

Re-examining exchange rate regimes in Asia after the global financial crisis

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Abstract

The Asian crisis of 1997 involved currency crises in many countries. The global financial crisis of 2008 has not had a similar large impact on exchange rates. Nor has it, unlike the Asian crisis, been followed by, countries announcing changes in the *de jure* regimes. In this paper, we find that it has resulted in significantly greater flexibility of exchange rates in some countries, and a change in a couple of countries of the *de facto* exchange rate regime. Korea has moved to a float, and Vietnam has enhanced greater flexibility. We find that on average, the exchange rate regime in Asia has slowly moved towards greater flexibility over the last five years, while retaining a focus on pegging to the USD.

JEL Codes: F31, F33

Keywords: Exchange rate regimes, Asia.

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Contents

1	Introduction	3
2	Methodology	4
2.1	Summary of empirical strategy	6
2.2	Examples	7
3	Evolution of exchange rate regimes in Asia	10
3.1	Robustness checks	14
4	Conclusion	17
A	Appendix: Exchange rate regime analysis for 12 countries	21
A.1	Bangladesh	21
A.2	Bhutan	23
A.3	China	24
A.4	Hong Kong	25
A.5	Indonesia	26
A.6	Sri Lanka	27
A.7	Nepal	28
A.8	Philippines	29
A.9	Pakistan	30
A.10	Singapore	31
A.11	Thailand	32
A.12	Taiwan	33

1 Introduction

This paper contributes to the literature in the field of analysing exchange rate regimes of Asia by applying a new methodology for dating structural change in the exchange rate regime with a sound inferential strategy.

Asian countries that witnessed currency crisis in the Asian crisis, and announced changes in the currency regime, did not implement a significant change in their *de facto* currency regimes. While for some time, greater flexibility was observed, after the period of turmoil in 1997, countries went back to very low volatilities of the exchange rate (Baig, 2001; Cavoli and Rajan, 2006; McKinnon, Schnabl, Stra e, Str, and Building, 2005; Bauer and Herz, 2009; Hernandez and Montiel, 2003). The volatility was higher than during the pre-Asian crisis period but in comparison to other countries, Asian countries continued to peg their exchange rates to the US dollar (Baig, 2001). Most empirical literature on the question of Asian exchange rate regimes emerged in the five years following the crisis, when there was enormous interest in the question of currency regimes in Asia.

More recently, the literature has focussed on whether the Chinese yuan has remained pegged to the US dollar and if currencies in the region move together (Goldstein and Lardy, 2003; Ho, Ma, and McCauley, 2005; Dungey, Fry, and Martin, 2004; Sheng, Kwek, and Cho, 2009). The ‘Bretton Woods II’ hypothesis conjectured that such *de facto* pegging was an optimal strategy for Asia, and was sustainable for the long run.

In the literature, there has been little focus on the evolution of the exchange rate regime in the full period since the Asian crisis. Further, with the global financial crisis of 2008, which was not accompanied by a currency crisis, there has been little re-examination of the behaviour of currency regimes in Asia. Since countries have not announced changes in currency regimes, the fact that some *de facto* regimes have changed, as we find in this paper, has gone largely unnoticed.

The measurement of *de facto* exchange rate regimes has gained importance with the finding that many central banks do not do as they say. We adopt the inferential strategy for measuring and classifying the exchange rate regime of Zeileis, Shah, and Patnaik (2008). We examine a data set of weekly currency returns data for 16 Asian countries from January 1, 1991 to May 31, 2009 ¹. Our results contribute to the *de facto* currency regime classification literature by identifying dates of structural breaks in the exchange rate regime through

¹For some countries the data starts from January 1, 1993.

a clear inferential strategy, and by having a real-valued measure of exchange rate flexibility in each sub-period.

Three countries moved towards greater flexibility during the global financial crisis of 2008. Of these, Korea moved to a float. Others, like China have remained inflexible *de facto* pegs to the US dollar. Asia, as a whole, has moved towards greater flexibility.

Our results also show that most countries show increased flexibility after the Asian crisis, and in particular between the years 2004 and 2009. We also find support for the results of earlier studies such as Krugman (1998); Edwards (2001); Calvo and Reinhart (2002a); Tiwari (2003); Levy-Yeyati E (2003); CM and KS (2004) which find that while there was very little currency flexibility in the years prior to the Asian crisis, even after the crisis, when many of these countries claimed to have moved to a managed float (Hernandez and Montiel, 2003; Sheng, Kwek, and Cho, 2009; Bauer and Herz, 2009), currency flexibility rose, but only very slightly.

Currency flexibility has gradually risen in the last five years. At the same time, the focus of exchange rate setting by central banks remains the US dollar, as in Hernandez and Montiel (2003); Bénassy-Quéré, Coeuré, and Mignon (2006a); Bauer and Herz (2009).

2 Methodology

In the last decade, the literature has revealed that the *de jure* exchange rate regime in operation in many countries that is announced by the central bank differs from the *de facto* regime in operation. This has motivated a small literature on data-driven methods for the classification of exchange rate regimes (see e.g., Reinhart and Rogoff, 2004; Levy-Yeyati and Sturzenegger, 2003; Calvo and Reinhart, 2002b). This literature has attempted to create datasets identifying the exchange rate regime in operation for all countries in recent decades, using a variety of alternative algorithms. While these databases are useful for many applications, they have limited usefulness in measuring the fine structure of intermediate regimes. As an example, the Reinhart and Rogoff classification sees the Indian rupee as a single exchange rate regime from 1993 onwards. As the evidence ahead shows, there is a fine structure in the post-1993 period which yields fresh insights into the causes and consequences of the exchange rate regime and monetary policy framework.

A valuable tool for understanding the *de facto* exchange rate regime in operation is a linear regression model based on cross-currency exchange rates (with respect to a suitable numeraire). Used at least since Haldane and Hall (1991), this model was popularized by Frankel and Wei (1994) (and is hence also called Frankel-Wei model). Recent applications of this estimation strategy include Bénassy-Quéré, Coeuré, and Mignon (2006b), Shah, Zeileis, and Patnaik (2005) and Frankel and Wei (2007). In this approach, an independent currency, such as the Swiss Franc (CHF), is chosen as an arbitrary ‘numeraire’. If estimation involving the Indian rupee (INR) is desired, the model estimated is:

$$d \log \left(\frac{\text{INR}}{\text{CHF}} \right) = \beta_1 + \beta_2 d \log \left(\frac{\text{USD}}{\text{CHF}} \right) + \beta_3 d \log \left(\frac{\text{JPY}}{\text{CHF}} \right) + \beta_4 d \log \left(\frac{\text{DEM}}{\text{CHF}} \right) + \epsilon$$

This regression picks up the extent to which the INR/CHF rate fluctuates in response to fluctuations in the USD/CHF rate. If there is pegging to the USD, then fluctuations in the JPY and DEM will be irrelevant, and we will observe $\beta_3 = \beta_4 = 0$ while $\beta_2 = 1$. If there is no pegging, then all the three betas will be different from 0. The R^2 of this regression is also of interest; values near 1 would suggest reduced exchange rate flexibility.

To understand the *de facto* exchange rate regime in a given country in a given time period, researchers and practitioners can easily fit this regression model to a given data window, or use rolling data windows. However, such a strategy lacks a formal inferential framework for determining changes in the regimes. This has motivated an extension of the econometrics of structural change for the purpose of analysing structural change in the Frankel-Wei model (Zeileis, Shah, and Patnaik, 2008). This involves extending the familiar Perron-Bai methodology (Bai and Perron, 2003) for identifying the dates of structural change in an OLS regression. Through this, dates of structural change in the exchange rate regime are identified.

For each country, a set of sub-periods are identified. In each sub-period, the regression R^2 serves as a summary statistic about exchange rate flexibility. Values near 1 convey tight pegs. Floating rates prove to have values of 0.3 to 0.4.

There are several other classification schemes of the *de facto* exchange rate regime. The advantages of this scheme consist of the following arguments:

- We are able to measure and quantify the fine structure of intermediate regimes, with a real-valued measure of exchange rate inflexibility,

the regression R^2 , which naturally suggests a real-valued measure of exchange flexibility, $1 - R^2$.

- Sharp dates are obtained, at which the exchange rate regime changed. We implement these methods using weekly percentage changes of exchange rates, which yields break dates to the resolution of the week. Through this, for each country, a time-series of exchange rate flexibility is obtained, of the value of the R^2 which prevailed at a point in time.
- The number of breaks and the placement of breaks is based on sound inference procedures and can be readily recomputed to utilise current data.

The data set consists of the following 16 Asian countries: India, China, Korea, Singapore, Malaysia, Phillipines, Thailand, Indonesia, Hong Kong, Taiwan, Bangladesh, Pakistan, Sri Lanka, Nepal, Bhutan and Vietnam. We examine a data set of weekly currency returns data from January 1, 1991 to May 31, 2009 ². The currencies in the data set include the Swiss Franc, which acts as the numeraire in the model, the Euro (proxied in the pre-Euro period by the DEM), the Japanese yen and the USD dollar.

2.1 Summary of empirical strategy

For each country, we apply the methodology of Zeileis, Shah, and Patnaik (2008) to identify dates of structural break in the exchange rate regression. Through this, for each country, a time-series of the currency flexibility is obtained. For each point in time, we compute summary statistics across the countries of : the R^2 , USD coefficient, EUR coefficient, the GBP coefficient and the JPY coefficient.

The interpretation of the location estimators of R^2 , the USD coefficient, etc. requires statistical inference procedures. Given the small samples, we use bootstrap estimation to obtain confidence intervals. In order to obtain more accurate results, the adjusted bootstrap percentile method is used, which does bias and skew correction of the bootstrap distribution (Davison and Hinkley, 1997; Canty and Ripley, 2009).

²For some countries the data starts from January 1, 1993.

Table 1 Example: Korea

The Korean Won was tightly pegged to the US dollar in the period before the Asian crisis. For the pre-crisis period, the regression result gives us an R^2 of 0.94 and a highly significant USD coefficient of 1. The period of the Asian crisis witnessed extreme volatility in the exchange rate, when the R^2 fell to 0.26. In the post crisis period, the Korean Won went back to being pegged, but to a basket. However, this time the peg was not so tight as the R^2 fell to 0.70 and the USD coefficient to 0.66. The EURO and JPY coefficients are also seen to be significant. At the start of April 2008 the Korean Won moved to a full float, where the R^2 is now 0.25, and no currency in the regression has a significant coefficient.

Start	End	USD	EUR	GBP	JPY	σ_e^2	R^2
1991-01-11	1997-10-17	1.05	-0.04	-0.01	0.03	0.15	0.94
		22.28	-1.73	-0.55	1.79		
1997-10-24	1999-01-08	0.40	0.01	0.42	0.28	4.20	0.26
		1.18	0.08	1.03	2.35		
1999-01-15	2008-03-28	0.66	0.28	0.09	0.26	0.72	0.70
		16.87	3.25	1.96	8.25		
2008-04-04	2009-05-29	0.33	0.46	0.18	-0.26	4.10	0.25
		1.43	1.44	1.28	-1.54		

2.2 Examples

Before we turn to the overall picture for Asia, we show examples of our findings on the evolution of the exchange rate regime in four countries. Results for the remaining 12 countries are in the appendix.

1. Korea

As found by earlier studies such as (Fukuda, 2001), the Korean Won was tightly pegged to the US dollar in the period before the Asian crisis. We find that even after adopting a *de jure* inflation targeting regime after the crisis, South Korea continued to implement a basket peg and intervened heavily in the Won-Dollar market. However, after 1998, there was more flexibility when compared with the pre-crisis environment. The current economic crisis gave a large depreciation of the Won and our methodology suggests that the Won has been allowed to float by the authorities.

2. Vietnam

Vietnam unified the official fixed exchange rate with the market rate and these two were unified through a sharp devaluation of the official USD-VND exchange rate in the early nineties. With a high current account deficit in 1993, the peg became more rigid. Our methodology

Table 2 Example: Vietnam

The Vietnamese Dong was tightly pegged to the US dollar in the 1990s. Regression results for Vietnam suggest that there has been two structural breaks before the Asian crisis. After the crisis, the flexibility of the USD-VND exchange rate followed the other Asian currencies, with an R^2 value of 0.49 till February 1999, after which the *de facto* exchange regime reverted back to a hard peg with an R^2 of 0.99 until the global financial crisis of 2008. On 14 March 2008, the currency became more flexible.

Start	End	USD	EUR	GBP	JPY	σ_e^2	R^2
1993-06-25	1994-03-25	0.82	0.20	-0.05	-0.16	0.44	0.84
		2.65	1.23	-0.25	-2.31		
1994-04-01	1997-03-14	1.00	-0.01	-0.01	0.01	0.03	0.99
		24.95	-0.29	-0.11	0.84		
1997-03-21	1997-12-19	0.95	-0.05	-0.20	-0.13	1.28	0.49
		1.87	-0.18	-0.87	-1.22		
1997-12-26	1999-02-05	0.99	-0.01	-0.01	0.01	0.01	0.99
		244.57	-0.54	2.35	0.12		
1999-02-12	1999-08-13	1.0	-0.16	-0.008	-0.01	0.12	0.94
		12.80	-0.76	-0.08	-0.33		
1999-08-20	2008-03-07	1.01	-0.01	-0.01	-0.001	0.008	0.99
		221.30	-0.70	-0.62	-0.29		
2008-03-14	2009-05-29	0.97	-0.03	-0.05	-0.06	0.35	0.87
		13.67	-0.36	-1.02	-1.32		

Table 3 Example: Malaysia

The Malaysian Ringgit was a long standing peg to the US dollar till 2005. The results for Malaysia suggest that the Asian crisis broke the peg for a brief period between August 1997 and February 1999, where the R^2 dropped to 0.30, after which the peg continued till 2005. The R^2 was close to 1.00 in both periods, before and after the crisis. In 2005 the ringgit became more flexible on the day that the Chinese exchange rate regime also changed. Like other Asian currencies, the beta coefficient on the dollar still remained high. There has been no change in the currency regime after the global financial crisis.

Start	End	USD	EUR	GBP	JPY	σ_e^2	R^2
1991-01-11	1997-08-01	0.94	-3.28e-2	2.44e-2	4.06e-2	3.19e-2	0.86
		1.3e+01	-9.2e-01	8.41e-01	1.52e+00		
1997-08-08	1999-02-19	0.34	-6.64e-2	5.07e-2	7.88e-2	2.73	0.30
		1.46e+00	-1.31e+00	1.66e+00	8.44e-01		
1999-02-26	2005-07-15	1.00	4.65e-15	1.26e-15	-1.12e-15	1.01e-28	1.00
		1.47e+15	1.22e+00	-4.70e-01	-8.90e-01		
2005-07-22	2009-05-29	0.75	2.50e-1	3.51e-2	9.05e-2	3.13e-1	0.82
		2.06e+01	4.07e+00	1.12e+00	-3.02e+00		

concur with other studies on Vietnam (Thanh, Minh, Truong, Thanh, and Quang, 2000) which suggest a hard peg. As witnessed in other Asian economies, the Asian crisis led to a period of flexibility in the Dong valuation, with the hard peg to the dollar resuming soon after right up to March 2008. The Dong has seen a slight increase in flexibility in the global financial crisis, with the US dollar remaining the anchor. The high and significant coefficient of USD after the global crisis indicates that the Dong remains pegged to the US dollar very tightly.

3. *Malaysia*

Malaysia, like other East Asian countries, pegged its currency to the US dollar before the Asian crisis. Unlike other currencies, the ringgit is the only currency to have had *de jure* peg to the US dollar after the crisis alongside capital controls being reimposed. In 2005, the *de jure* claim was that of a floating exchange rate. Our regression results suggest that there has been greater flexibility allowed in the USD-MYR exchange rate determination with a R^2 of 0.84. There has been no new structural change after the global financial crisis.

4. *India*

The Indian economy was not directly affected by the Asian crisis, nor

Table 4 Example: India

The *de jure* exchange regime for the Indian rupee is that of a managed float since 1994. However, regression results for India suggest that there has been a cycle of inflexibility and greater flexibility, with three distinct breaks in the exchange rate regime. There was a long period of hard peg with a R^2 of 0.98 till March 1995. There was a substantial degree of flexibility between March 1995 and August 1998, the period of the Asian crisis, where the R^2 stood at 0.72 after which the rupee value went back to a peg to the US dollar, taking the R^2 of 0.97 till March 2004. Since then there has been greater flexibility in the rupee with both the beta coefficient on the dollar and the euro being significant. The rupee appears to have moved to a basket peg since April 2004. There has been no structural break in the currency regime after the global financial crisis.

Start	End	USD	EUR	GBP	JPY	σ_e^2	R^2
1993-04-09	1995-03-03	0.97	0.02	0.01	0.02	0.02	0.98
		55.12	0.348	0.839	1.678		
1995-03-10	1998-08-21	0.94	0.06	-0.02	0.04	0.85	0.72
		12.79	-0.16	0.53	1.39		
1998-08-28	2004-03-19	0.99	0.01	0.09	0.01	0.07	0.97
		61.73	2.91	-0.157	0.99		
2004-03-26	2009-08-21	0.72	0.02	0.47	0.08	0.75	0.69
		14.62	5.36	1.98	0.53		

was the rupee. However, the *de facto* exchange regime analysis shows a change in the second half of 1998, drifting towards a hard peg on the US dollar. The rupee became far more flexible in 2004, owing to tremendous appreciation pressure on the rupee, despite unprecedented levels of central bank intervention. The rupee has witnessed a greater level of volatility in the last period after 2004, prompting a shift away from the hard peg to the dollar.

Figure 1 summarises the time-series for exchange rate inflexibility obtained for the four countries described above. This summarises the evolution of exchange rate flexibility for these countries.

3 Evolution of exchange rate regimes in Asia

We now turn to the key questions about the evolution of the exchange rate regime in Asia:

- How have exchange rate regimes in Asia evolved since 1991?
- Was there acute exchange rate inflexibility pre-Asian-crisis?

Figure 1 The time-series of exchange rate inflexibility: four country examples

The exchange rate regime analysis identifies dates of structural breaks, and in each time-period, arrives at a measure of inflexibility (the R^2). This graph shows the four time-series of inflexibility for the four country examples of the text.

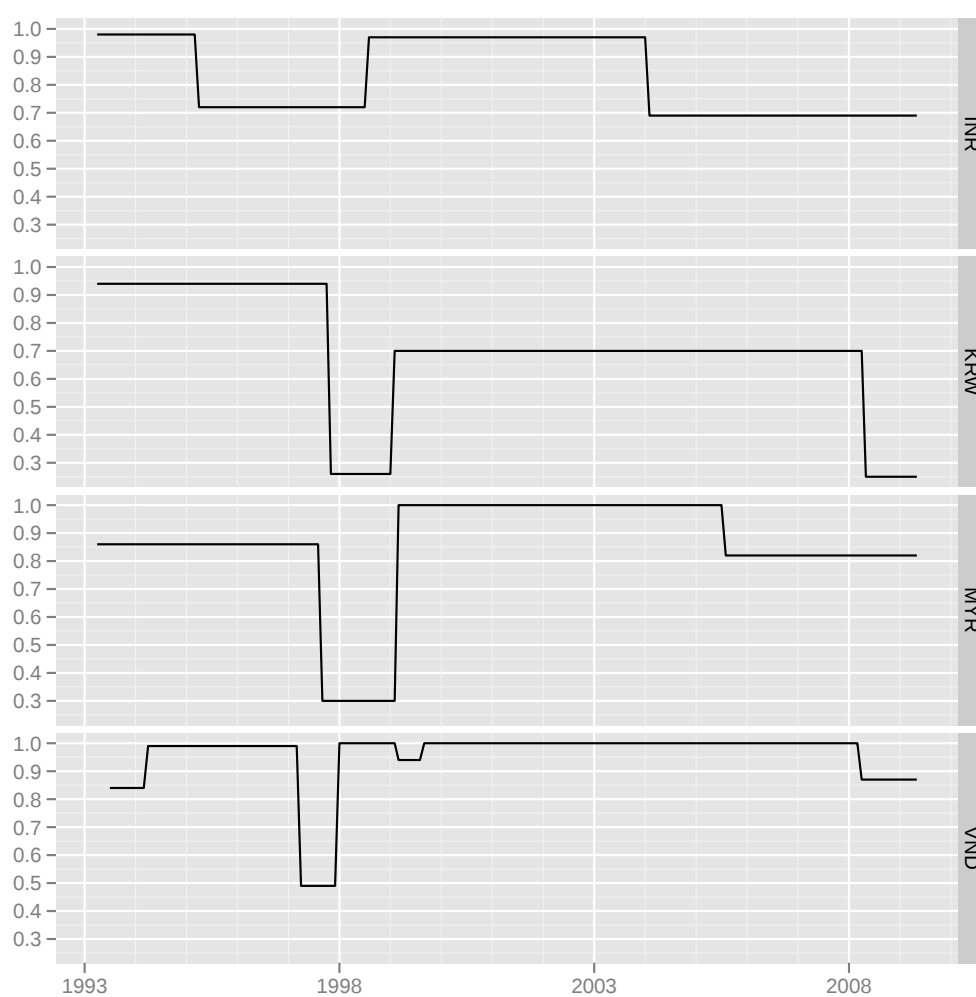
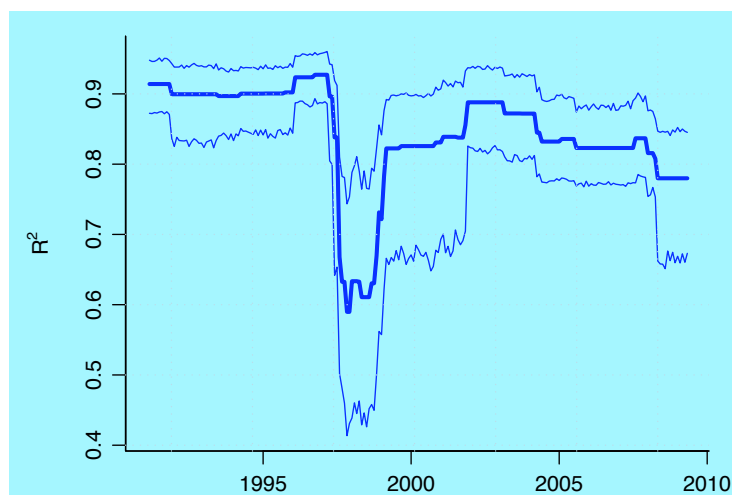


Figure 2 Exchange rate flexibility

For each of the Asian countries in the sample the dating methodology of Zeileis, Shah, and Patnaik (2008) is applied. This reveals the *de facto* exchange rate regime that is in operation at all points in time. The regression R^2 values across all countries are summarised in this graph. The mean of the R^2 and its confidence intervals are reported. This yields a summary statement of how exchange rate flexibility in Asia has evolved through time.



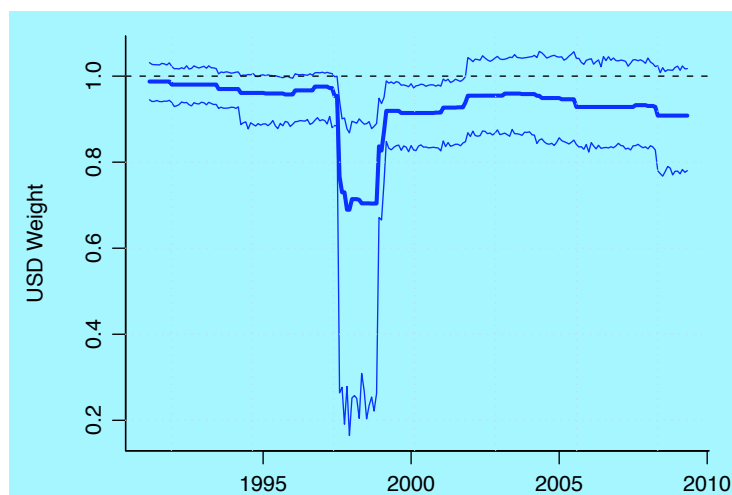
- After the Asian crisis, did Asia go right back to pre-crisis pegging? (*Fear of Floating*)
- In the years after the Asian crisis, has Asia embarked on a ‘*Bretton-Woods-II*’ world of USD pegging rooted in competitive exchange rate mercantalism?
- Has Asia shifted away from a USD focus towards either EUR or JPY in exchange rate pegging?
- Has the global financial crisis of 2008 led to a change in exchange rate regimes in Asian countries?

While there is significant heterogeneity in terms of the degree of flexibility within Asia, most of the currencies have embarked on the path of greater flexibility around similar circumstances and time periods. The following summary statistics provide a greater insight into exchange rate management across Asia.

Figure 2 shows the mean of the regression R^2 values across all countries. The 95% bootstrap confidence interval is superposed on the graph. It vividly shows the extreme exchange rate inflexibility in the decade preceding the

Figure 3 A shift away from USD pegging?

The average US dollar coefficient over the years has decreased in absolute terms. However, it is noteworthy that the confidence interval in the period between 2000 and 2005 does not reject the possibility of a beta coefficient of 1. This reiterates the statement that although there was greater flexibility currently than before, the monetary authorities have continued to focus on the US dollar.



Asian crisis, which is now understood to have been a key contributor to the crisis.

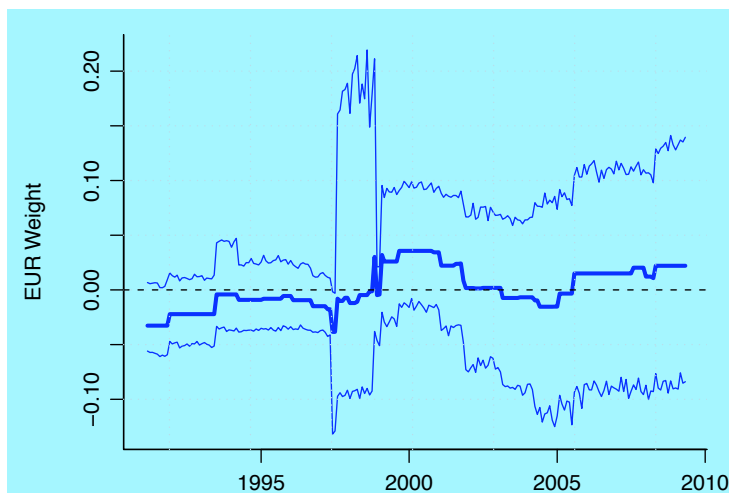
In the immediate aftermath of the crisis, there was greater flexibility for a brief period, but then ‘fear of floating’ resurfaced, as was pointed out by Calvo and Reinhart (2002c). However, this graph suggests that exchange rate inflexibility in Asia did not go all the way back to pre-crisis levels.

While Dooley, Folkerts-Landau, and Garber (2003) have hypothesised the emergence of an Asian-led ‘Bretton Woods II’ regime, through the last decade, exchange rate inflexibility in Asia has declined at a slow pace. It appears that there was a brief period of acute inflexibility, and after 2003 there is some evidence of a shift towards greater flexibility. However, the 95% confidence interval in 2003 overlaps with the 95% confidence interval of 2009; hence the null of no-change cannot be rejected.

Has this possibility of greater exchange rate flexibility been accompanied by a shift in focus away from the US dollar among Asian central banks? Figure 3 shows the time-series and confidence interval of the estimated USD coefficient of the exchange rate regression. It shows little movement away from the value of 1.0 after 2000. What may be taking place is greater flexibility around a USD peg.

Figure 4 Rise of the Euro?

Asian countries did not move towards pegging their currencies to the Euro.



In recent years, the Euro has risen as an alternative to the USD in reserves portfolios and as a major global currency. However, Figure 4 shows that through the entire period, Asia has ignored the Euro in exchange rate pegging. The 95% confidence intervals always bracket 0 and there is no sign of a shift towards a greater importance to the Euro.

In similar fashion, Figure 5 shows that there is no sign of a nascent Yen bloc emerging. The null of a zero yen coefficient cannot be rejected.

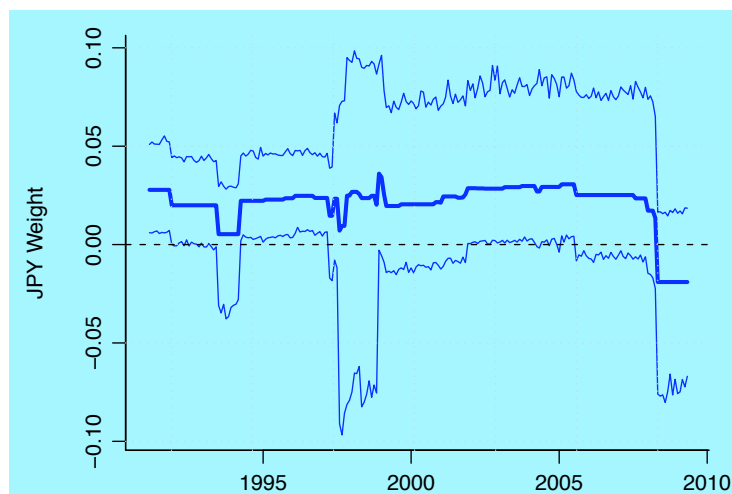
To summarise, our findings confirm the incidence of tight USD pegging before Asian crisis. After the Asian crisis, Asia returned to a regime of high inflexibility (*fear of floating*), but not quite the pre-crisis situation. In the following years, we find a short period of acute inflexibility that has been made prominent by Dooley, Folkerts-Landau, and Garber (2003). However, this ‘Bretton-Woods II configuration’ may lack durability; there is early evidence of Asia moving towards greater flexibility. At the same time, there has been no shift away from the US dollar towards other currencies, or to basket pegs. Asian currencies have, in general, only moved towards greater flexibility about a *de facto* peg to the US dollar.

3.1 Robustness checks

We perform three robustness checks on the main results:

Figure 5 A nascent yen bloc?

There is no movement towards the Yen also.



1. GDP weights instead of equal weights when averaging across countries.
2. An alternative location estimator – the trimmed mean – to avoid the undue influence of extreme values on the sample mean.
3. An examination of whether the overall Asian results hold for ASEAN countries.

Does the use of equal weights for all countries make our results biased in favour of small counties? To answer this question, we weight countries by GDP. Figure-6 plots the mean data of the R^2 value for Asia using equal weights and GDP weights. GDP weighted R^2 data suggests greater inflexibility because of the presence of China and India ³ However, the difference between the two series is small, particularly in recent years.

Figure-7 plots the trimmed mean alongside the ordinary mean. There is negligible difference between the two in the recent past. These results are hence not an artifact of extreme values.

ASEAN countries appear to have greater flexibility than the overall Asian average. This hints at significant heterogeneity between the individual countries of Asia in the overall averages.

³Hong Kong has a Linked Exchange Rate System, while China and India remain in exible in most part of the series and have greater GDP weights than a country with greater exibility such as South Korea.

Figure 6 Exchange rate flexibility: equal weights vs. GDP weights

This figure plots the mean data of the R^2 value for Asia using equal weights and GDP weights. The key findings do not change if GDP weights are used.

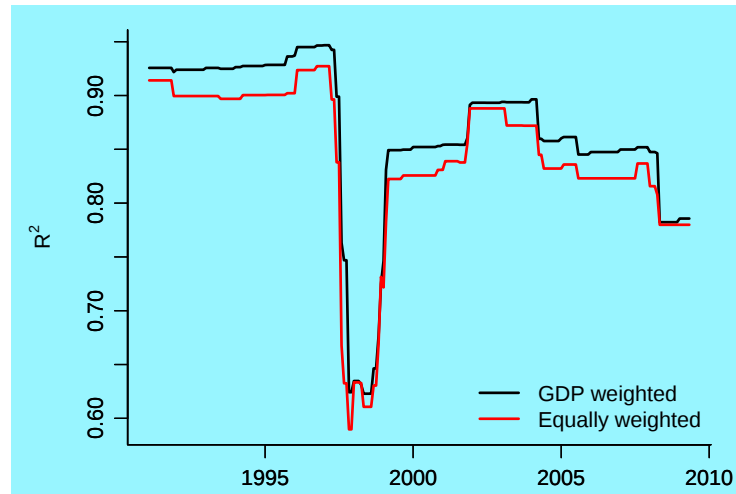


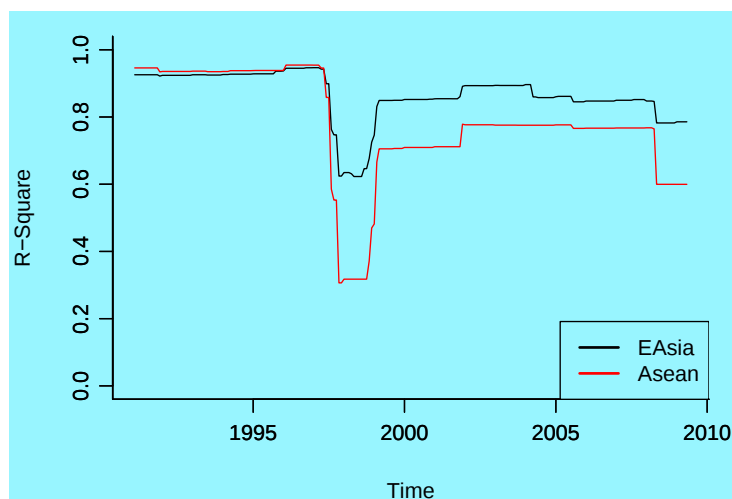
Figure 7 Exchange rate flexibility: trimmed mean vs. ordinary mean

This figure takes away one third of the values on both side of the distribution of R^2 to get rid of extreme values and plots the trimmed mean, along with the ordinary mean. It shows that the key results are robust to removing outliers. In other words, our results are not biased because of the presence of outliers.



Figure 8 Exchange rate flexibility: ASEAN vs. full Asia

This figure shows that the ASEAN countries moved to greater levels of flexibility than all Asian countries.



4 Conclusion

In 1994, the $\bar{R}^2$ value for Asia stood at 0.93. Most currencies were tightly pegged to the US dollar. At this time East Asian economies liberalised their capital account without taking into account the appropriate macroeconomic framework required to deal with large capital flows, causing the Asian crisis.

A full decade and two years after the Asian crisis, Asia continues to fear greater flexibility in the exchange rate. The $\bar{R}^2$ went up to 0.82 right after the crisis, and to 0.88 in 2004. Since 2004, Asia has witnessed a slow increase in flexibility of exchange rates with the most recent $\bar{R}^2$ being 0.78.

The increase in flexibility has not meant a decline in the role of the dollar as an anchor currency. Instead, Asia has *de facto* made the exchange rate more flexible around the dollar as the anchor currency.

Tracking the regime through the global financial crisis, one can see that Korea, and Vietnam have shifted regimes, with the Korean won becoming a full float.

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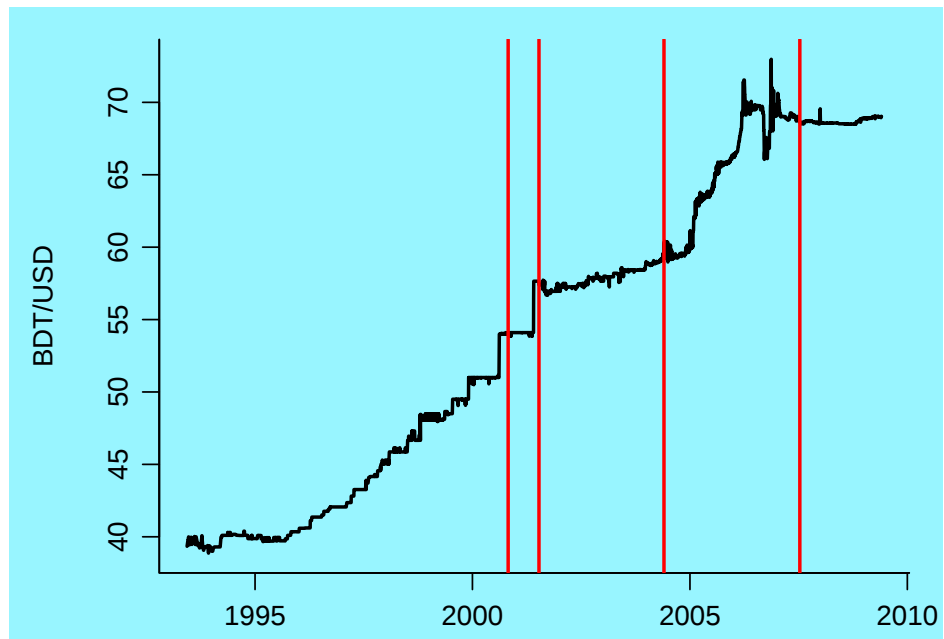
A Appendix: Exchange rate regime analysis for 12 countries

In the main text of the paper, four examples are shown, for Korea, Vietnam, Malaysia and India. Results for the remaining 12 countries are in this appendix.

A.1 Bangladesh

The Bangladeshi Taka has gone through multiple *de jure* regime since its independence. In our sample period, the Taka was stated to have been pegged to a basket of currencies (of major trading partners) with the US dollar as the intervening currency till 1999. It followed an adjustable peg system between 2000 and 2003. On the 31 of May 2003, the *de jure* claim is that of a float, while our analysis suggests that the taka had a brief spell of flexibility with an R^2 of 0.78 till July 2007 after which it has returned to being a hard peg on the US dollar.

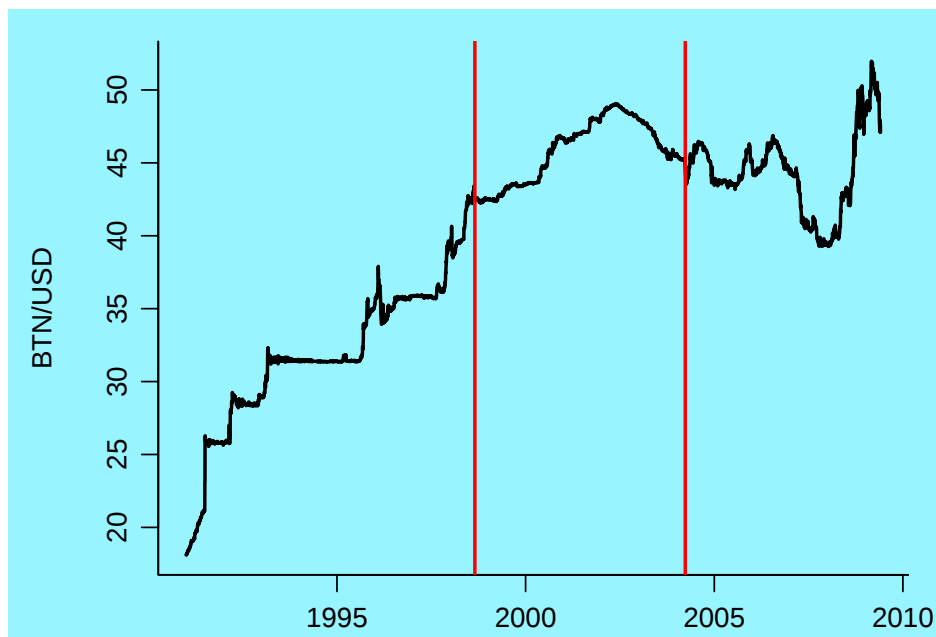
start	end	r2	USD	DUR	GBP	JPY	Variance
1993-06-18	2000-10-20	0.92	0.99	0.02	-0.02	-0.02	0.18
			39.08	2.10	-0.67	-1.35	
2000-10-27	2001-07-06	1.00	1.00	-0.00	-0.00	-0.00	0.00
			162.06	-1.18	-0.02	-0.61	
2001-07-13	2004-05-21	0.98	1.01	0.03	0.02	-0.01	0.04
			60.98	0.74	0.92	-0.70	
2004-05-28	2007-07-06	0.78	0.93	-0.07	0.12	0.03	0.40
			16.55	-0.44	1.66	0.46	
2007-07-13	2009-05-29	1.00	0.99	0.02	-0.00	-0.00	0.00
			185.79	2.68	-1.03	-0.13	



A.2 Bhutan

The Bhutanese Ngultrum does not exchange independently with other nation's currency but is interchangeable with the Indian rupee. The *de jure* claim is a peg to the Indian rupee. As may be witnessed, the statistics do not suggest a peg to the Indian rupee.

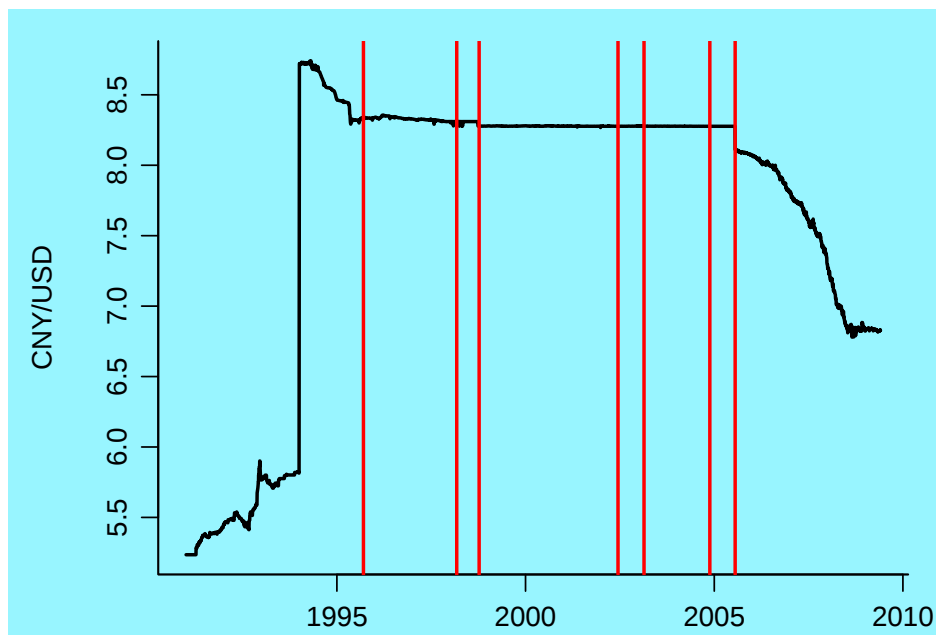
start	end	r2	USD	DUR	GBP	JPY	Variance
1991-01-11	1998-08-21	0.83	1.11	-0.03	-0.02	-0.04	0.51
			13.42	-0.70	-0.64	-1.47	
1998-08-28	2004-03-19	0.97	1.01	0.00	-0.01	-0.01	0.07
			69.46	0.23	-0.29	-1.06	
2004-03-26	2009-05-29	0.81	1.24	-0.35	-0.15	-0.05	0.58
			27.02	-4.29	-3.79	-1.31	



A.3 China

The *de jure* crawling peg of the renminbi was announced on 22 July 2005. Although the claim is that the Chinese renminbi is pegged against a basket of currencies instead of the US dollar, our results suggest that the *de facto* regime remains a pegged regime with the US dollar as its anchor. While official statements have been made about gradually increasing flexibility, after July 2005, no other structural break has been identified.

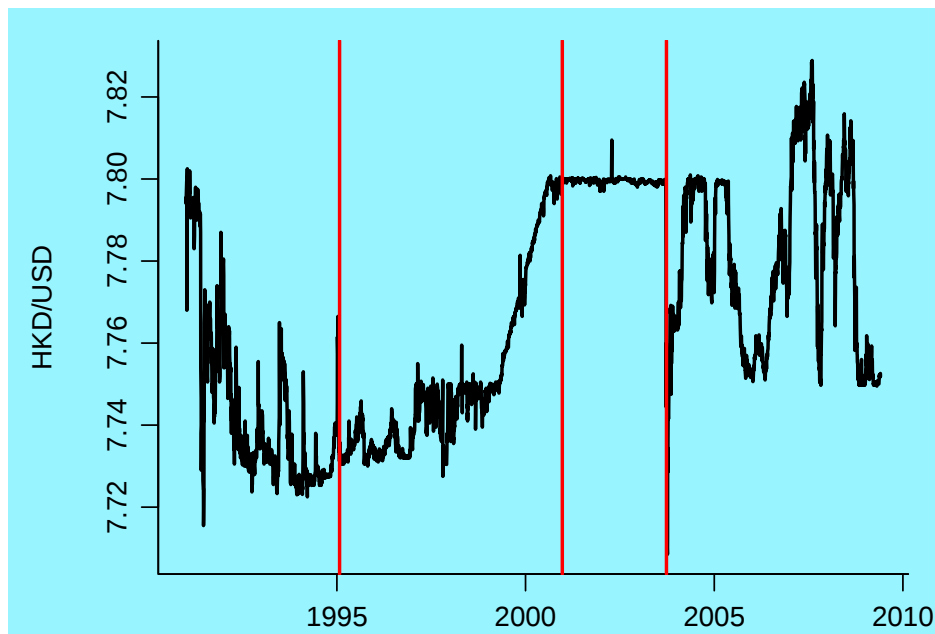
start	end	r ²	USD	DUR	GBP	JPY	Variance
1991-01-11	1995-09-08	0.97	1.04	-0.04	-0.01	-0.01	0.06
			29.07	-2.31	-0.82	-0.78	
1995-09-15	2005-07-15	1.00	1.00	-0.00	0.00	-0.00	0.00
			147.32	-0.10	1.63	-0.18	
2005-07-22	2009-05-29	0.97	0.96	0.04	0.00	0.00	0.06
			59.32	1.69	0.01	0.24	



A.4 Hong Kong

The Hong Kong Monetary Authority (HKMA) follows a linked exchange rate system whereby the currency is maintained around HK\$ 7.80 to 1 USD within a band of ± 0.05 . While the *de jure* exchange regime is that of a peg to the US dollar, the markets have consistently tested the HKMA's intent. Therefore, the breakdates for Hong Kong mark those events in history where intense upward and downward pressure had to be defended vigorously by the HKMA. The coefficients on the USD is measured as 1.00 through all these periods.

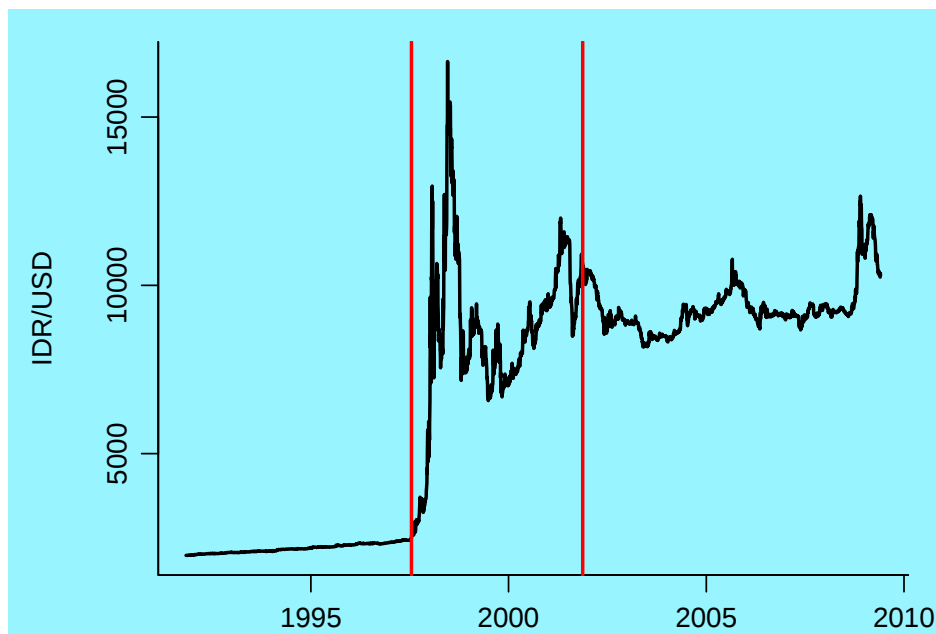
start	end	r2	USD	DUR	GBP	JPY	Variance
1991-01-11	1995-01-20	1.00	1.02	-0.02	0.00	-0.01	0.01
			75.38	-2.38	0.39	-0.88	
1995-01-27	2000-12-15	1.00	1.00	0.00	0.00	0.00	0.00
			441.65	0.25	0.92	3.83	
2000-12-22	2003-09-19	1.00	1.00	0.00	0.00	-0.00	0.00
			1822.53	0.96	0.10	-0.10	
2003-09-26	2009-05-29	1.00	0.98	0.01	0.00	0.01	0.01
			218.94	1.33	0.01	2.54	



A.5 Indonesia

The Indonesian rupiah exhibited remarkable stability till the Asian crisis, being under a hard currency peg regime. The *de jure* float against a basket of major world currencies happened as early as 1978, but in 1997 (during the Asian Crisis), there was remarkable flexibility in the rupiah with the R^2 dropping to 0.16. The rupiah regime bounced back to an R^2 value of 0.68 post November 2001, marking a shift into an intermediate regime.

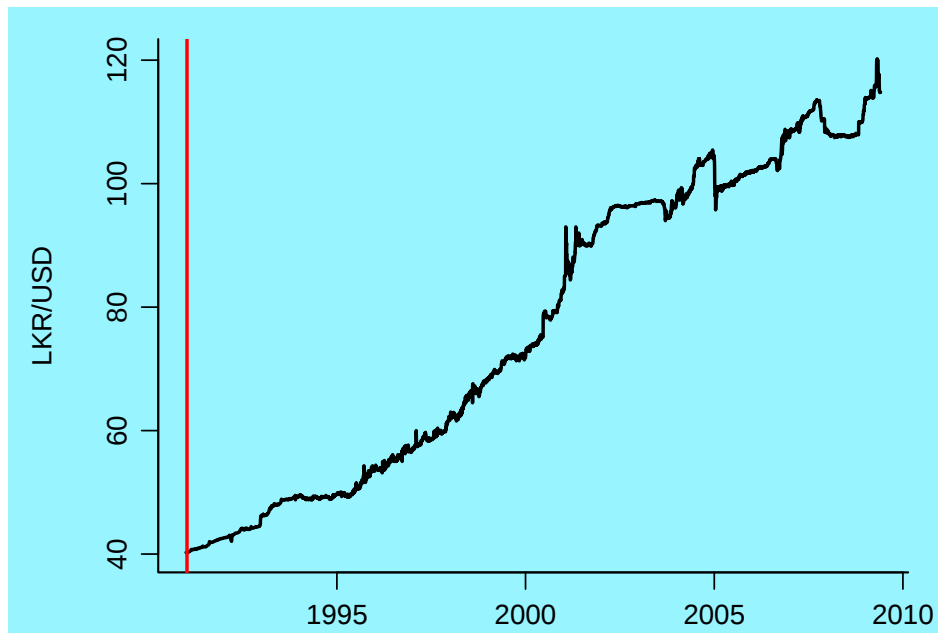
start	end	r2	USD	DUR	GBP	JPY	Variance
1991-11-15	1997-07-11	0.98	1.03	0.00	-0.02	-0.01	0.05
			35.03	0.15	-1.65	-1.23	
1997-07-18	2001-11-09	0.16	1.10	-0.22	0.00	-0.13	12.68
			4.40	-2.12	0.01	-0.87	
2001-11-16	2009-05-29	0.68	1.35	-0.32	-0.14	-0.08	1.55
			22.72	-2.79	-2.33	-1.57	



A.6 Sri Lanka

Having been in a state of war throughout the time period under study, the rupee has always been under stress due to poor macroeconomic conditions (double digit inflation, poor level of reserves, high fiscal deficit and political uncertainty). Despite these factors, the Sri Lankan exchange regime does not show any change from the peg to the US dollar.

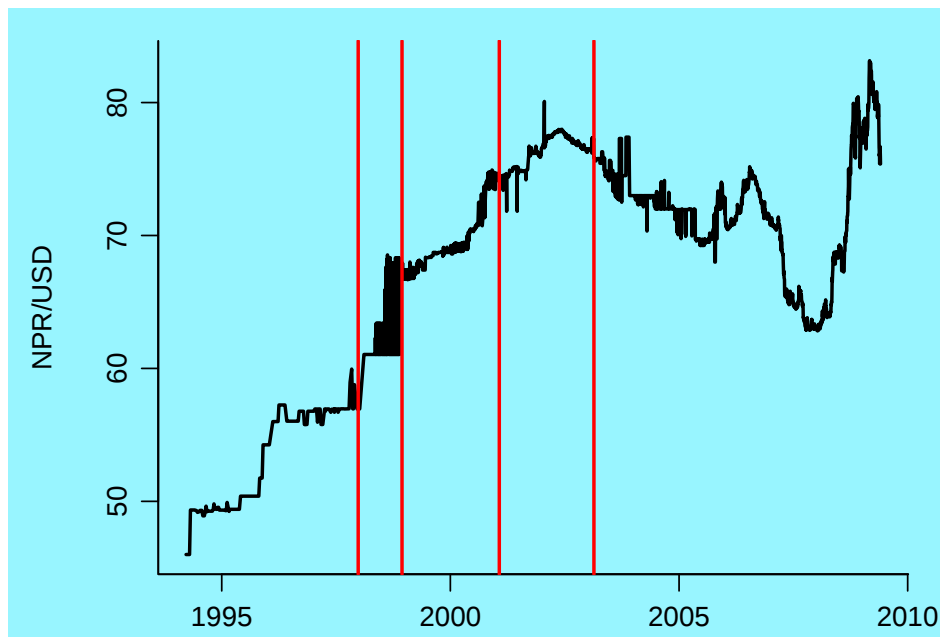
start	end	r2	USD	DUR	GBP	JPY	Variance
1991-01-11	2009-05-29	0.86	0.95 47.28	0.00 0.12	0.00 0.10	0.03 1.97	0.36



A.7 Nepal

The Nepalese *de jure* regime claims a peg to the Indian rupee. However, like in Bhutan, the currency movements and also regression statistics suggest something different from the stated position, with greater flexibility in the recent past.

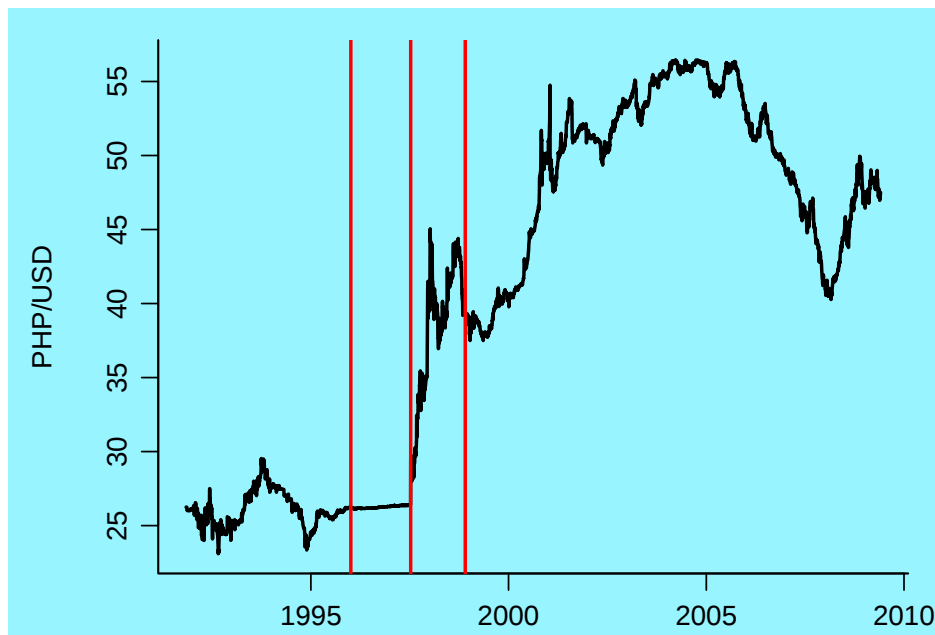
start	end	r2	USD	DUR	GBP	JPY	Variance
1994-04-01	1997-12-19	0.81	0.64	0.13	0.18	0.10	0.68
			3.57	1.44	2.31	2.24	
1997-12-26	1998-12-04	1.00	1.00	0.00	0.00	0.00	0.00
			75.62	0.75	0.35	0.61	
1998-12-11	2001-01-19	0.84	0.84	0.01	0.30	-0.03	0.46
			12.79	0.36	4.01	-0.75	
2001-01-26	2003-02-14	0.97	1.02	-0.19	-0.05	0.02	0.05
			44.79	-4.07	-1.74	1.11	
2003-02-21	2009-05-29	0.72	1.10	-0.33	-0.04	0.03	0.93
			21.06	-3.46	-0.79	0.73	



A.8 Philippines

The Philippine Peso had significant level of flexibility until the Asian crisis. Despite being one of the two Asian economies to have adopted inflation targeting, and a *de jure* float of the peso, the value of the peso is still anchored on the US dollar.

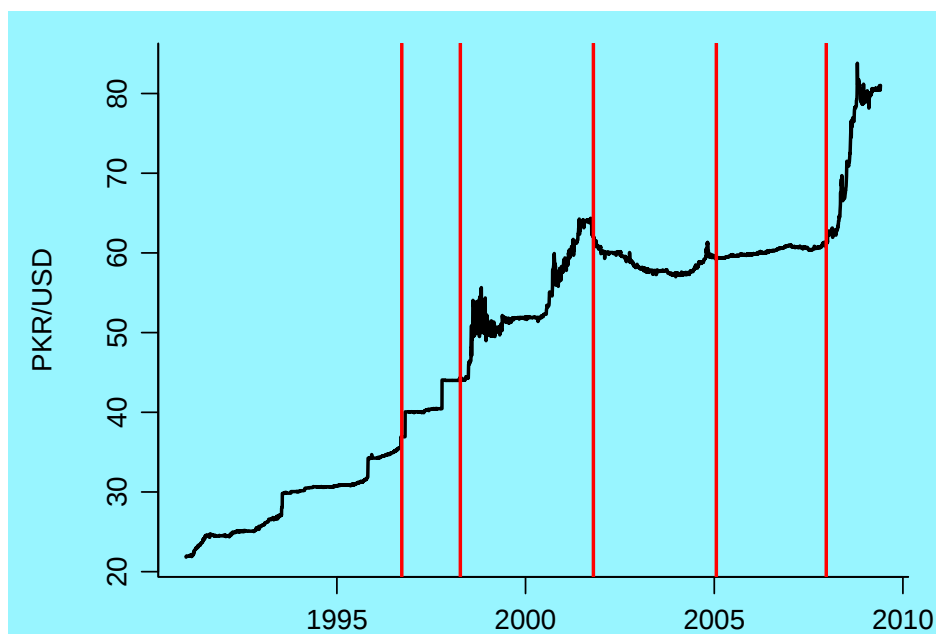
start	end	r2	USD	DUR	GBP	JPY	Variance
1991-11-15	1995-12-29	0.65	0.86	0.07	-0.02	-0.03	1.49
			4.64	0.73	-0.24	-0.49	
1996-01-05	1997-07-04	1.00	1.01	0.01	-0.01	-0.01	0.00
			49.36	0.69	-1.82	-2.23	
1997-07-11	1998-11-20	0.30	-1.14	0.83	0.27	-0.45	4.63
			-1.94	2.67	0.91	-3.89	
1998-11-27	2009-05-29	0.78	1.12	-0.01	-0.08	-0.02	0.69
			33.29	-0.51	-2.40	-0.83	



A.9 Pakistan

Pakistan gradually moved from a hard peg on the US dollar, into a multiple exchange rate system and then into a free float on the *de jure* classification. However, our methodology suggests that the Pakistani rupee remains a hard peg to the US dollar, but for a brief spell between April 1998 and October 2001, when there were sanctions against Pakistan and there was an IMF program underway. The rupee has been more flexible since December 2007.

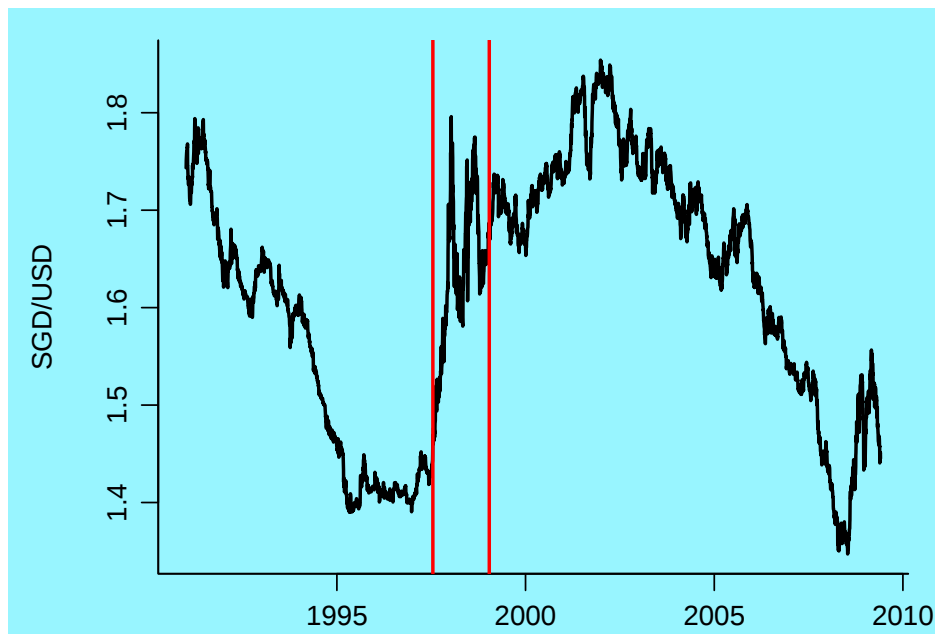
start	end	r2	USD	DUR	GBP	JPY	Variance
1991-01-11	1996-09-13	0.94	0.85 15.06	0.09 3.33	0.02 0.67	0.02 0.70	0.18
1996-09-20	1998-04-03	1.00	0.99 46.68	0.01 0.55	-0.00 -0.39	-0.00 -0.33	0.00
1998-04-10	2001-10-12	0.64	0.85 10.84	0.10 3.20	0.08 0.92	-0.04 -0.84	1.16
2001-10-19	2005-01-14	0.93	1.04 34.05	-0.15 -1.86	0.02 0.48	-0.01 -0.35	0.16
2005-01-21	2007-12-14	0.99	0.99 86.04	0.04 1.48	-0.01 -0.35	0.01 1.05	0.02
2007-12-21	2009-05-29	0.65	0.96 8.09	-0.09 -0.61	0.01 0.09	-0.09 -1.08	1.29



A.10 Singapore

The Singapore Dollar follows, *de jure*, the band basket crawl regime, with the Monetary Authority of Singapore (MAS) managing the value of the Singapore dollar according to a basket of currencies. The weights in the basket are not publicly disclosed, and the weights seen in our exchange rate analysis may hence be of interest. The breaks in the regime suggested by our methodology points to the significant decisions by the MAS to change the slope or the width of the band within which the Singapore dollar is maintained. For instance, the structural break in 1999 coincides with issues faced in the USD-SGD market during the dot-com bubble. The Asian crisis did not have a significant impact on the SGD as the MAS effectively curbed any offshore trading of the Singapore Dollar.

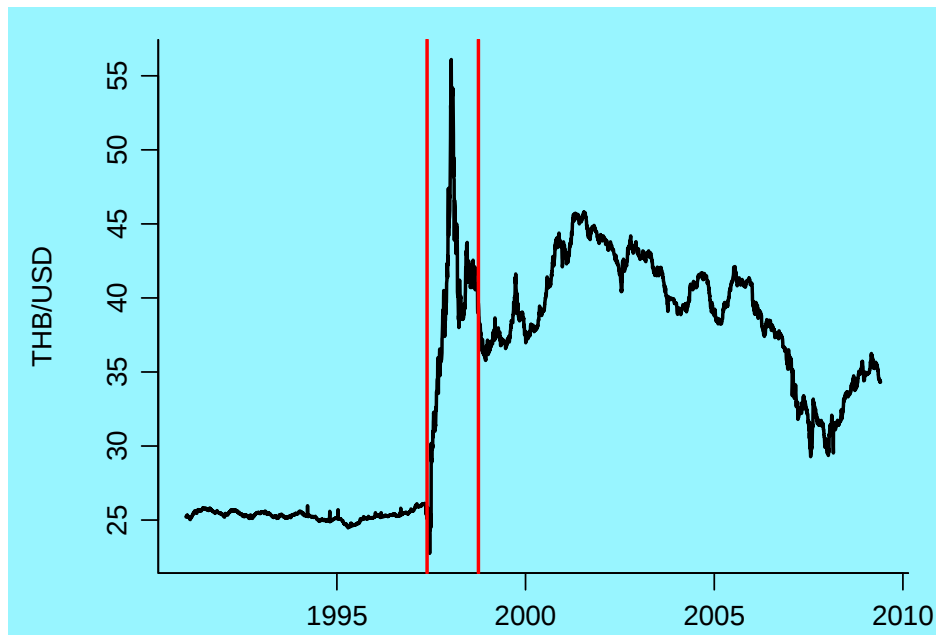
start	end	r2	USD	DUR	GBP	JPY	Variance
1991-01-11	1997-07-11	0.94	0.98 23.26	-0.12 -5.58	0.02 1.09	0.10 6.47	0.11
1997-07-18	1999-01-08	0.31	0.17 0.98	-0.04 -1.15	0.44 2.33	0.21 3.07	1.52
1999-01-15	2009-05-29	0.84	0.63 31.39	0.26 6.80	0.08 3.83	0.09 5.92	0.25



A.11 Thailand

The decision to float the Thai baht took place during the Asian Crisis. Though the Bank of Thailand had a two-tier currency market with separate exchange rates for offshore and onshore currency transactions, this was unified in January 1998. Like other Asian currencies, the Thai baht also exhibited enormous flexibility (with an R^2 of 0.06) during the Asian Crisis. The Thai Baht, thereafter, has been a managed float with the US dollar as its main anchor.

start	end	r2	USD	DUR	GBP	JPY	Variance
1991-01-11	1997-05-16	0.99	1.02	-0.09	0.01	0.07	0.02
			65.31	-11.39	1.18	12.36	
1997-05-23	1998-09-25	0.06	0.73	-0.42	-0.01	0.21	4.82
			0.98	-1.16	-0.03	1.06	
1998-10-02	2009-05-29	0.67	0.71	0.10	0.08	0.12	0.81
			20.53	3.87	2.31	4.75	



A.12 Taiwan

The *de jure* flexible exchange rate system was adopted way back in 1979, with an added clause that when the market is disrupted by seasonal or irregular factors, the Central Bank of the Republic of China (Taiwan) (CBC) will step in. In essence, our methodology captures the nuanced statement from the CBC with a peg on the US dollar before the Asian crisis, and a peg with greater flexibility after the Asian Crisis.

start	end	r2	USD	DUR	GBP	JPY	Variance
1991-01-11	1997-07-25	0.93	1.02	-0.07	0.03	0.05	0.17
			20.24	-2.82	1.49	2.52	
1997-08-01	1998-10-30	0.35	0.90	-0.26	0.20	0.23	1.32
			2.29	-1.38	1.21	3.68	
1998-11-06	2009-05-29	0.86	0.77	0.02	0.11	0.06	0.29
			35.75	1.09	5.40	3.55	

