THE ASEAN DOLLAR STANDARD IN THE POST-CRISIS ERA:

A RECONSIDERATION

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ABSTRACT

This paper examines the role of global currencies in ASEAN exchange rate regimes. The investigation considers the post-crisis era from January 1, 1999 through December 31, 2007 and focuses on the five original members of ASEAN (Indonesia, Malaysia, Philippines, Singapore, Thailand) plus Vietnam. Unlike most papers that use classical regression analysis of logarithmic data in first differences to detect the influence of various foreign currencies on particular Asian currencies, this paper considers modern time series analysis more seriously. In particular, this paper finds evidence of cointegration among individual ASEAN currencies and some of the global currencies. Examination of the cointegrating vectors yields four main findings. First, there is a notable absence of a clear US dollar standard. Second, the yen is downright unimportant, suggesting that ASEAN currencies are quite far from a yen standard. Third, ASEAN currencies are also quite far from a euro standard. Fourth, and most surprisingly, the UK pound is very important, and furthermore, this may be affecting the first three findings. These results are at odds with the traditional regressions which suggest that ASEAN is on a dollar standard, although it is not a perfect dollar standard because coefficients are not at unity and various other currencies are significant in different equations. Hence, the overall conclusion from this research is that there is a wide variety of influences on ASEAN exchange rates in both the long run and the short run. This suggests that ASEAN, as a group, is not pursuing -- and is in fact not ready for -- a global-currency standard.

1. Introduction

ASEAN[1] countries have recently been discussing monetary integration, particularly in the context of building an ASEAN Economic Community (AEC). At the 2003 ASEAN Summit, leaders reaffirmed their commitment to the "ASEAN Vision 2020" that originated in 1997, and agreed to create the AEC by 2015 to achieve deeper economic integration of the area on the heels of the ASEAN Free Trade Agreement. Although not a central feature of an AEC, monetary integration is receiving attention as a piece of the overall macroeconomic policy concerns related to the AEC.[2] In addition, ASEAN monetary integration is part of the overall discussion of Asian monetary integration within the context of Asian regionalism. The prevailing wisdom, however, perhaps captured best by Kenen and Meade (2008), is that, "China and Japan are likely to keep their own national currencies, whereas the ASEAN countries or a subset of its members could form a monetary union of their own (p. 148)."

This paper examines monetary integration in ASEAN by considering the role of various global currencies – particularly the US dollar – in the region. In contrast to Europe, where monetary integration was a multilateral effort culminating in the creation of a supranational currency, ASEAN integration is more likely occurring through a back-door method in which separate countries explicitly or implicitly adopt a global-currency standard (such as a dollar standard, a yen standard, a euro standard, or some basket of global currencies) limiting domestic monetary policy. Once more than one country

[1] ASEAN is the Association of Southeast Asian Nations. It consists of Indonesia, Malaysia, Philippines, Singapore, Thailand, Laos, Cambodia, Brunei, Vietnam, and Myanmar.

[2] For more on the ASEAN Economic Community, see Hew (2007).

adopts the same standard, exchange rates between the countries are linked and monetary policies are *de facto* integrated. The research thus examines the question, "to what extent is there monetary integration in ASEAN?" by examining exchange rates in the region. More directly, the research considers whether there is a "global-currency standard" in ASEAN by looking at the time series relationships between local currencies and the major global currencies.

The topic is important for three policy discussions of exchange rates in Asia. One ongoing debate is whether Asia is a dollar bloc (McKinnon and Schnabl, 2004; McKinnon, 2005), sometimes referred to as "dollarized" (Nakai, 2004). An alternative hypothesis is that Asia is a yen bloc (Kwan, 2001; Karras, 2005), although this partly considers what will happen in the future. The main theoretical foundation used to address the debate is from the optimum currency area literature (Mundell, 1961). For example, Alesina, Barro, and Tenreyro (2003) investigate optimal currency areas by identifying countries that would logically be anchored to the dollar, the euro, or the yen. The empirical analysis focuses on data for three factors over the period 1960-1997: trade intensity with respect to GDP; inflation and price co-movements; and output co-movements. With respect to ASEAN, empirical findings are available for Indonesia, Malaysia, Singapore, and Thailand.[3] However, as summarized in Table 1, there is no clear optimum anchor. Trade patterns suggest that the yen would be an optimal anchor, but price co-movements suggest that the dollar would be the optimal anchor (except for Thailand), and output co-movements even suggest that the euro would be the optimal anchor (again except for Thailand).

[3] The other countries have a low demand for an external nominal anchor because they have low inflation and do not trade much with any of the three potential anchors.

A second debate is whether to adopt a global-currency standard (e.g., a dollar standard or a yen standard) or create a new supranational currency (e.g., Larraín and Tavares, 2003; Jeon and Zhang, 2007). There are several proposals to adopt a regional currency. For example, Ogawa and Shimizu (2006a) consider an Asian Monetary Unit (AMU) for the ASEAN countries plus China, Japan, and Korea (ASEAN + 3). Moon, Rhee, and Yoon (2006) consider a Regional Currency Unit for China, Japan, and Korea, as well as for the five original ASEAN countries,[4] or ASEAN5 + 3. Agarwal, Penm, Wong, and Martin (2004) consider an ASEAN dollar for all 10 ASEAN countries. Unfortunately, proposals that center around creation of a new currency do not yet have any real momentum toward that option.

A third policy discussion centers around currency baskets. The traditional "basket" contained just one currency – the U.S. dollar – but more recently several global currencies have been considered. Williamson (2005) proposes a basket containing 40.2% dollars, 31.6% euros, and 28.2% yen for nine countries (the ASEAN5 plus China, Hong Kong, Korea, and Taiwan) based on trade patterns. Ogawa and Shimizu (2006b) also consider G3 baskets containing the dollar, the yen, and the euro, but specifically consider individual currency baskets for East Asian currencies as precursors for a common currency basket.[5] The latter might in fact be a stepping stone to a common currency. In this area, Pontines (2006) estimates optimal weights for currencies that might form an optimum currency basket. Other researchers are more broadly considering whether the macroeconomies would be suitable for a common regional currency (e.g, Chow and Kim, 2003; Kim, 2007).

[4] Indonesia, Malaysia, Philippines, Singapore, and Thailand.
[5] For a theoretical approach to multilateral coordination, see Ogawa and Ito (2002).

This paper sheds light on all three of these discussions by explicitly determining the current status of global currencies in the region. The empirical investigation uses exchange rate data for the five original members of ASEAN (Indonesia, Malaysia, Philippines, Singapore, and Thailand) plus Vietnam. The Brunei dollar or ringgit is pegged 1:1 to the Singapore dollar so is not examined separately. Data for the other three members of ASEAN are not available. Analysis considers the six countries separately, and considers whether they are close to a global-currency standard (such as a dollar standard, yen standard, euro standard, or some basket of these). The focus is on the post-crisis era from January 1, 1999 through December 31, 2007, using nine years of daily data. The question is not entirely new, as Frankel and Wei (1994) and McKinnon and Schnabl (2004) use regression analysis to detect the influence of various foreign currencies on particular Asian currencies. This paper applies the same enquiry specifically to ASEAN countries, and also considers modern econometric time series analysis more seriously.

The empirical approach proceeds in steps. For the main investigation, and in line with Frankel and Wei (1994) and McKinnon and Schnabl (2004), research detects the influence of various global currencies on a particular ASEAN currency by using the Swiss franc as an "outside" currency. We work with daily data in order to consider the immediate impact ties between local currencies and external global currencies, a methodology that is designed to uncover high-frequency pegging. However, there may also be a long-run relationship achieved through short-term adjustment processes, so we tackle the question from the perspective of modern time series analysis by examining the univariate time-series properties of the data (in logarithmic terms) and, if appropriate,

testing whether the exchange rate series are cointegrated. If an ASEAN currency is cointegrated with any of the global currencies, we examine the cointegrating vector(s) to uncover the long-run relationship(s) among exchange rates. If an ASEAN currency is not cointegrated with the global currencies, we run a classical least squares regression using data in first differences and consider coefficients estimated that way.

2. Empirical Investigation

This section empirically considers the extent to which ASEAN currencies are tied to the major global currencies. We are particularly interested in the degree to which they are anchored to the US dollar, which would indicate the presence of an ASEAN dollar standard. The main alternative is the presence of a yen bloc, which would be revealed by close ties between the ASEAN currencies and the Japanese yen. Our focus is on the post-crisis period, January 1, 1999 through December 31, 2007, using daily exchange rate data.[6]

2.1 Methodology

This paper adapts the perspective of Frankel and Wei (1994) and McKinnon and Schnabl (2004) to examine the behavior of exchange rates. The main insight is that researchers may detect the influence of various foreign currencies on a particular local

[6] The data are from Datastream and represent the WM/Reuters series. The raw series are measured against the euro, except for the SF/$ exchange rate, so are converted into currency units per Swiss franc via the obvious transformation. The series are: SWISSF$ (SF/$), JPEURSP (¥/€), SWEURSP (SF/€), UKEURSP (£/€), SREURSP (SDR/€), IDEURSP (Indonesian rupiah/€), MYEURSP (Malaysian ringgit/€), PHEURSP (Philippine peso/€), SGEURSP (Singapore dollar/€), THEURSP (Thai baht/€), and VIEURSP (Vietnamese dong/€).

currency by using an "outside" currency – the Swiss franc – as a numeraire for measuring exchange rate volatility. The method has been applied to East Asian currencies to assess the influence of the dollar, the yen, and the Deutschemark. For this new investigation of ASEAN, we use the euro instead of the Deutschemark, and we furthermore include the British pound in order to evaluate its influence as a world currency.[7]

We work with daily data in order to consider the immediate ties between local currencies and external global currencies. Such analysis is designed to uncover high-frequency "pegging," either through central bank intervention or through fundamental market linkages. However, there may also be a long-run relationship achieved through short-term adjustment processes, so we tackle the question from the perspective of modern time series analysis. In this regard, we consider a methodology involving three steps.

In the first step, we consider the univariate time series properties of the data in logarithmic terms. We principally consider Augmented Dickey-Fuller (ADF) unit root tests. We follow the procedures outlined in Enders (2004, pp. 213-214) and carefully examine the serial correlation coefficient (ρ). If this step reveals that the series are stationary in (log) levels, or I(0), we will proceed to estimate the relationship between local currencies and global currencies using classical least squares regressions of the data

[7] The pound is used almost as much as the yen in global currency trading, and is a component of the International Monetary Fund's SDR. A survey of currency trading in April 2004 by the Bank for International Settlements (2005) revealed that the U.S. dollar is used in 89% of global currency trades, while the euro is used in 37%, the yen is used in 20%, the pound is used in 17%, and the Swiss franc is used in 6%. Because two currencies are used in each transaction, percentages sum to 200%. The SDR (Special Drawing Right) is a virtual "basket" currency issued by the IMF, consisting of specific amounts of the dollar, euro, yen, and pound.

in levels. If this step reveals that the series are stationary in differences (of logs), or I(1), we proceed to the second step.

In the second step, we consider the multivariate time series properties by investigating whether the ASEAN exchange rate series and the four global-currency exchange rate series – that are separately I(1) – are cointegrated. With all series I(1), there may be one (or more) linear combination(s) of the series that is (are) stationary. We use the Johansen trace test statistics (λ_{trace}) to test for cointegration, starting from the hypothesis that there are no cointegrating vectors ($r = 0$). We specifically focus on the small-sample-corrected trace test statistic.[8]

In the third step, we examine the relationship between each ASEAN currency and the four global currencies. If an ASEAN currency is cointegrated with the four global currencies, we examine the coefficients in the cointegrating vector(s). If an ASEAN currency is not cointegrated with the global currencies, we examine coefficients from a classical least squares regression using data in first differences.[9]

[8] The results were obtained using the software *CATS in RATS*, version 2, by J.G. Dennis, H. Hansen, S. Johansen, and K. Juselius, Estima 2005.

[9] Chow, Kim, and Sun (2007) find that ASEAN currencies are not cointegrated with the global currencies, but then convert the traditional least squares regression into a vector autoregression (VAR) and examine variance decompositions and impulse response functions to determine the long-run behavior of exchange rates. This approach is an important alternative to the usual least-squares regression, but we focus more on the cointegration results juxtaposed against the traditional regressions as the relevant benchmark. Chow, Kim, and Sun (2007) need to use the VAR particularly because they introduce a regional currency into the analysis, which in turn creates simultaneity bias in the traditional equations. However, the method is more generally applicable and is worth further investigation.

The methodology may be illustrated using SDR exchange rates. For the period 2001-2005, the basket contained \$0.5770, €0.4260, ¥21.0, and £0.0984.[10] Our methodology can be applied to recover the weights on each currency in the basket using exchange rates quoted as SDR/SF, \$/SF, €/SF, ¥/SF, and £/SF.

First, we examine the univariate time series properties. Using the log of the SDR/SF exchange rate, the Augmented Dickey-Fuller tests (with 1 lag of the dependent variable) are $\tau_\mu = -1.384$ (which is not significant at the 90% level, and estimates $\rho = 0.998$) and $\tau = -0.098$ (which is not significant, and estimates $\rho = 1.000$). The drift term is not significant so we favor τ over τ_μ, although both produce the same conclusion.[11] Clearly, the series is nonstationary in levels. For the differenced series, $\tau = -25.699$ (which is significant at all levels), and we thus conclude that the series is stationary in differences. Hence, the log of the SDR/SF exchange rate is I(1). Similarly, the four global currencies against the SF are found to be I(1) in logs. We suppress discussion of these tests here, but such discussion would be nearly identical to the discussion for the period 1999-2007 contained below (with reference to Table 2).

Second, we consider the multivariate time series properties by investigating whether the five exchange rate series are cointegrated. The Johansen test of the hypothesis that there are no cointegrating vectors ($r = 0$) is $\lambda_{trace} = 72.499$, which is not significant at the 90% level. We thus conclude that the series are not cointegrated. The test was calculated using the most general model allowing for linear trends in the variables and a constant in the cointegrating space, along with three lags of the dependent

[10] The SDR is regularly redefined, and since January 1, 2006 has contained \$0.6320, €0.4100, ¥18.4, and £0.0903.
[11] Prior tests also conclusively rejected the hypothesis of a trend term in the equation.

variables. The trend terms seem to be required. However, the model without the trend terms produces $\lambda_{trace} = 62.492$ (not significant at the 90% level) and the same conclusion that the series are not cointegrated. Similarly, models considering different lag lengths reach the same conclusion: the λ_{trace} statistics for 1 through 5 lags are, respectively, 79.446, 73.823, 72.499, 73.165, and 72.957 (none are significant at the 90% level). We are thus very confident in the conclusion that the five series are not cointegrated.

Third, and given the absence of cointegration, the relationship between the SDR and the four global currencies is appropriately estimated using the first differences of the series in a classical least squares regression. The result is (with robust standard errors in parentheses):

$$(\Delta S_{SDR/SF})_t = \underset{(.000)}{0.000} + \underset{(.001)}{0.415}(\Delta S_{\$/SF})_t + \underset{(.001)}{0.134}(\Delta S_{¥/SF})_t + \underset{(.003)}{0.317}(\Delta S_{€/SF})_t + \underset{(.001)}{0.124}(\Delta S_{£/SF})_t + u_t$$

$$\text{adjusted } R^2 = 1.00 \qquad \text{D-W} = 2.11$$

The coefficients represent the average weights over this time period: 41.5% on the dollar, 13.4% on the yen, 31.7% on the euro, and 12.4% on the pound, for a total of 99.0%. We can reject the hypothesis that the coefficient on the dollar is unity [$\chi^2(1) = 155{,}894$] and the joint hypothesis that the coefficient on the dollar is unity and the coefficients on the other currencies are zero [$\chi^2(4) = 159{,}738$]. We thus conclude that the IMF is not anchoring the SDR exclusively to the dollar, which is clearly not a surprise. [Nevertheless, the partial R^2, indicating the proportion of the variation in (changes in) the SDR that is explained by (changes in) the dollar given the coefficient of 0.415, is high, at 0.992.]

At this point, a synopsis of some of the results in McKinnon and Schnabl (2004) provides an additional context in which to evaluate the upcoming results for ASEAN. For the post-crisis period in Asia, McKinnon and Schnabl use the period from January 1999 through December 2003. They report (in footnote 6) that "tests did not yield any evidence for any cointegrating vector between the four exchange rates (p.360)", and thus proceed with a least-squares regression using differenced data. For the nine countries (the ASEAN5 and China, Hong Kong, Korea, and Taiwan), regression $\overline{R}^2$ values range from 0.32 to 1.00. Coefficients on the dollar range from 0.75 to 1.00 and are all statistically significant. Although many coefficients on the yen and the DM are statistically significant, they are all smaller than the coefficient on dollar, ranging from 0.00 to 0.21. The inescapable conclusion is that East Asian countries were on a dollar standard during this period.

2.2 Univariate Time Series Properties

Table 2 presents Augmented Dickey-Fuller (ADF) unit root tests for the currency series under consideration. We start by allowing for a drift and a trend in each series, along with lags of the variable under consideration. However, all series reject the hypothesis that a trend is present, so we concentrate only on cases without a trend included. The focus is on the τ_μ and τ ADF tests for the cases with drift and without drift, respectively.

Statistics for the dollar, yen, euro, and pound are shown in Panel A of Table 2. The four currencies (in natural logs) have autocorrelation (ρ) coefficients ranging from 0.996 to 0.999 when the drift term is included, and the ADF τ_μ tests fail to reject the

hypothesis that the coefficient is unity. We thus proceed to test for the presence of the drift. We cannot reject the hypothesis of no drift in the dollar, yen, and euro, so we present ADF τ tests excluding the drift and conclude that we cannot reject the hypothesis that the coefficient is unity. For the pound, the hypothesis that the series does not contain a drift is rejected at the 95% level but not at the 99% level, thus leaving some discretion in the way to proceed. Retaining the drift, τ_μ essentially indicates that $\rho=1$. Eliminating the drift, τ indicates that $\rho=1$. Hence, we comfortably conclude that all four currencies contain unit roots, and the data are thus nonstationary in levels. ADF τ tests on the first differences of the series clearly indicate that the differenced series are stationary, thus leading to the conclusion that the series are I(1).

The results of the univariate time series statistics are similar for the ASEAN currencies, as shown in Panel B of Table 2. The autocorrelation coefficients are very high and range from 0.997 (for the Malaysian ringgit) to 1.000 (for the Vietnamese dong). All ADF τ_μ tests fail to reject the hypothesis that the coefficient is unity. The only exception is for the Malaysian ringgit, which rejects the hypothesis at the 90% level but not at the 95% level. Although this gives us some discretion in the way to proceed, we conclude for now that we cannot reject the hypothesis that the coefficient is unity. Again, we proceed to test for the presence of the drift. We cannot reject the hypothesis of no drift in the any of the ASEAN currencies, except for the Malaysian ringgit. We thus present ADF τ tests excluding the drift and conclude that we cannot reject the hypothesis that the coefficient is unity for any of the ASEAN currencies. Hence, we conclude that all ASEAN series contain unit roots, and are thus nonstationary in levels. ADF τ tests on the

first differences indicate that the differenced series are stationary, leading to the conclusion that the ASEAN currencies are I(1).

2.3 Results of Cointegration Tests for the Global Currencies Alone

We now consider whether the series are cointegrated. As a preliminary investigation, we consider the four global currencies before including the ASEAN currencies. Furthermore, we revert to the example of the SDR/SF exchange rate above and consider the period 2001-2005. Recall that we concluded that the SDR and the four global currencies were not cointegrated. Testing whether the four global currencies themselves are cointegrated produces a Johansen test statistic for the hypothesis that there are no cointegrating vectors (r=0) of $\lambda_{trace} = 58.347$, which is not significant at the 90% level. This suggests that the four exchange rates vis-à-vis the Swiss franc can move away from each other in the long run. Because the SDR is known to be a linear combination of the four global currencies, it isn't a surprise that the SDR and the four global currencies are not cointegrated if the four global currencies themselves are not cointegrated.

Extending the period to include the entire post-crisis era, 1999-2007, reveals less conclusive results. The Johansen test statistic for the hypothesis that r=0 is now $\lambda_{trace} = 63.966$, which is significant at the 95% level but not the 99% level. Hence, we have some discretion in deciding whether the four global currencies are cointegrated, but it certainly looks like the additional four years of data tilts the analysis toward concluding that the series are cointegrated. The test statistic for the hypothesis that r=1 is $\lambda_{trace} = 36.668$, which is not significant, comfortably rejecting the hypothesis that there is more than one cointegrating vector. Hence, if we conclude that the four global currencies are

cointegrated, there is most likely only one cointegrating vector. Similarly, models considering different lag lengths reach similar conclusions: the λ_{trace} statistics for 1 through 5 lags are, respectively, 69.045**, 67.342**, 63.966**, 61.881*, and 60.853* (all are significant at the 90% level, and lags 1-3 are significant at the 95% level but not at the 99% level).

Further analysis of the system using three lags of the dependent variables reveals that the cointegrating vector (where exchange rates are in logarithmic forms and standard errors are in parentheses) is:

$$(S_{£/SF})_t = \underset{(.078)}{0.367}(S_{\$/SF})_t + \underset{(.081)}{0.050}(S_{¥/SF})_t + \underset{(.137)}{0.828}(S_{€/SF})_t - \underset{(.000)}{0.000}\ TREND_t$$

Given the standard errors of the coefficients above, we test the hypothesis that the coefficient on the ¥/SF exchange rate is zero and cannot reject it [$\chi^2(1) = 0.129$]. We thus impose the restriction that the coefficient is zero and consider the new cointegrating vector:

$$(S_{£/SF})_t = \underset{(.062)}{0.387}(S_{\$/SF})_t + \underset{(.140)}{0.842}(S_{€/SF})_t - \underset{(.000)}{0.000}\ TREND_t$$

The equation suggests that there is a long-run relationship among the £/SF, $/SF, and the €/SF exchange rates. In particular, a 10% increase in the $/SF exchange rate (depreciation of the dollar) is associated with a 3.87% increase in the £/SF exchange rate (depreciation of the pound) and a 10% increase in the €/SF exchange rate is associated with an 8.42% increase in the £/SF exchange rate. There is also a trend (although the display does not carry enough digits beyond the decimal place to show what it is).

In many regards, it makes sense that the £/SF, $/SF, and €/SF exchange rates are tied together in a long-run equilibrium. Extensive competition, trade, and capital flows among the UK, the US, the euro area, and even Switzerland likely impose discipline on the bilateral exchange rates to prevent them from diverging from each other in the long run. Furthermore, because of the (n-1) problem, three currencies are measured against a fourth currency, and that fourth currency is not likely to be fully "neutral." Pound, dollar, and euro depreciations might be at least partially due to Swiss franc appreciation against all currencies.[12]

Some other researchers have found cointegration among developed-country currencies. Haug, MacKinnon, and Michelis (2000) find cointegration among exchange rates for 12 European Union (EU) countries (against the ECU and the DM, alternately) over the period 1979-1995 prior to the creation of the euro. They find 3-8 cointegrating vectors, and conclude that there is some convergence of policies among large subsets of the EU countries, but not complete convergence. Policies have apparently been aligned

[12] By tradition, the Swiss franc has been used as the numeraire ever since Frankel and Wei (1994) adopted it. Selection of the Swiss franc as a major currency outside currency-management agreements is logical, but not necessarily scientific. In a recent re-examination of Asian exchange rates, the Asian Development Bank (2008) chose the U.K. pound "as the numeraire because it is the only widely traded third currency that is presumably not highly correlated with the euro (p. 195)." This suggests that further investigation into the choice of numeraire might be valuable. Recognizing the problems of choosing a numeraire, Bénassy-Quéré, Coeuré, and Mignon (2006) describe an exchange rate peg on a dollar/euro/yen basket as an orthogonality condition for bilateral exchange rates vis-à-vis these currencies, and then estimate the weights on the currencies using the generalized method of moments technique. This approach may become more popular in the future if problems selecting a numeraire are more seriously documented. Bénassy-Quéré, Coeuré, and Mignon (2006) indicate that, for the period 1999-2004, the Swiss franc is a perfect peg to the euro and the U.K. pound is pegged to a basket consisting of the dollar (52%) and the euro (56%), with some negative influence from the yen (-8%). The technique restricts the sum of the coefficients to be unity, which is not necessarily a desirable feature because it does not allow for partial pegging to currency baskets.

enough so that the exchange rates move toward an equilibrium in the long run and do not drift too far apart over time. Jeon and Lee (2002) find cointegration among G-7 exchange rates (against the dollar) for the period 1985-1996 after the Plaza Agreement. They find 1-2 cointegrating vectors, and conclude that "exchange rates are more tightly cointegrated after the Plaza agreement due to foreign exchange interventions and the international macroeconomic policy coordination (p. 64)." Neither paper reports the actual cointegrating vectors.

Given the discussion above, it's worth considering the interpretation of the coefficients in the cointegrating vector. The coefficients 0.387 and 0.842 seem reasonable insofar as proportions are concerned. The pound is apparently a currency basket consisting 39% of dollars and 82% of euros. There is some puzzle as to why these sum to more than 100%, although the negative trend may play a role of mitigating this. Equally interesting is the conclusion that the ¥/SF exchange is not part of the cointegration, suggesting that the yen is segmented from rest of the currencies and is free to diverge in the long run. These findings provide the foundation for analysis of cointegration among the ASEAN exchange rates and the four global currency exchange rates.

2.4 Results of Cointegration Tests Including the ASEAN Currencies

Table 3 presents the Johansen trace test statistics for the systems of five exchange rates: an ASEAN exchange rate and the four global currency exchange rates. The tests are calculated using the most general model allowing for linear time trends in the variables and a constant in the cointegrating space, along with three lags of the dependent

variables. The hypothesis that there are no cointegrating vectors (r = 0) can be rejected at the 95% level in five of the six cases. For the Singapore dollar/SF exchange rate, the hypothesis that there are no cointegrating vectors can be rejected at the 90% level but not at the 95% level. For the Malaysian ringgit/SF and Vietnamese dong/SF exchange rates, the hypothesis can be rejected at the 99% level. Hence, although there is some room to apply discretion, it seems that all ASEAN currencies are cointegrated with the major global currencies. Singapore presents the weakest case, and Malaysia and Vietnam present the strongest. In all cases, the hypothesis that r=1 cannot be rejected at the 95% level, although for Malaysia the hypothesis can be rejected at the 90% level. Hence, there is most likely only one cointegrating vector in each system, although there is a weak case to consider a second cointegrating vector for Malaysia.

Table 4 presents the cointegrating vectors from the analysis, each normalized around the ASEAN exchange rate. For each, the cointegrating vector considering four global currencies and a trend is presented. We test for significance of coefficients by using exclusion restrictions on the cointegrating vector, and when the hypothesis that the coefficient is zero cannot be rejected, we restrict the coefficient to be zero and report the new cointegrating vector.

Malaysia, Singapore, and Vietnam each offer rather parsimonious equations with just three variables in the cointegrating relation. For Malaysia, the cointegrating vector suggests that the ringgit is pegged in the long run to a currency basket containing 68% dollars and 127% pounds. Hence, the dollar and the pound are both important in the long-run relationship, and that the pound is about twice as important as the dollar.

However, the magnitude of the effect from the pound in fact seems a bit large in conjunction with the effect from the dollar, as the two together sum to nearly 200%.

Results are similar for the Singapore dollar: it is pegged to a currency basket containing 44% US dollars and 142% pounds. Once again, the dollar and the pound are both important in the long-run relationship and the magnitude of the effect from the pound seems a bit large in conjunction with the effect from the dollar, as the two sum to nearly 200%. For both Malaysia and Singapore, the yen is notably absent from the long-run relationship, suggesting that the Malaysian ringgit and the Singapore dollar are certainly not part of a yen bloc in Asia.

Vietnam offers a slightly different result. The dong is pegged to a currency basket containing 128% dollars and 31% yen. For the dong, the dollar and the yen are both important in the long-run relationship, although the dollar appears to be about four times more important than the yen.

The Thai baht is cointegrated with the yen and the pound, and there is a trend. The baht is pegged to a currency basket containing 248% pounds and –38% yen. This suggests that the yen is important but that in a long-run equilibrium the baht and the yen actually move inversely to each other vis-à-vis the Swiss franc.

The Indonesian rupiah also demonstrates the importance of the pound, and has inverse relationships with the dollar and the euro. The rupiah is pegged to a currency basket containing 366% pounds, –192% euros, and –107% dollars. There is also a trend. Normalizing around the £/SF exchange rate instead of the ringgit/SF exchange rate, as we did earlier when we considered only the four global currencies, we get (standard errors in parentheses):

$$(S_{£/SF})_t = \underset{(.076)}{0.293}(S_{\$/SF})_t + \underset{(.168)}{0.525}(S_{€/SF})_t + \underset{(.067)}{0.273}(S_{rupiah/SF})_t - \underset{(.000)}{0.000}\ TREND$$

This is approximately the same as the final cointegrating vector for the £/SF against the other global currencies, although has somewhat smaller coefficients on the $/SF and €/SF exchange rates as it allows for a role of the rupiah/SF exchange rate. Hence, the behavior isn't as much of a puzzle as when the cointegrating vector normalized around the rupiah/SF exchange rate is examined. Nevertheless, the interpretation of influences on the rupiah is problematic.

The Philippine peso appears to be cointegrated with all four global currencies. It is directly related to the dollar and the euro, and inversely related to the yen and the pound. Magnitudes are all very high, so it's a bit difficult to tell what's going on. Renormalizing around the £/SF exchange rate again helps interpretation, yet begs for an answer to the question as to why:

$$(S_{£/SF})_t = \underset{(.315)}{0.971}(S_{\$/SF})_t - \underset{(.179)}{0.617}(S_{¥/SF})_t + \underset{(.548)}{1.878}(S_{€/SF})_t - \underset{(.152)}{0.218}(S_{peso/SF})_t$$

At this stage, it seems clear that cointegration among the ASEAN currencies and the global currencies must be taken seriously. Inspection of the cointegrating vectors reveals four findings, though it should be noted that the coefficients in the cointegrating vectors are not very credible.

The first finding is that there is no clear "dollar standard" in the ASEAN countries. In these long-run relationships, the $/SF exchange rate is most important only for the Vietnamese dong. However, the $/SF exchange rate is also an important component for the Malaysian ringgit, the Singapore dollar, and Philippine peso. The $/SF exchange rate is important to the Indonesian rupiah, but is inversely related.

The second finding from this investigation is that the yen is relatively unimportant in ASEAN. The yen is an important (yet secondary) component only for the Vietnamese dong. It's also a component of the cointegrating vectors for the Thai baht and the Philippine peso, but is inversely related. Hence, it seems obvious that there is not a yen bloc in ASEAN.

The third finding is that the euro is also relatively unimportant in ASEAN. The euro is the most important contributor to the cointegrating vector for the Philippine peso, so much so that it begs for an explanation. The euro is also an important contributor to the cointegrating vector for the Indonesian rupiah, but is inversely related.

The fourth – and most puzzling – finding is that the UK pound is very important, and this begs for more investigation. Of the six ASEAN currencies, four (the Malaysian ringgit, Singapore dollar, Thai baht, and Indonesian rupiah) are predominantly influenced directly by the £/SF exchange rate. One currency (the Vietnamese dong) is not affected by the £/SF exchange rate, and one other currency (the Philippine peso) is influenced inversely by the £/SF exchange rate.

Uncovering incredible magnitudes for coefficients in cointegrating vectors is not unusual. In this regard, it may be more important to focus on the tests for cointegration as evidence that there is a currency basket peg in the long run rather than try to determine

the exact weights on the currencies. Recall that neither Haug, MacKinnon, and Michelis (2000) nor Jeon and Lee (2002) revealed the cointegrating vectors even though cointegration was detected.

An alternative explanation of the situation is that reliance on Johansen tests might be resulting in spurious findings of cointegration. Recently, Phengpis (2006) compares six different tests for cointegration among exchange rates during the European and Asian crisis periods and concludes that there are strong doubts on the presence of cointegration even when the Johansen tests indicate there is cointegration. Although the present research is using the Johansen tests with a much longer period of data and a completely different purpose, we need to acknowledge that our finding of cointegration, based on the conventional Johansen tests, may not be the definitive finding with regard to cointegration. However, we leave validation or refutation to future work, and instead simply consider our results juxtaposed against results of regressions using differenced data, which would have been our preferred methodology if we had found that there is no cointegration among the exchange rates.

2.5 Results of Regressions using Differenced Data

Given the questions raised by the results of the cointegration tests, this subsection quickly presents the more traditional regressions using differenced data (in logarithmic form). If the exchange rates are indeed cointegrated, the traditional regressions will not adequately represent a long-run relationship. However, the regressions may help us understand the short-run relationships and thus shed light on the long-run relationships.

We specifically estimate the regression:

$$(\Delta S_{LC/SF})_t = \beta_0 + \beta_1(\Delta S_{\$/SF})_t + \beta_2(\Delta S_{¥/SF})_t + \beta_3(\Delta S_{€/SF})_t + \beta_4(\Delta S_{£/SF})_t + u_t$$

for each ASEAN currency (LC), as well as a more parsimonious version removing any insignificant variables. This is exactly the methodology of Frankel and Wei (1994) and McKinnon and Schnabl (2004). As explained in McKinnon and Schnabl (2004, p. 344), the coefficients represent the weights of the respective currencies in a currency basket determining the behavior of the local currency. If a currency is closely linked to one of the currencies appearing on the right-hand side of the equation, the corresponding coefficient will be close to unity. If a coefficient is close to zero, there is no stabilization against that particular currency. A high $\overline{R}^2$ coefficient, particularly close to unity, indicates that local currency exchange rates against the Swiss franc can be almost fully explained by fluctuations in major currencies against the Swiss franc. Equations are estimated using the methodology of White to obtain heteroscedasticity-consistent standard errors and covariances.

The regression results are presented in Table 5. The $\overline{R}^2$ values range from 0.33 for Indonesia to 1.00 for Vietnam. All coefficients are sensible, and the striking conclusion is that the ASEAN currencies are on a US dollar standard in the short run. All coefficients on the change in the $/SF exchange rate are statistically significant, and they are higher than any other coefficients for each of the six ASEAN currencies. They range from 0.666 for the Singapore dollar to 0.998 for the Vietnamese dong.

A smattering of other coefficients are significant. The Japanese yen is much less important than the dollar, with coefficients ranging from zero (Vietnamese dong and Malaysian ringgit) to 0.208 (Indonesian rupiah). The euro is not particularly important, but is a bit more important than the cointegrating vectors suggested, with coefficients

ranging from zero (Vietnamese dong) to 0.304 (Indonesian rupiah). Conversely, the pound is considerably less important than the cointegrating vectors suggested, with coefficients being zero for each case except the Malaysian ringgit (a coefficient of just 0.060) and the Singapore dollar (with a coefficient of just 0.067).

The results in Table 5, which require the assumption that the exchange rates are not cointegrated, suggest that ASEAN is on a dollar standard. However, it's not a perfect dollar standard because coefficients are not always at unity. The last column of Table 5 reports the $\chi^2(1)$ test statistic of the hypothesis that $\beta_1 = 1$.[13] Only for Vietnam can we conclude that $\beta_1 = 1$ (although we can even reject that hypothesis at the 10% level for the parsimonious equation). Given the significance of some other coefficients in various equations, it seems clear that there is not a uniform combination of global currency influences across all ASEAN currencies.

3. Conclusion

This paper reconsiders the US dollar standard presumed to prevail in ASEAN. We specifically examine the time series relationships between local currencies for the ASEAN5 countries plus Vietnam and the major global currencies using daily data over the period 1999-2007. Unlike previous authors, we find evidence of cointegration among individual ASEAN currencies and some of the global currencies. We interpret this as evidence of a currency basket peg in the long run for each ASEAN currency. In other words, each local currency is tied to some combination of the dollar, the yen, the euro, and the pound in the long run. This finding allows us to consider the cointegrating

[13] This is a χ^2 test with one degree of freedom since equations are estimated using the method of White to correct for heteroscedasticity in the residuals.

vectors to identify the long-run relationships among exchange rates, which provide the weights on the currencies in the basket.

The coefficients in the cointegrating vectors are broadly reasonable, but are difficult to interpret in the context of basket pegs. Nevertheless, examination of the cointegrating vectors yields four main findings. First, there is a notable absence of a clear U.S. dollar standard. In these long-run relationships, the $/SF exchange rate is most important only for the Vietnamese dong, although it is a statistically significant component for the Malaysian ringgit, the Singapore dollar, and Philippine peso. Second, the yen is relatively unimportant in ASEAN, so it seems obvious that there is *not* a yen bloc in ASEAN. The yen is an important (yet secondary) component only for the Vietnamese dong. Third, the euro is similarly unimportant in ASEAN, so it seems clear that there is no euro standard in ASEAN either. The euro is the most important contributor to the cointegrating vector for the Philippine peso, but is otherwise unimportant.

The fourth – and most surprising – finding is that the U.K. pound is very important. This in fact begs for more investigation, and previous authors have not even considered this currency. Of the six ASEAN exchange rates, four are predominantly influenced directly by the pound exchange rate. This suggests there may in fact be an ASEAN pound standard! Furthermore, this finding may be affecting the first three findings addressed above.

Given the questions raised by the cointegration results, we proceeded to consider the more traditional regressions using differenced data (in logarithmic form). If the exchange rates are indeed cointegrated, the traditional regressions do not adequately

represent a long-run relationship but suggest short-run relationships. However, the regressions produce coefficients that are sensible, and conceptually more plausible. Foremost, the results suggest that ASEAN is on a dollar standard, although it's not a perfect dollar standard because coefficients are not at unity. Given the significance of various other coefficients in different equations, it seems clear that there is not a uniform combination of global currency influences across all ASEAN currencies.

The differences between the long-run (cointegration) results and the short-run (traditional regression) results constitute the overall puzzle at this point. In particular, the importance of the U.K. pound in the cointegrating vectors is striking, especially compared to its relative unimportance in the traditional regressions. In this regard, the findings in this paper might best be considered tentative, as they raise more questions for future research. In particular:

1. What is the role of the U.K. pound in ASEAN? Simply removing the pound from consideration may remove the puzzle uncovered in the cointegrating vectors, but will not actually answer this question. However, finding an answer to the question may prove difficult.
2. Does the choice of the numeraire matter for (either the cointegration or the traditional regression) the results? It might be that the Swiss franc is not the best base currency, as it might not be truly "outside" or "neutral within" the system of global currencies. However, there is no obvious alternative at this point, so a search for a better numeraire (or a way around the issue) may be a topic in itself.

3. Is there really cointegration? Reliance on Johansen tests might result in spurious findings of cointegration, so additional cointegration tests may shed light on the situation.

These questions are in fact inter-related. For example, inclusion of the U.K. pound may be influencing the conclusion of cointegration, linking questions 1 and 3. For that matter, the choice of the numeraire may be influencing the conclusion of cointegration, linking questions 1 and 2. Furthermore, the pound may be considered as a numeraire, as in Asian Development Bank (2008), linking questions 1 and 2. Clearly, there is room for more work in this area.

Taking the results from cointegration tests and from regressions using differenced data together, the overall conclusion from this research is that there is a wide diversity of influences on ASEAN exchange rates. This indicates that ASEAN, as a group, is not pursuing a global-currency standard. The extent of monetary integration in ASEAN is thus quite minor. The diversity of influences also suggests that ASEAN is not ready for a regional global-currency standard or a common currency.

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Table 1
Best Currency Anchor for Selected ASEAN Countries
Alesina, Barro, and Tenreyro (2003) Results Based on Three Criteria

Country	Trade/GDP Ratio	Co-Movement of Prices	Co-Movement of Output
Indonesia	Yen	**Dollar**	Euro
Malaysia	Yen	Dollar	Euro
Singapore	Dollar/Yen	**Dollar**	Euro
Thailand	Yen	**Yen**	Yen

Note: Bold indicates a high magnitude for the difference between the currency listed and next-ranked alternative.
Source: Alesina, Barro, and Tenreyro (2003), Tables 13 and 14.

Table 2
Augmented Dickey-Fuller Unit Root Tests
Currencies Against the Swiss Franc, January 1, 1999 to December 31, 2007
(in natural logs; 2347 observations)

Panel A
Major Global Currencies

Exchange Rate	Levels						Differences		
	With Drift			Without Drift			Without Drift		
	ρ	τ_μ	lags	ρ	τ	lags	ρ	τ	lags
U.S. Dollar	0.999	-0.566	0	1.000	-0.805	0	-0.021	-49.467***	0
Japanese Yen	0.999	-0.843	0	1.000	0.535	0	0.019	-47.477***	0
European Euro	0.999	-1.100	2	1.000	0.178	2	-0.003	-35.351***	1
U.K. Pound	0.996	-2.236	0	1.000	-0.189	0	0.013	-47.827***	0

Panel B
Major ASEAN Currencies

Exchange Rate	Levels						Differences		
	With Drift			Without Drift			Without Drift		
	ρ	τ_μ	lags	ρ	τ	lags	ρ	τ	lags
Indonesian Rupiah	0.998	-1.211	3	1.000	0.690	3	-0.054	-30.461***	2
Malaysian Ringgit	0.997	-2.732*	0	1.000	-1.189	0	-0.027	-49.727***	0
Philippine Peso	0.999	-1.177	1	1.000	0.689	1	-0.070	-51.915***	0
Singapore Dollar	0.999	-1.251	1	1.000	-0.442	1	-0.056	-51.212***	0
Thai Baht	0.998	-1.418	3	1.000	0.352	3	-0.149	-30.710***	2
Vietnamese Dong	1.000	-0.257	0	1.000	1.106	0	-0.022	-49.487***	0

Note: * significant at the 90% level; ** significant at the 95% level; *** significant at the 99% level

Table 3
Johansen Cointegration Tests of ASEAN Currencies with the Dollar, Yen, Euro, and Pound
Currencies Against the Swiss Franc, January 1, 1999 to December 31, 2007
(in natural logs; 2347 observations)

	λ_{trace}				
Exchange Rate	r=0	r=1	r=2	r=3	r=4
Indonesian Rupiah	91.06**	52.304	33.945	18.208	8.082
Malaysian Ringgit	114.848***	62.617*	32.663	14.441	6.577
Philippine Peso	95.557**	53.603	31.496	14.446	3.159
Singapore Dollar	84.491*	51.443	31.842	14.709	3.140
Thai Baht	91.886**	54.836	31.623	15.286	3.542
Vietnamese Dong	134.887***	54.382	30.890	17.173	5.918

Notes: models estimated include a trend and use 3 lags
* significant at the 90% level; ** significant at the 95% level; *** significant at the 99% level

Table 4
Cointegrating Vectors
Currencies Against the Swiss Franc, January 1, 1999 to December 31, 2007
(in natural logs; 2347 observations; t-statistics in parentheses)

Exchange Rate	$S_{\$/SF}$	$S_{¥/SF}$	$S_{€/SF}$	$S_{£/SF}$	TREND
Indonesian Rupiah	-1.078 (-2.432)	0.079 (0.222)	-1.856 (-1.845)	3.564 (4.055)	0.000 (4.766)
	-1.074 (-2.463)		-1.923 (-1.931)	3.662 (4.414)	0.000 (5.713)
Malaysian Ringgit	0.835 (3.113)	-0.013 (-0.060)	0.114 (0.188)	1.068 (2.008)	-0.000 (-0.773)
	0.675 (6.017)			1.265 (4.159)	
Philippine Peso	5.608 (3.616)	-3.238 (-2.610)	10.849 (3.081)	-6.847 (-2.226)	-0.000 (-0.459)
	4.456 (4.317)	-2.832 (-3.429)	8.615 (3.453)	-4.587 (-2.215)	
Singapore Dollar	0.517 (3.623)	-0.095 (-0.837)	0.008 (0.025)	1.409 (4.977)	-0.000 (-0.051)
	0.435 (7.739)			1.423 (9.091)	
Thai Baht	0.194 (1.109)	-0.435 (-2.864)	0.051 (0.118)	2.274 (6.024)	0.000 (3.639)
		-0.377 (-2.519)		2.484 (10.477)	0.000 (4.578)
Vietnamese Dong	1.234 (14.963)	0.212 (3.217)	0.310 (1.659)	-0.062 (-0.381)	0.000 (1.773)
	1.275 (15.194)	0.312 (3.657)			

Table 5
Regressions of $\Delta S_{LC/SF} = \beta_0 + \beta_1(\Delta S_{\$/SF}) + \beta_2(\Delta S_{¥/SF}) + \beta_3(\Delta S_{€/SF}) + \beta_4(\Delta S_{£/SF}) + u$
January 1, 1999 – December 31, 2007

Exchange Rate	β_0	β_1	β_2	β_3	β_4	$\overline{R}^2$ D-W	$\chi^2(1)$ test of $\beta_1 = 1$
Indonesian Rupiah	0.007 (0.382)	0.830 (18.726)	0.205 (4.249)	0.284 (2.376)	0.047 (0.818)	0.33 1.76	14.70***
		0.848 (20.079)	0.208 (4.338)	0.304 (2.679)		0.33 1.76	273.20***
Malaysian Ringgit	-0.021 (-2.273)	0.904 (22.993)	0.055 (1.559)	0.072 (2.811)	0.052 (1.845)	0.65 1.99	5.97**
	-0.021 (-2.273)	0.936 (37.342)		0.055 (2.767)	0.060 (2.071)	0.65 1.99	6.40**
Philippine Peso	0.002 (0.308)	0.898 (47.168)	0.078 (3.515)	0.099 (1.995)	0.029 (0.998)	0.65 2.04	28.80***
		0.909 (55.646)	0.080 (3.620)	0.112 (2.289)		0.65 2.04	1714.32***
Singapore Dollar	-0.004 (-0.981)	0.666 (52.740)	0.194 (17.656)	0.175 (6.430)	0.067 (4.84)	0.86 2.04	698.85***
		0.666 (52.723)	0.194 (17.665)	0.175 (6.449)	0.067 (4.854)	0.86 2.04	5364.42***
Thai Baht	-0.002 (-0.274)	0.742 (38.966)	0.191 (11.742)	0.184 (4.334)	0.026 (1.211)	0.64 2.10	183.98***
		0.751 (42.500)	0.193 (11.907)	0.195 (4.856)		0.64 2.10	2485.24***
Vietnamese Dong	0.006 (8.320)	0.997 (570.651)	0.001 (0.729)	-0.002 (-0.506)	0.001 (0.295)	1.00 2.02	2.28
	0.006 (8.330)	0.998 (870.172)				1.00 2.02	3.06*

Notes: The number of observations in each equation is 2,347.
* significant at the 90% level; ** significant at the 95% level; *** significant at the 99% level