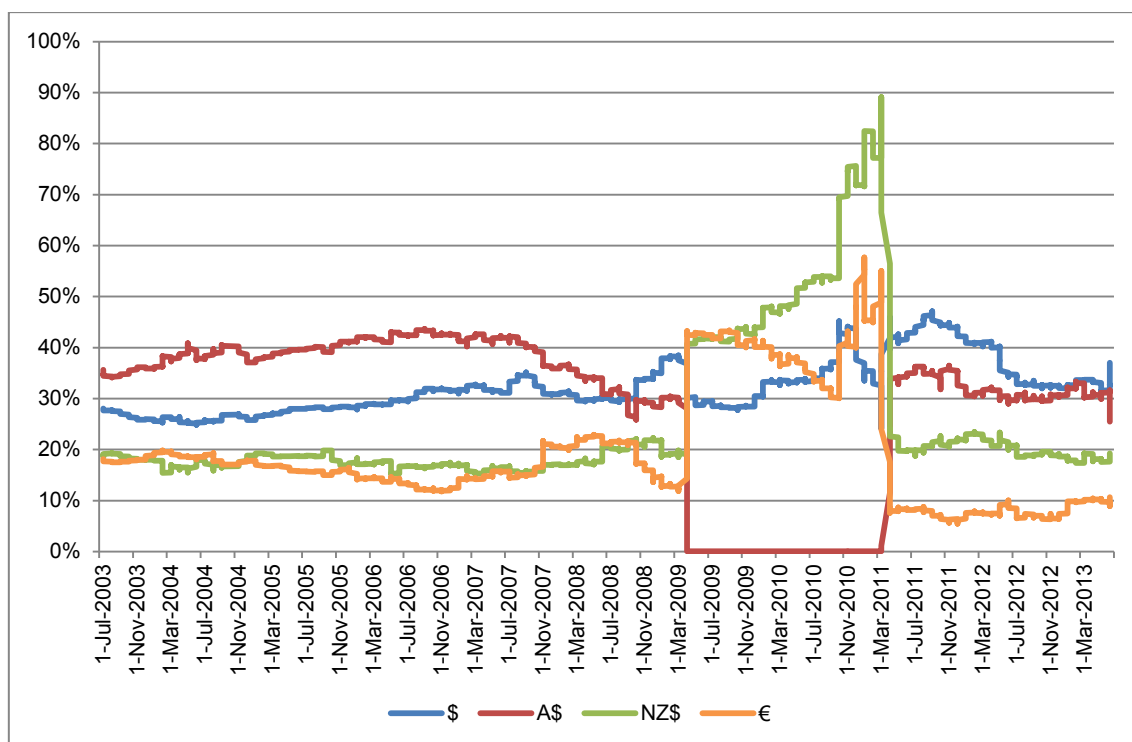
As for PNG and Vanuatu, the backward OLS does not improve the results. The R²s are again very low, indicating that the movements of the two currencies were determined by factors other than the movement of other currencies. The results therefore suggest that neither country is implementing a basket currency policy in their exchange rate management.

4.2 Rolling Regression Approach

In order to better understand the exchange rate policy of the Pacific DMCs, we analyzed the composition of the currency baskets over time, applying a rolling regression approach. We thereby regressed the daily exchange rates of the six Pacific DMCs with the other exchange rates in the baskets in the first 480 days (a "window") of the period under analysis. After the coefficient of this regression was calculated, we then shifted to the next day and ran another regression while maintaining the same window size. This process was continued until the end of analyzed period. In total, we

were able to calculate 2,069 regression coefficients. The results of the rolling regressions are summarized in Figures 2 to 5.⁵

Figure 2: Rolling Regression on Fiji Dollar Basket Currencies



\$ = US dollar; A\$ = Australian dollar; € = euro; NZ\$ = New Zealand dollar.

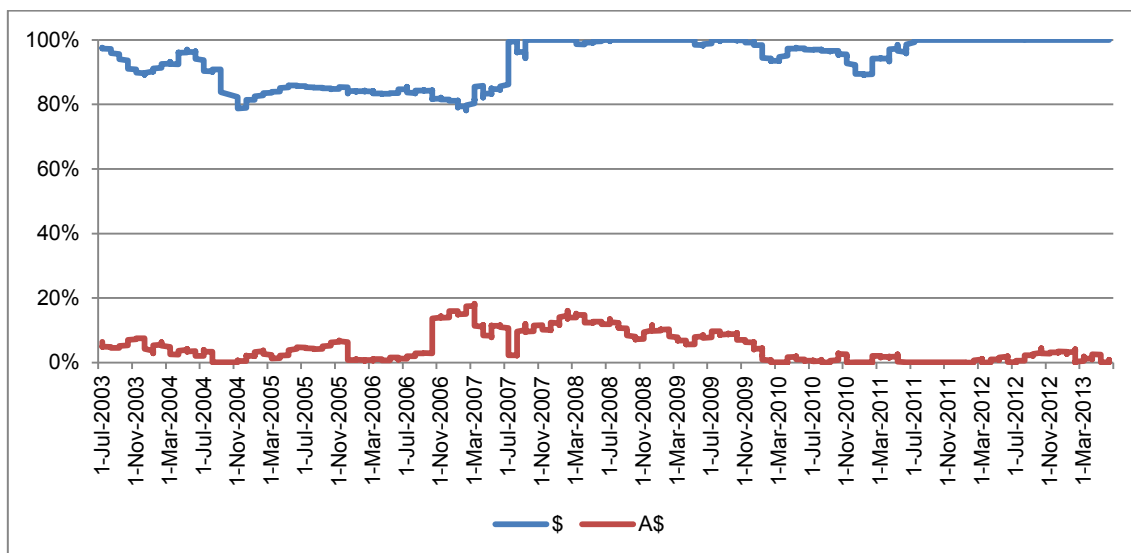
Source: Authors' calculations.

The vertical axis in Figure 2 records the magnitude of the regression coefficients that the OLS estimations yielded for every 480-day period. As we move forward in time along the horizontal axis the coefficients of the subsequent 480-day period are added. First of all, for the Fiji dollar we observe that the weights of the four currencies in the basket changed constantly and, during several periods, rather drastically. From 2003 to mid-2008, the Australian dollar had the largest weight in the currency basket. Then, the US dollar became the largest share in the basket. During the global financial and economic crisis the New Zealand dollar became increasingly important as an anchor. After the financial crisis, the US dollar remained the dominant currency in the basket.

Figure 3 shows the results of the rolling regression of the Solomon Islands dollar. We observe that from 2003 to 2011 the Australian dollar regularly reached weights of above 5%. However, since then, it has lost its importance and the Solomon Islands dollar seems to be pegged almost 100% to the US dollar.

⁵ In order to facilitate the readability of the figures, the statistical significance of the coefficients is not reported nor the coefficients with a value below zero.

Figure 3: Rolling Regression on Solomon Islands Dollar Basket Currencies

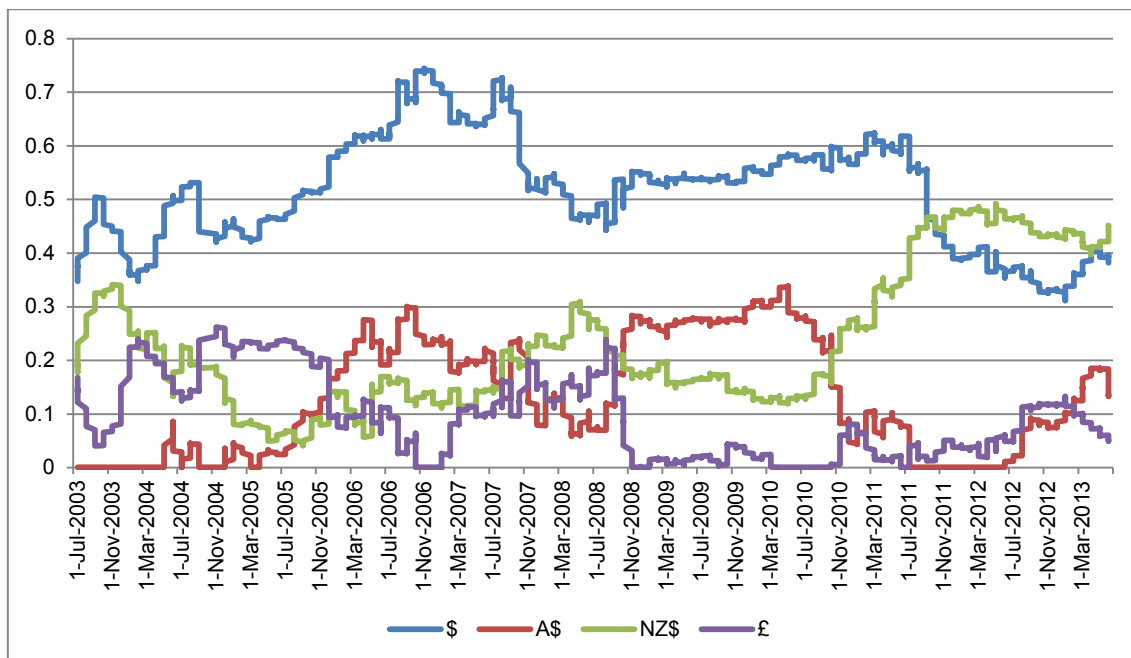


\$ = US dollar; A\$ = Australian dollar

Source: Authors' calculations.

The currencies in Tonga's basket changed substantially over the time period, as we can observe in Figure 4. Overall, it seems that the US dollar had the largest weight in almost every period except from mid-2011 onward. The New Zealand dollar and Australian dollar come next in importance. The New Zealand dollar gained in popularity, especially from mid-2011 onward.

Figure 4: Rolling Regression on Pa'anga Basket Currencies



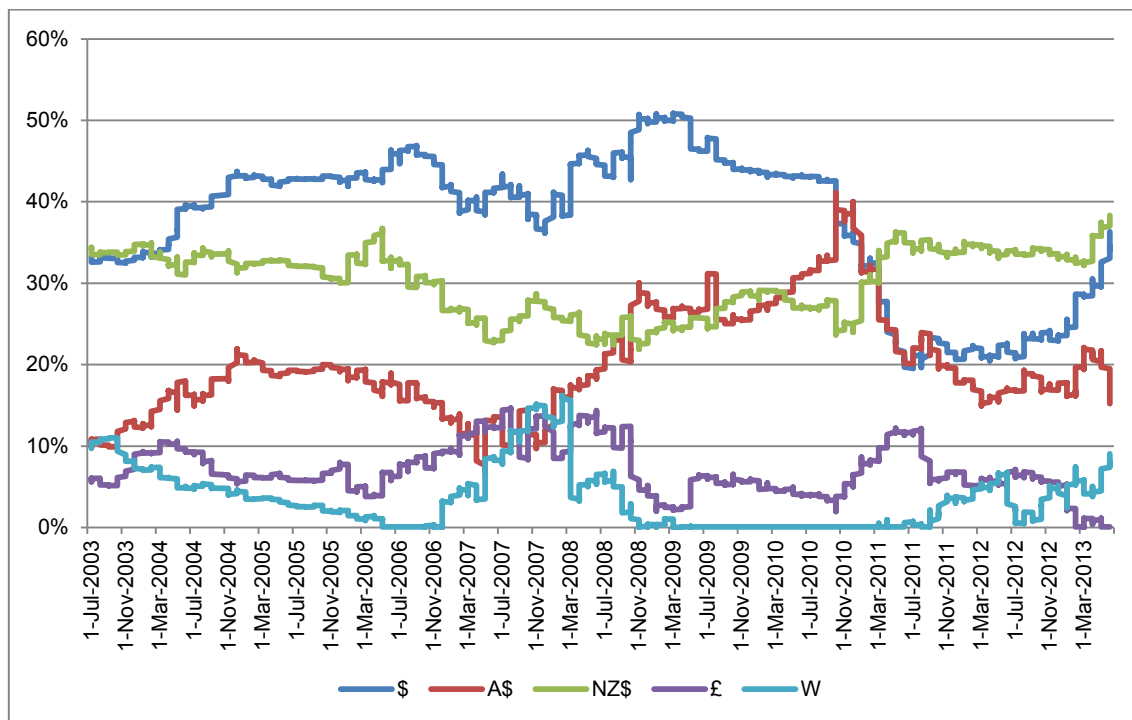
\$ = US dollar; A\$ = Australian dollar; NZ\$ = New Zealand dollar; £ = pound sterling.

Source: Authors' calculations.

Figure 5 shows that the situation in Samoa has been similar to that of Tonga; the basket currencies appear to have varied greatly over time. The US dollar was the most important anchor in the basket, however its share declined below that of the New

Zealand dollar after the global financial and economic crisis. The New Zealand dollar's share fluctuated as well, but remained more stable at around 30%. The share of the Australian dollar increased until the end of 2010, but then declined towards the end of the period under analysis.

Figure 5: Rolling Regression on Tala Basket Currencies



\$ = US dollar; £ = pound sterling; A\$ = Australian dollar; NZ\$ - New Zealand dollar; W = won.

Source: Authors' calculations.

When we compare the four countries with currency baskets, we find that the basket currencies of Tonga and Samoa have been adjusted more frequently than those of Fiji and the Solomon Islands. This higher responsiveness to exogenous shocks might partially explain why the volatility of Tonga and Samoa's GDP is lower than that of Fiji and the Solomon Islands.

As our regression results in Section 4.1 already suggested, no patterns could be traced for the share of currencies in the kina and vatu baskets. We therefore do not report the rolling regression results.

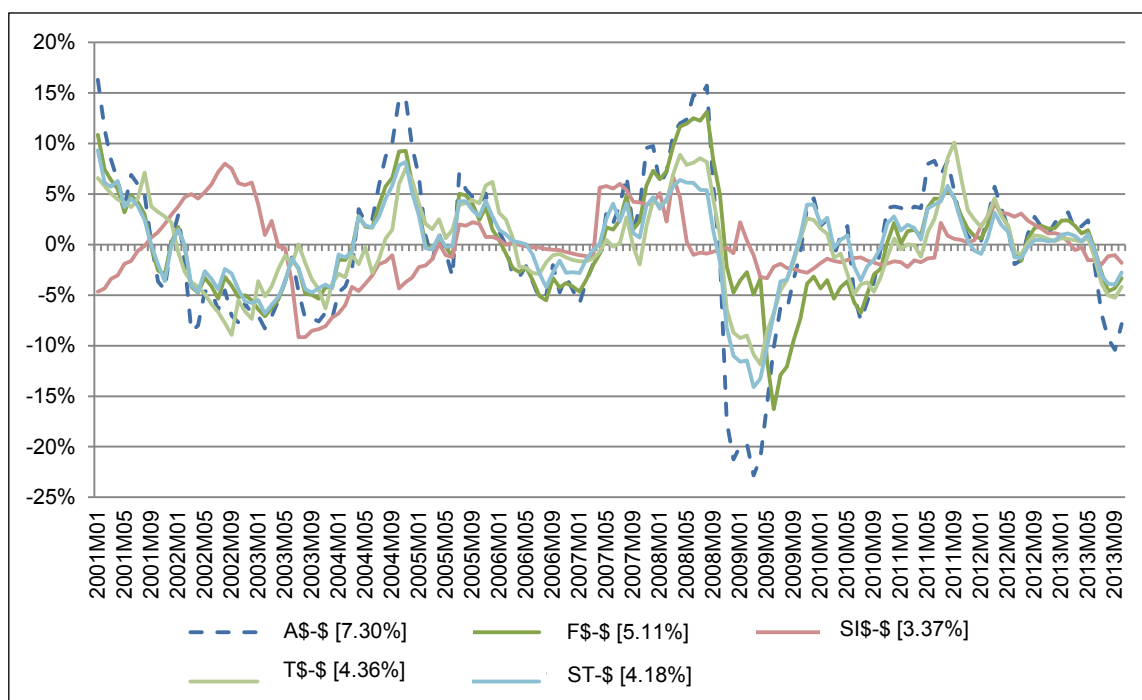
5. EXCHANGE RATE VERSUS GROSS DOMESTIC PRODUCT VOLATILITY

We would like to assess how the exchange rates of the six Pacific DMCs have evolved over the past decade against the US dollar and the Australian dollar and compare it to the movement of the US dollar against the Australian dollar.

Figure 6 depicts the average monthly exchange rates of the four Pacific DMCs that maintain a currency board, against the US dollar. The bracketed figures in the legend

show the volatility of the exchange rate against the US dollar.⁶ It can be seen that the fluctuations of the four Pacific currencies closely followed each other and the fluctuations of the Australian dollar against the US dollar. The only major exception is the period from January 2001 to June 2003, when the Solomon Islands dollar developed counter-cyclically to all other currencies. We also observe the systematically higher volatility of the Australian dollar against the US dollar (the dotted line) in comparison to the volatility of the exchange rate of the four Pacific DMCs, since the dotted line is almost always either above or below all four currencies.

Figure 6: Fluctuation of Monthly-Averaged-Exchange-Rates-to-US Dollar of the Pacific Developing Member Countries with Currency Boards Compared to the Australian Dollar–US Dollar Exchange Rate



\$ = US dollar; A\$ = Australian dollar; F\$ = Fiji dollar; T\$ = pa'anga; SI\$ = Solomon Islands dollar; ST = tala.

Note: Numbers in brackets denote the average volatility over the entire time period.

Source: Authors' calculations.

In Figure 7, we compare the volatility of the kina and the vatu against the volatility of the Australian dollar against the US dollar. We observe that for the kina, the volatility from the beginning of the period until May 2004 was substantially higher than that of the Australian dollar. However, after May 2004, PNG's currency became more stable and only returned to higher volatility in the aftermath of the global financial and

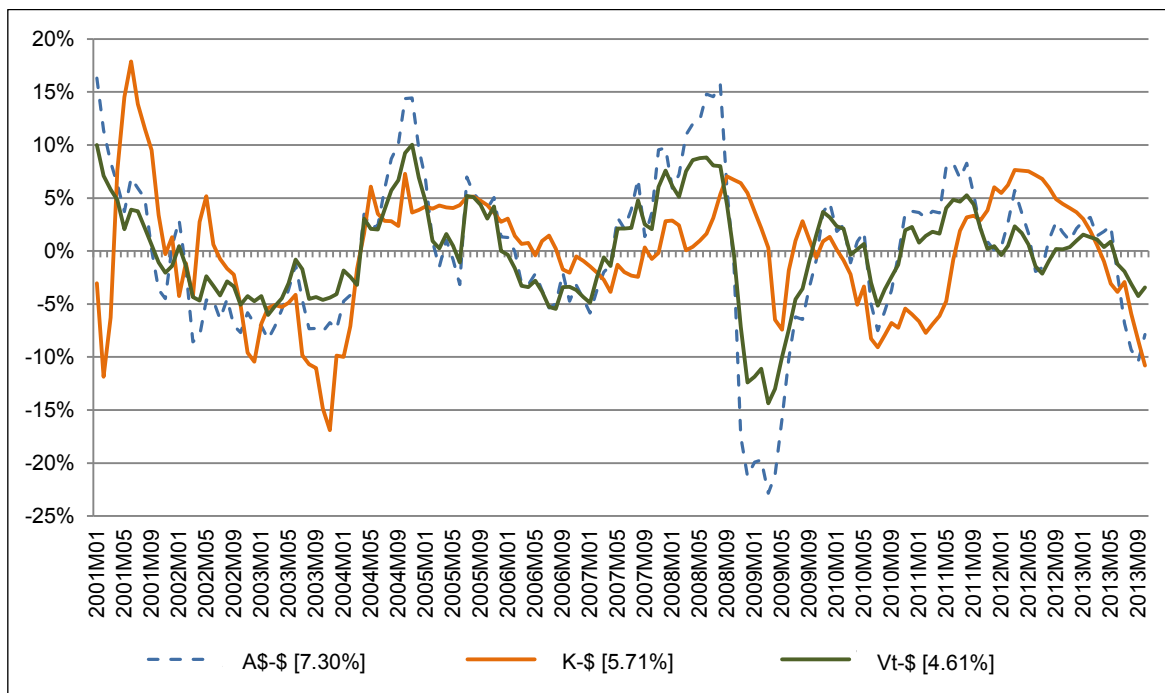
⁶ Volatility was measured by the standard deviation of the respected variables.

$$\sigma = \sqrt{\frac{\sum(x_t - E(x_t))^2}{T - 1}}$$

We took the smoothened trend that resulted from the Hodrick–Prescott Filter as the expected value of x ($E(x_t)$) for each time period. The deviance term is measured in percentage form by dividing $(x_t - E(x_t))$ with $E(x_t)$.

economic crisis (January 2009 onwards). In contrast, the vatu–US dollar exchange rate consistently had a lower volatility compared to the Australian dollar–US dollar exchange rate.

Figure 7: Fluctuation of Monthly-Averaged-Exchange-Rates-to-US Dollar of the Kina and the Vatu Compared to the Australian Dollar–US Dollar Exchange Rate



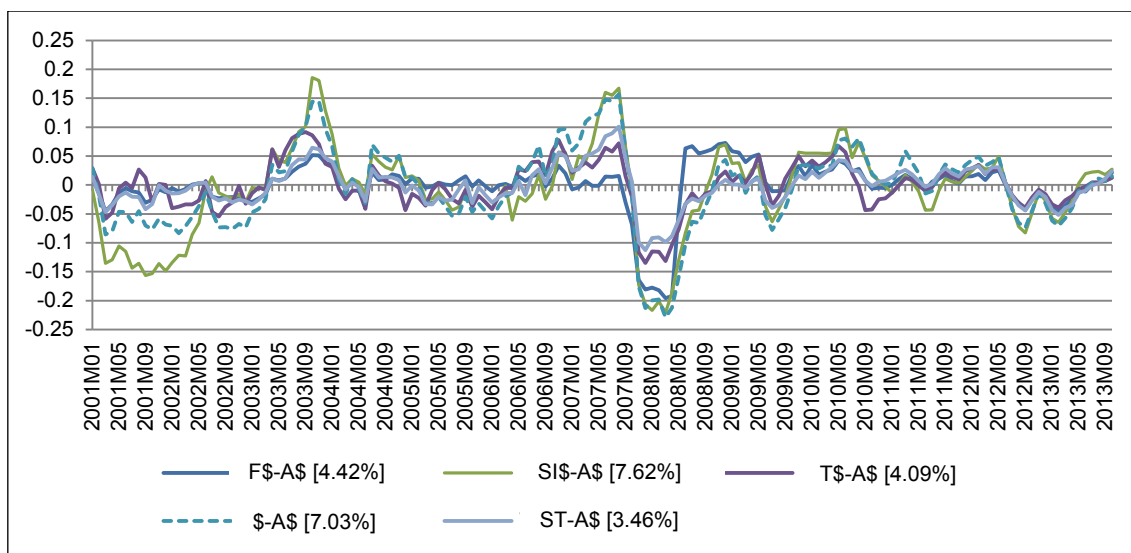
\$ = US dollar; A\$ = Australian dollar; K = kina; Vt = vatu.

Note: Numbers in brackets denote the average volatility over the entire time period.

Source: Authors' calculations.

Figure 8 shows the fluctuations of the four Pacific basket currencies against the Australian dollar and compares them to the fluctuations of the Australian dollar against the US dollar. The bracketed figures in the legend show the volatility of the exchange rate against the Australian dollar. We observe that the exchange fluctuations of the Fiji dollar, the pa’anga and the tala against the Australian dollar were all lower compared to the Australian dollar–US dollar fluctuations. The only basket currency that exhibited a higher fluctuation than the Australian dollar–US dollar exchange rate was the Solomon Islands dollar.

Figure 8: Fluctuation of Monthly-Averaged-Exchange-Rates-to-Australian Dollar of the Pacific Developing Member Countries with Currency Boards Compared to the US Dollar–Australian Dollar Exchange Rate



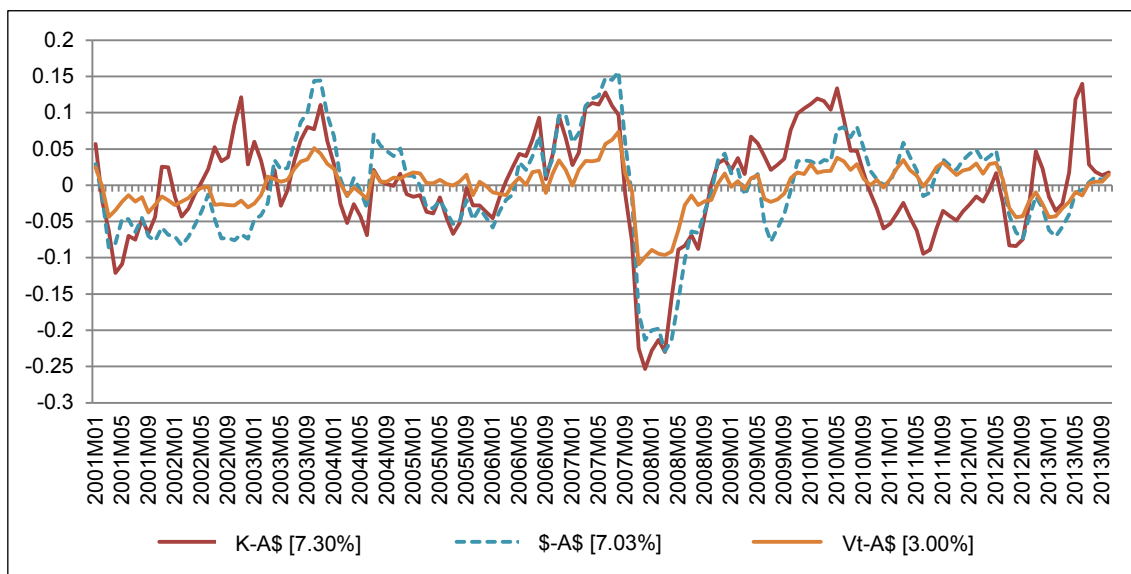
\$ = US dollar; A\$ = Australian dollar; F\$ = Fiji dollar; T\$ = pa'anga; SI\$ = Solomon Islands dollar; ST = tala.

Note: Numbers in brackets denote the average volatility over the entire time period.

Source: Authors' calculations.

Figure 9 shows the exchange rate fluctuations of the kina and vatu against the Australian dollar, as well as the fluctuations of the Australian dollar against the US dollar. We notice that the exchange fluctuations of the vatu against the Australian dollar were substantially lower than the Australian dollar–US dollar fluctuations. In contrast, the kina showed very similar fluctuations to those of the Australian dollar–US dollar exchange rate.

Figure 9: Fluctuation of Monthly-Averaged-Exchange-Rates-to-Australian Dollar of the Kina and Vatu Compared to Australian Dollar–US Dollar Exchange Rate



\$ = US dollar; A\$ = Australian dollar; K = kina; Vt = vatu.

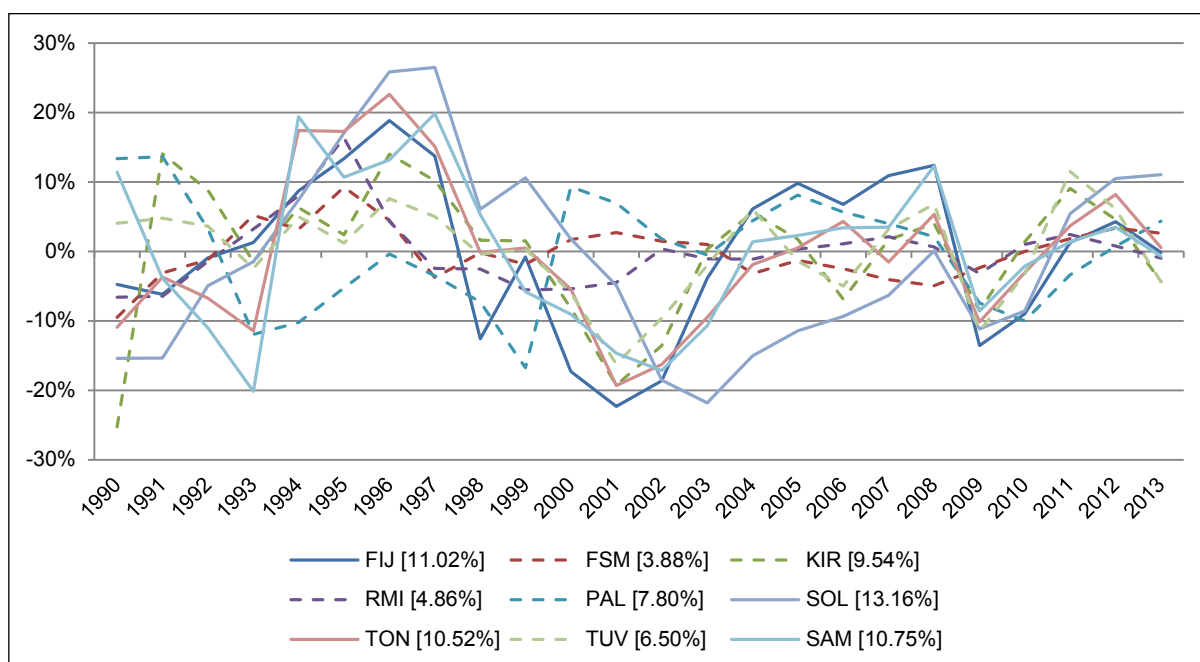
Note: Numbers in brackets denote the average volatility over the entire time period.

Source: Authors' calculations.

As we showed in our theoretical model, exchange rate policies can have a direct impact on the economic performance of a country. In Figures 10 and 11 we therefore depict the volatility of the GDP of the 14 Pacific DMCs and compare them in light of their respective exchange rate policies. The GDP volatility is measured by the same formula as the exchange rate volatility and is listed in brackets in the legends of the figures. GDP data comes from the World Development Indicators (2014) gathered by the World Bank and is in current US dollars.

Figure 10 compares the economic volatility in Pacific DMCs that adopted an external currency (dotted lines) to countries that adopted currency board (solid lines). We observe that countries with currency boards appear to have higher economic volatility than those that have an external currency in place. The impression is confirmed by the calculated volatility. For the period 1990–2013, Fiji, Samoa, the Solomon Islands, and Tonga all experienced higher economic volatility compared to Pacific DMCs with external currencies. The GDP volatility was 11.02% for Fiji, 10.75% for Samoa, 13.16% for the Solomon Islands, and 10.52% for Tonga. This compared to 9.54% for Kiribati, 4.86% for the Marshall Islands, 3.88% for the Federated States of Micronesia, 7.80% for Palau, and 6.50% for Tuvalu.

Figure 10: Fluctuation of Gross Domestic Product in the Pacific Developing Member Countries with Currency Boards versus Pacific Developing Member Countries with External Currencies



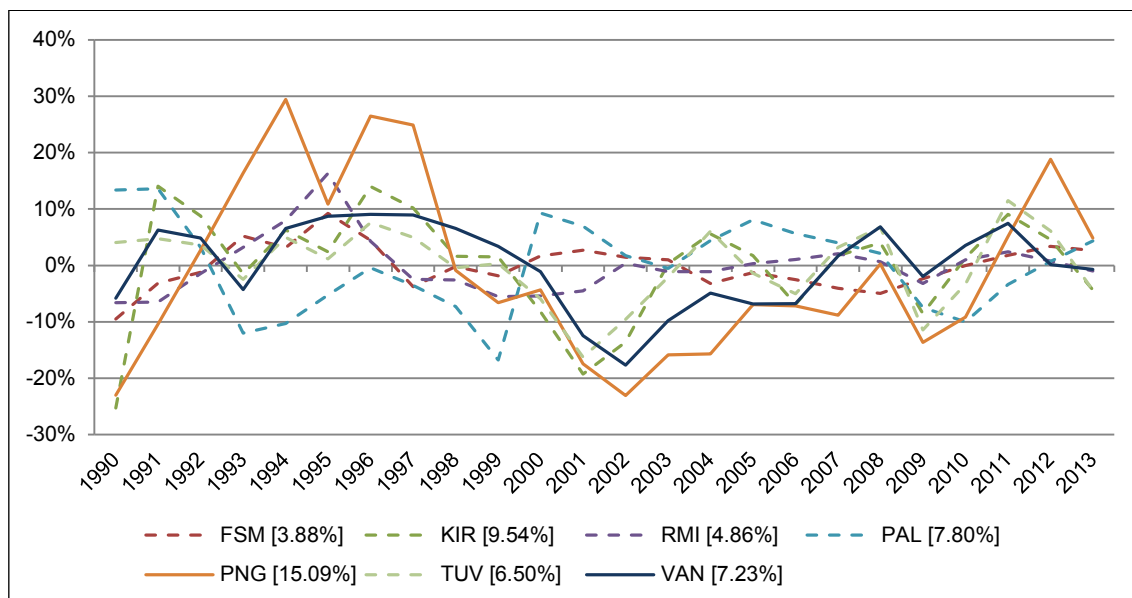
FIJ = Fiji; FSM = the Federated States of Micronesia; KIR = Kiribati; RMI = the Marshall Islands; PAL = Palau; SAM = Samoa; SOL = the Solomon Islands; TON = Tonga; TUV = Tuvalu.

Note: Numbers in brackets denote the average volatility over the entire time period.

Source: Authors' calculations.

Figure 11 illustrates the GDP volatility of PNG and Vanuatu compared to the five Pacific DMCs using an external currency. For PNG, we notice that the economic volatility is substantially higher. However, the GDP volatility of Vanuatu is not significantly different from the volatility in the five Pacific DMCs using an external currency. Thus, overall we find evidence that countries with a currency basket arrangement experienced higher GDP volatility. For the two countries using a managed float no clear trend can be discerned.

Figure 11: Fluctuation of Gross Domestic Product of Papua New Guinea and Vanuatu versus Pacific Developing Member Countries with External Currencies



FSM = the Federated States of Micronesia; KIR = Kiribati; RMI = the Marshall Islands; PAL = Palau; PNG = Papua New Guinea; TUV = Tuvalu; VAN = Vanuatu.

Note: Numbers in brackets denote the average volatility.

Source: Authors' calculations.

To better understand the underlying mechanisms that caused a higher GDP volatility, one needs to know that all Pacific DMCs that use basket currency regimes also impose foreign exchange controls in order to manage their foreign reserves and to control the stability of exchange rates. We know from the Mundell–Fleming model (Mundell 1963; Fleming 1962) that an open economy faces the impossible trinity: a monetary authority cannot pursue three different objectives simultaneously, i.e. a fixed exchange rate, the free movement of capital, and an independent monetary policy. A basket currency regime is one type of fixed exchange rate mechanism, and therefore monetary authorities need to forego one of the three objectives. Fiji, Samoa, the Solomon Islands, and Tonga all decided to sacrifice the free flow of capital movement while preserving their sovereignty over their monetary policies.

Wood (2010) studies the impact of capital controls for the Pacific Islands. He finds that, in the short run, capital controls can be successful in protecting the exchange rate and alleviating pressure from monetary policy. However, in the long run he predicts that capital controls will deter foreign investment, reduce business confidence, result in trade distortions, and might even lead to currency inconvertibility. In the worst case, they will lead to a fully-fledged balance of payment crisis.

6. SIMULATION OF THE THEORETICALLY OPTIMAL SHARES

In Section 3 we developed a simple theoretical model to determine the optimal share of foreign currencies in a basket given specific loss functions of the government. In this section, we build on our theoretical model and conduct simulations to determine the optimal shares of foreign currencies in the currency baskets of Fiji, Samoa, the

Solomon Islands, and Tonga. In order to calculate the optimal share as given by equation (10), we first need to estimate the equations (6), (8), and (9).

The necessary data for the estimations was collected in the following way. First, we gathered yearly data from the World Development Indicators (2014) database and ADB Outlook (2014) for each country for the period 1995 to 2012. The data collected was the GDP, nominal interest rate, government expenditure, balance of trade, revenue from tourism, world GDP, the average value of the Australian dollar–US dollar exchange rate, and the average value of domestic currency to the Australian dollar and the US dollar exchange rate. We added revenues from tourism and the balance of trade to obtain the value of current account as assumed in equation (7). As suggested in the model, the exchange rate variables were then converted into their logarithmic form. As usually done, we used the trends from the Hodrick–Prescott filter as the expected value of each variable. We then measured the deviation of each variable by deducting the actual value to the estimated value of the respective variable.

For the estimation technique, we estimated equations (6) and (8) simultaneously running a two-stage least squares regression, whereas the coefficients in equation (9) was obtained by using a simple OLS regression. The results are shown in Tables 4 to 6 below.

Table 4: Coefficients of Two-Stage Least Squares Regression of Deviation of Gross Domestic Product of Domestic to US Dollar Exchange Rate, and of Domestic to Australian Dollar Exchange Rate on Deviation of Balance of Trade of Fiji, Papua New Guinea, Samoa, the Solomon Islands, Tonga, and Vanuatu (equation 8)

	FIJ	SOL	TON	SAM
$(y - \bar{y})$	-0.8953 ** (-2.5357)	0.7655 * (1.9784)	-0.9498 *** (-3.5115)	2.2162 (0.9184)
$(e^{X/\$} - \bar{e}^{X/\$})$	-1.33E+09 * (-1.8229)	3.30E+08 (1.2989)	-1.95E+08 ** (-2.7463)	-9.36E+08 (-0.7846)
$(e^{X/A\$} - \bar{e}^{X/A\$})$	1.06E+09 *** (4.4431)	1.48E+07 (0.1652)	7.73E+07 ** (2.1936)	-1.32E+09 (-0.7750)
R^2	0.7640	0.1766	0.4255	0.0379

FIJ = Fiji; SOL = the Solomon Islands; TON = Tonga; SAM = Samoa.

Note: Number in parentheses denote t-values; *** significant at 1% level, ** significant at 5% level, * significant at 10% level.

Source: Authors' calculations.

Table 5: Coefficients of Ordinary Least Squares Regression of Deviation of Domestic to US Dollar Exchange Rate, of Domestic to Australian Dollar Exchange Rate, and of World Gross Domestic Product on Deviation of Tourism Revenue of Fiji, Papua New Guinea, Samoa, the Solomon Islands, Tonga, and Vanuatu (equation 9)

	FIJ		SOL		TON		SAM
$(e^{X/\$} - \bar{e}^{X/\$})$	-2.27E+08	**	-4.85E+07		-1.38E+07		-2.23E+07
	(-2.1571)		(-1.4708)		(-1.5968)		(-1.5541)
$(e^{X/A\$} - \bar{e}^{X/A\$})$	-3.19E+08	**	5.43E+06		-8.02E+06		-6.14E+06
	(-2.4012)		(0.3292)		(-0.8140)		(-0.2533)
$(Y_w - \bar{Y}_w)$	1.46E-05	**	1.13E-06		3.74E-07		1.89E-06
	(2.9069)		(1.3005)		(1.3130)		(6.7018)
R ²	0.7628		0.3418		0.4274		0.8215

FIJ = Fiji; SOL = the Solomon Islands; TON = Tonga; SAM = Samoa.

Note: Numbers in parentheses denote t-values; *** significant at 1% level, ** significant at 5% level, * significant at 10% level.

Source: Authors' calculations.

Table 6: Coefficients of Two-Stage Least Squares Regression of Deviation of the Interest Rate, of Government Spending, and of Current Account on Deviation of Gross Domestic Product of Fiji, Papua New Guinea, Samoa, the Solomon Islands, Tonga, and Vanuatu (equation 6)

	FIJ		SOL		TON		SAM
$(r - \bar{r})$	2.38E+06		-4.91E+05		1.06E+05		-2.76E+05
	(0.2006)		(-0.1735)		(0.0954)		(-0.1117)
$(G - \bar{G})$	0.0272	***	0.0214	***	0.0277	***	0.0012
	(4.7580)		(3.2420)		(4.4510)		(1.1513)
$(CA - \bar{CA})$	-0.9634		-0.6756		1.3323	*	0.4296
	(-1.5033)		(-1.0949)		(2.1045)		(2.3028)
R ²	0.7136		0.4852		0.6095		0.0149

FIJ = Fiji; SOL = the Solomon Islands; TON = Tonga; SAM = Samoa.

Note: Number in parentheses denote t-values; *** significant at 1% level, ** significant at 5% level, * significant at 10% level.

Source: Authors' calculations.

Estimating the basket currency value (θ) was complicated because the countries did not announce it. Moreover, while it is assumed that they were maintaining a fixed basket currency value, in reality it could change over time. We looked up the *de facto* weight estimated in Section 4.1 in order to estimate θ . As explained in Section 1, we only consider two currencies in the basket, the US dollar and the Australian dollar, whereas the *de facto* weights might involve other foreign currencies as well. Therefore, we need to adjust the weight of the two currencies by using the following formula:

$$Adj\ v = \frac{\text{de facto weight of \$}}{\text{de facto weight of \$} + \text{de facto weight of A\$}} \quad (12)$$

$$adj\ (1 - v) = 1 - adj\ v \quad (13)$$

Since we assume that every country holds a fixed basket value, we also need to determine the proper value of the exchange rates of the US dollar and the Australian dollar for estimating θ . We therefore use the average value of each country's domestic currency to the US dollar and Australian dollar exchange rates for the entire periods. The basket currency value is then calculated by using the following formula:

$$\theta_x = adj\ v \cdot \overline{e^{X/\$}} + adj\ (1 - v) \cdot \overline{e^{X/A\$}} \tag{14}$$

The result of the measured basket currency value for Fiji, Samoa, the Solomon Islands and Tonga is exhibited in Table 7.

Table 7: Estimated Values of Basket Currencies in Fiji, Solomon Islands, Tonga, and Samoa

	F\$	SI\$	T\$	ST
Theta	0.5201	1.6362	0.7855	0.7687

F\$ = Fiji dollar; SI\$ = Solomon Islands dollar; ST = tala; T\$ = pa'anga.

Source: Authors' calculations.

If $w_2=1$

$$v = \frac{\left(\theta - \overline{e^{X/A\$}}\right)}{e^{A\$/\$}}$$

If $w_1=1$

$$v = \frac{\left(\theta + e^{A\$/\$} - \overline{e^{X/\$}}\right)}{e^{A\$/\$}}$$

If $w_1 \& w_2=0$

$$v = \frac{c_0 + c_1(r - \bar{r}) + c_2(G - \bar{G}) + c_3 \left(a_0 + b_0 + (a_2 + b_1) \left(\theta + e^{\frac{A\$}{\$}} - \overline{e^{X/USD}} \right) + (a_3 + b_2) \left(\theta - \overline{e^{X/A\$}} \right) + b_3(Y_w - \bar{Y}_w) \right)}{c_3 k e^{\frac{A\$}{\$}}}$$

We simulate the optimal share of the US dollar and the Australian dollar in each country's basket currency for 2002 to 2012. Four government objectives are studied:

- i. minimizing fluctuations of the exchange rate against the US dollar, i.e. $w_1 = 1$;
- ii. minimizing fluctuations of the exchange rate against the Australian dollar, i.e. $w_2 = 1$;
- iii. minimizing fluctuations in GDP, meaning that w_1 and w_2 become equal to 0; and
- iv. putting equal weight on GDP and exchange rates minimization, i.e. w_1 and w_2 equal to 1/3.

The simulations are conducted on a yearly basis, following equation (10). We also impose a boundary constraint that the optimal weight shall fall in between 0 and 1. Any value for $v > 1$ will be regarded as 1 and any value for $v < 0$ will be regarded as 0.

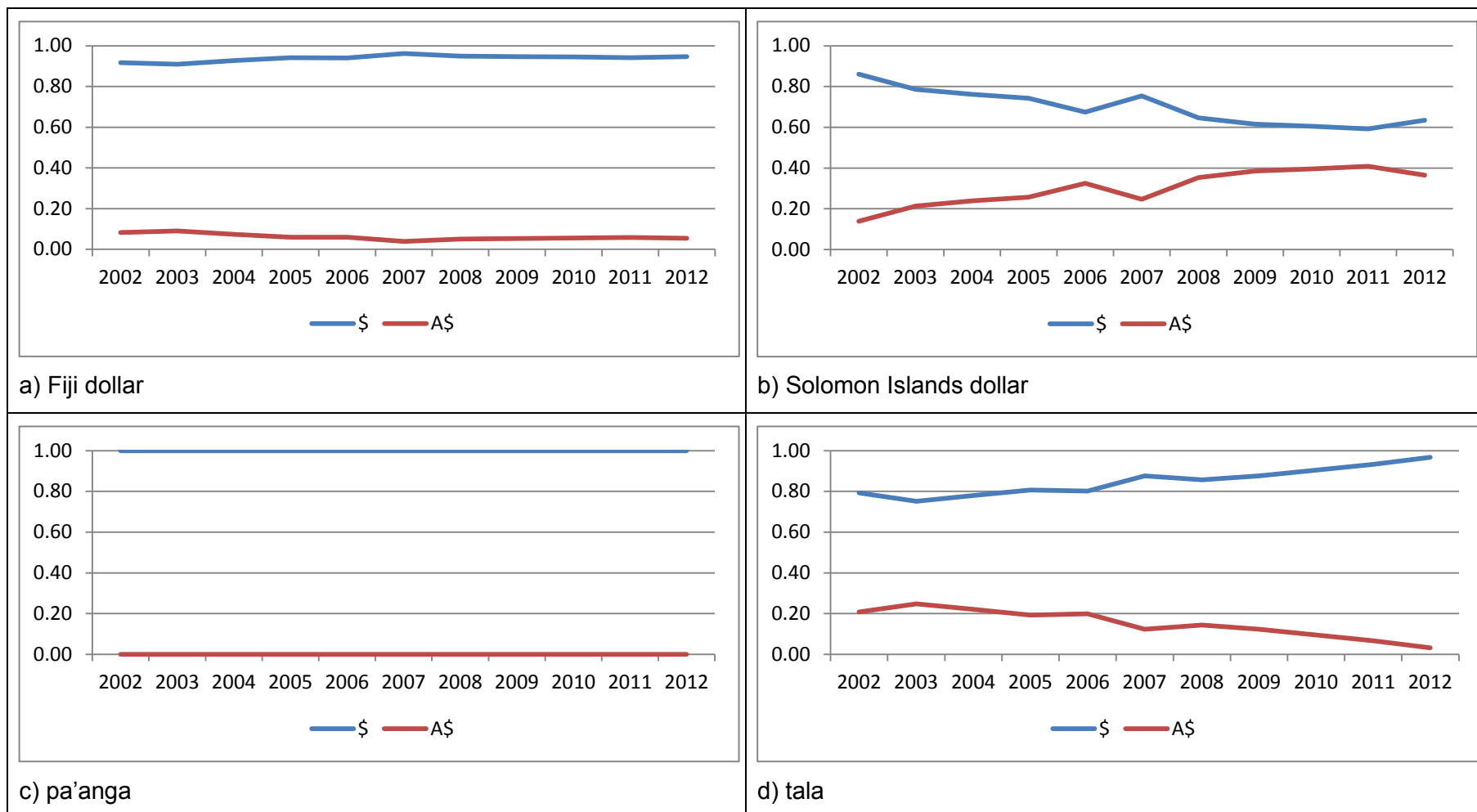
The simulation results of the first scenario ($w_1 = 1$) are depicted in Figure 12. We find that the US dollar should have become the dominant currency in all Pacific DMC basket currencies. For Fiji, our model predicts an optimal share of the US dollar in excess of 90% and of less than 10% for the Australian dollar. For the Solomon Islands, the weight of the US dollar in the basket has been decreasing, but was always well above 50%. For Tonga, our model predicts a full peg to the US dollar for all periods. Finally, in Samoa the optimal share of the US dollar shows an increasing trend reaching 100% in 2012.

The simulation results of the second scenario ($w_2 = 1$) are shown in Figure 13. As expected, the Australian dollar is now becoming more prominent in all currency baskets, except for the Solomon Islands. For Fiji, the share of the Australian dollar starts at above 80% and increases to 100% over time. In contrast, our model predicts that in the Solomon Islands, the US dollar should remain the main currency basket. For Tonga, we now find that the pa'anga should be fully pegged to the Australian dollar. Finally, in Samoa, the Australian dollar should have been the dominant basket currency until 2008. By then, the US dollar would have started to dominate the Tongan currency basket.

The simulation results of the third scenario ($w_1 = w_2 = 0$) are shown in Figure 14. We find that the US dollar is again dominant in all currency baskets for almost the entire period. For Fiji and Tonga the simulations suggest that they could have limited the GDP fluctuations if they had pegged their currency to the US dollar. For the Solomon Islands a US dollar peg would have been the best solution for the period from 2002 to 2011 and then a rather balanced share between the US dollar and the Australian dollar in 2012. Finally, for Samoa, the simulations recommend that the Australian dollar should have been the dominant currency in the basket during 2002–2003. However, its optimal share kept decreasing and by 2004 the US dollar would have been the main currency in the basket.

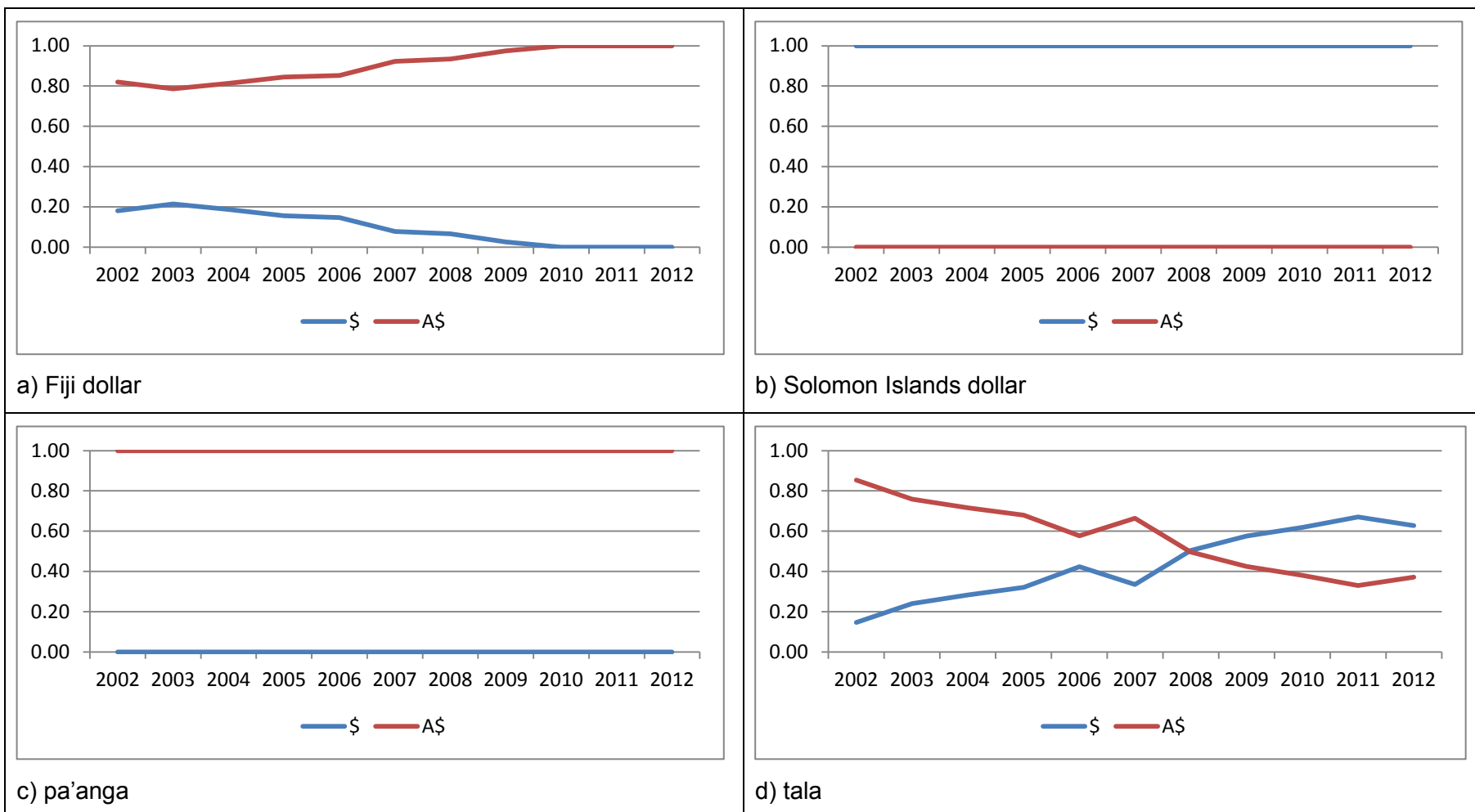
Finally, Figure 15 shows the results of the fourth simulation ($w_1 = w_2 = 0.33$). They look very similar to the ones of the third scenario, except for Samoa where the dominance of the US dollar should have started even earlier, in 2003 instead of 2004. In addition, the tala should have been fully pegged to the US dollar since 2009.

Figure 12: Optimal Share of US Dollar and Australian Dollar when $w_1 = 1$ (Minimize Exchange Rate Fluctuations to the US Dollar)



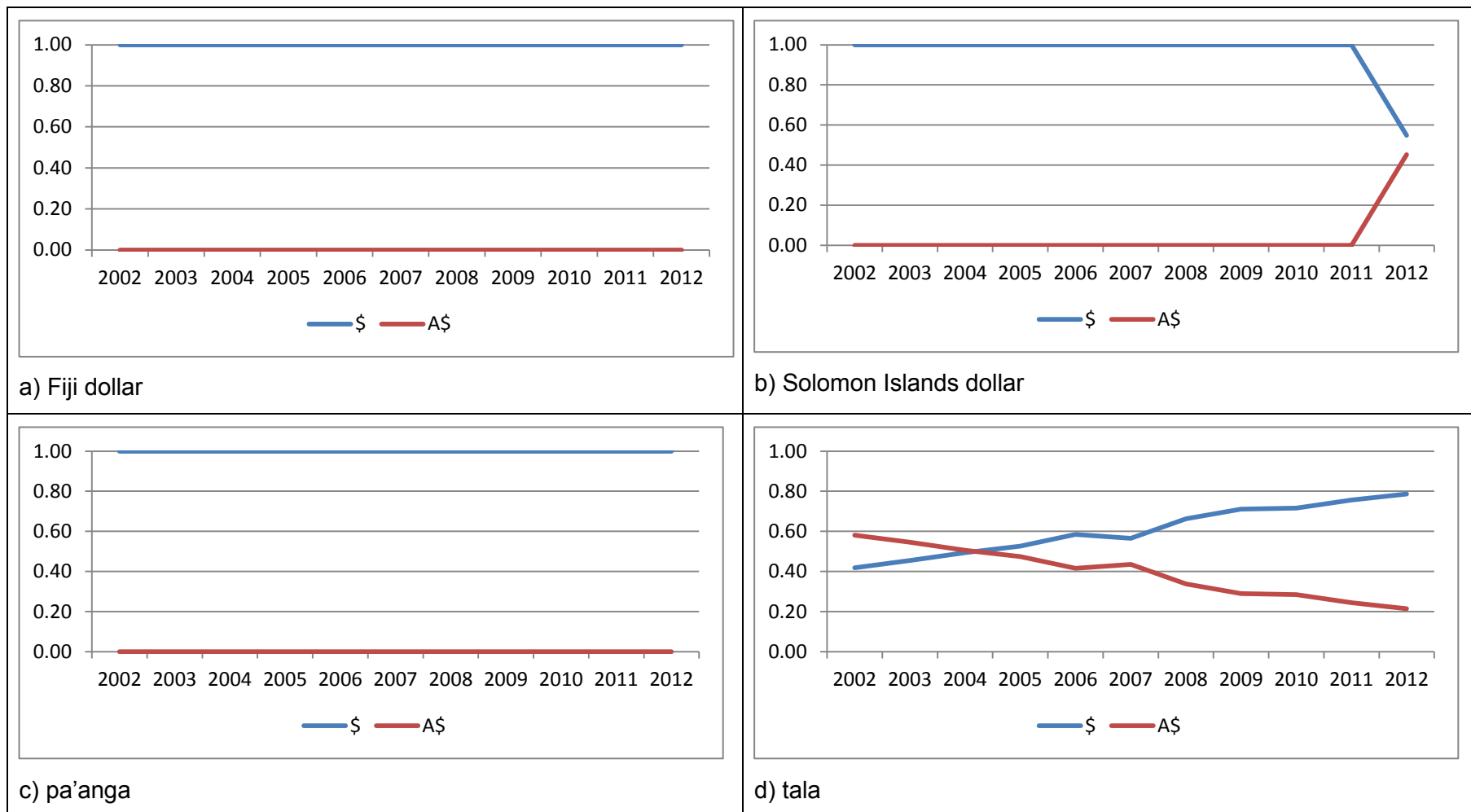
\$ = US dollar; A\$ = Australian dollar.
 Source: Authors' calculations.

Figure 13: Optimal Share of US Dollar and Australian Dollar when $w_2 = 1$ (Minimize Exchange Rate Fluctuations to the Australian Dollar)



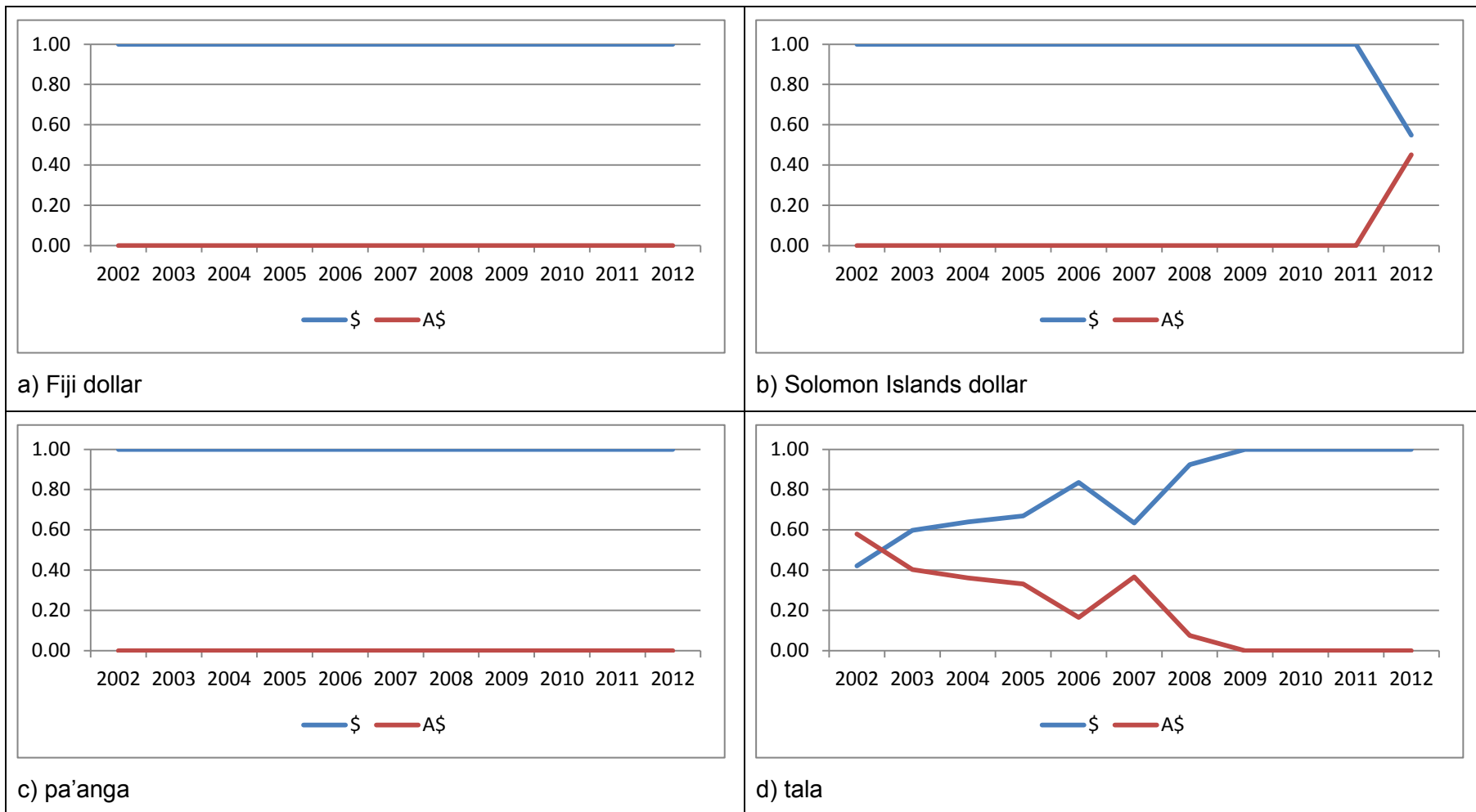
\$ = US dollar; A\$ = Australian dollar.
 Source: Authors' calculations.

Figure 14: Optimal Share of US Dollar and Australian Dollar when w_1 and $w_2 = 0$ (Minimize Gross Domestic Product Fluctuations)



\$ = US dollar; AUD = Australian dollar.
 Source: Authors' calculations.

Figure 15: Optimal Share of US Dollar and Australian Dollar when w_1 and $w_2 = 0.3333$ (All Objectives with Equal Weights)



\$ = US dollar; AUD = Australian dollar.
 Source: Authors' calculations.

7. CONCLUSION

Currently, most Pacific DMCs maintain exchange regimes that have a low degree of flexibility, namely managed float, currency basket, or even external currency. In this paper we studied the exchange rate choices of the six Pacific DMCs that issues their own notes, i.e., Fiji, PNG, Samoa, the Solomon Islands, Tonga, and Vanuatu. Our analysis focused on the four countries that employ basket currency policy in managing their exchange rate.

We built a simple theoretical model to analyze an optimal basket currency policy. We adopted the model introduced by Yoshino et al. (2003) and made two important extensions. First, we introduced a loss function that includes a minimization of GDP fluctuations as well as exchange rate fluctuations. Second, we explicitly modeled tourism flows. Solving the model, we were able to calculate the theoretically optimal weight of the Australian dollar as well as the US dollar in the currency basket.

We then estimated the *de facto* weights of the basket currencies following the methodology introduced by Frankel and Wei (1994). We found that the US dollar still holds the major share in the basket currencies of Pacific DMCs. Other currencies that have significant shares in the currency baskets were the Australian dollar, the New Zealand dollar, the euro, the pound sterling, and the won. We also conducted a rolling regression approach to analyze the structural change of the basket composition in a more frequent manner. Our rolling regression results indicated that the monetary authorities in Fiji and the Solomon Islands wanted to maintain constant shares in their currency portfolios, whereas the portfolios in Samoa and Tonga were often reviewed. Estimating the *de facto* weights has proven difficult in the case of PNG and Vanuatu as neither country has implemented a basket currency policy.

Following on from this we compared the GDP volatility and exchange rate fluctuations of Pacific DMCs with hard pegs to Pacific DMCs with intermediate regimes. We found that most of the Pacific DMCs with intermediate regimes were able to maintain rather stable exchange rates, but had difficulties in stabilizing the fluctuations of their GDP. Finally, we undertook several simulations for various loss functions based on our theoretical model. We found that irrespective of the loss function, Fiji and Tonga would be better off pegging their currency to the US dollar. On the other hand, the Solomon Islands would be better off pegging their currency to the Australian dollar. For Samoa, a basket currency would be the best policy to implement. Overall, the simulation results suggested that, in general, Pacific DMCs with intermediate currency regimes put strong emphasis on stabilizing the exchange rate, rather than using the exchange rates as a shock absorber for external economic shocks. Our proposed model therefore offers guidance on how to optimize the currency basket weights in order to stabilize the GDP fluctuations while simultaneously preserving the currency value.

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APPENDIX

Overview of the History of Exchange Rate Arrangements

1. Fiji

Exchange rate regime: Basket currency to five major trading partners: Australia, Japan, New Zealand, the United Kingdom, and the United States.

Introduced: 1975

Methodology of calculating weights: Reviewed each year by the reserve bank based on the share of each partner country in the total value of trade, tourist transactions, external debt service, and share of each currency in invoicing of trade.

Source:

International Monetary Fund (IMF). 1995. Fiji—Background Material. *IMF Staff Country Report*. 95 (128).

2. Samoa

Exchange rate regime: Currency basket. The exchange rate of the local currency, the tala, is measured against the basket of currencies of its six major trading partners. The basket is reviewed periodically to ensure that exchange rates are in line with changing economic and market conditions. The central bank's exchange rate policy is aimed primarily at supporting the balance of payments, whilst ensuring that Samoa maintains its competitiveness with its major trading partners.

Introduced: 1985

Sources:

Samoa International Finance Authority.

http://sifa.ws/index.php/aboutus/overview_of_samoa/

Foundation for Development Cooperation. 2007. *Policy and Regulatory Framework for Remittance—Samoa*. Brisbane: Foundation for Development Cooperation.

3. Tonga

Exchange rate regime: Currency basket against the Australian dollar, New Zealand dollar, US dollar, and yen (added in 2000).

Introduced: 1991 (before 1991, the currency was pegged to the Australian dollar)

Source:

IMF. 2010. Tonga: 2010 Article IV Consultation—Staff Report, Staff Supplement, and Public Information Notice on the Executive Board Discussion. *IMF Staff Country Report*. 10 (112).

4. Vanuatu

Exchange rate regime: Managed Float

Introduced: Before 1986

Source:

IMF. 2014. *Annual Report on Exchange Arrangements and Exchange Restrictions 2014*. Washington D.C.

5. Papua New Guinea

Exchange rate regime: Managed float. From 1988 to 1994 Papua New Guinea had a basket currency in place (weighted by trade share).

Introduced: 1994

Source:

Rupa, R. and W. Onea. 2010. Overview of Foreign Exchange Issues in Papua New Guinea. Presentation for The Pacific Financial Technical Assistance Centre CCBS 5th Annual Course. Tonga. 10–13 August.

http://www.pftac.org/filemanager/files/Macro_Training/CCBS_2010/7_Overview_of_Foreign_Exchange_issues_in_Papua_New-tonga.ppt

6. Solomon Islands

Exchange rate regime:

1990–2002 Crawling peg

2002–2008 Peg

2008–present Free float

Source:

IMF. 2014. *Annual Report on Exchange Arrangements and Exchange Restrictions 2014*. Washington D.C.