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Estimation of De Facto Exchange Rate Regimes: Synthesis of the Techniques for Inferring Flexibility and Basket Weights

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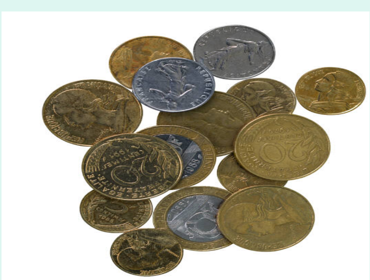

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Summary

- A synthesis of two techniques for statistically estimating de facto exchange rate regimes:

  (1) a technique that the authors have used to estimate implicit de facto weights when the hypothesis is a basket peg with little flexibility.

  (2) a technique used by others to estimate the de facto degree of exchange rate flexibility when the hypothesis is an anchor to the dollar, but with flexibility around that anchor.

- Many currencies today follow variants of Band-Basket-Crawl => it is important to have a technique that can cover both dimensions: inferring weights and inferring flexibility.

- We try out the approach
  - on 20-some currencies,
  - over the period 1980-2007.

It is harder to classify a country’s regime than one would think

- As is by now well-known, de facto ≠ de jure.
- But it is genuinely difficult to classify most countries’ de facto regimes, which are intermediate regimes, the Corners Hypothesis notwithstanding.

- Some currencies have basket anchors, often with some flexibility that can be captured either by a band or by leaning-against-the-wind intervention.
- Most basket peggers keep the weights secret. They want to preserve a degree of freedom from prying eyes, whether to pursue
  - a lower degree of de facto exchange rate flexibility, as China,
  - or a higher degree, as with others.
- This is a case of the necessity of distinguishing de facto from de jure exchange rate regimes, a task that has produced a lively recent sub-literature.
- But inferring de facto *weights* and inferring de facto *flexibility* are equally important, whereas most authors have hitherto done only one or the other.

De jure regime ≠ de facto

1. **Most "fixed" aren't:** Countries declaring a peg, often abandon it.
   Only 6 major open economies had kept a peg > 5 yrs. -- Obstfeld & Rogoff (1995).
   Mean duration of pegs in Western. Hem.: 10 months -- Klein & Marion (1997).

2. **Most "floating" aren't:** "floaters'" Var.of *E* (vs. Res) not > fixers'
   ≡ "Fear of Floating" -- Calvo & Reinhart (2002).

3. **Most basket pegs aren't.**
   Weights are kept secret => It takes more than 100 observations for an observer to distinguish a true basket peg statistically
   -- Frankel, Schmukler & Serven (2000)

IFS abandoned its de jure classification tables after 1999.

Dominant way to estimate de facto regimes: estimate degree of flexibility,

typically presuming that \$ = anchor currency

- Calvo & Reinhart (2002):
  Variability of Exchange Rate (E)
  vs. *Reserves*.
- Levy-Yeyati & Sturzenegger (2005):
  cluster analysis based on Variability
  of E & ΔE, and of Δ *Reserves*
- Shambaugh (2004) :
  Variability of E vs. base currency.

But, the de facto classification schemes give very different answers among themselves.

Why?

- Different ways of quantifying flexibility
- The correct anchor currency may not always be the dollar
- Most currencies cannot be neatly categorized on a spectrum of flexibility
  – For one thing, countries switch parameters and regimes frequently.

Correlations Among Regime Classification Schemes

	IMF	GGW	LY-S	R-R
IMF	1.00 (100.0)			
GGW	0.60 (55.1)	1.00 (100.0)		
LY-S	0.28 (41.0)	0.13 (35.3)	1.00 (100.0)	
R-R	0.33 (55.1)	0.34 (35.2)	0.41 (45.3)	1.00 (100.0)

(Frequency of outright coincidence, in %, given in parenthesis.)

GGW =Ghosh, Gulde & Wolf. LY-S = Levy-Yeyati & Sturzenegger. R-R = Reinhart & Rogoff

Sample: 47 countries. From Frankel (2004).

The IMF now has its own "de facto classification"

-- BOR (Bubula & Otker-Robe, 2002) –

still close to the official IMF one.

Bénassy-Quéré, C., & M. (2004): correlation (BOR, IMF) = .76

Table 5

Coefficients of correlation between 3-item regime classifications

		Pre crises[a]				Post crises[b]			
		BQCM	LYS	IMF	BOR	BQCM	LYS	IMF	BOR
Pre crises[a]	BQCM	1							
	LYS	0.19	1						
	IMF	0.34	0.29	1					
	BOR	0.28	0.26	0.63	1				
Post crises[b]	BQCM	0.24				1			
	LYS		0.50			0.60	1		
	IMF			0.58		0.62	0.69	1	
	BOR				0.55	0.64	0.65	0.76	1

Source: Author's calculations.

(a) 1994–1997 (BQCM) or 1996 (LYS, IMF, BOR).

(b) 1999-2004 (BQCM) or 2000 (LYS, IMF, BOR).

Another branch of the de facto regime literature estimates implicit basket weights:

Regress Δvalue of local currency against Δ values of major currencies.

- First examples:
  - Frankel (1993) and Frankel & Wei (1994, 95).
- More:
  - Bénassy-Quéré (1999), Ohno (1999), Frankel, Schmukler, Servén & Fajnzylber (2001), Bénassy-Quéré, Coeuré, & Mignon (2004)….
- Example of China, post 7/05:
  - Eichengreen (2006) , Shah, Zeileis, & Patnaik (2005), Yamazaki (2006) and Frankel-Wei (2006, 07) .
  - Finding: RMB still pegged, with 95% weight on $.

Implicit basket weights method -- regress Δvalue of local currency against Δ values of major currencies -- continued.

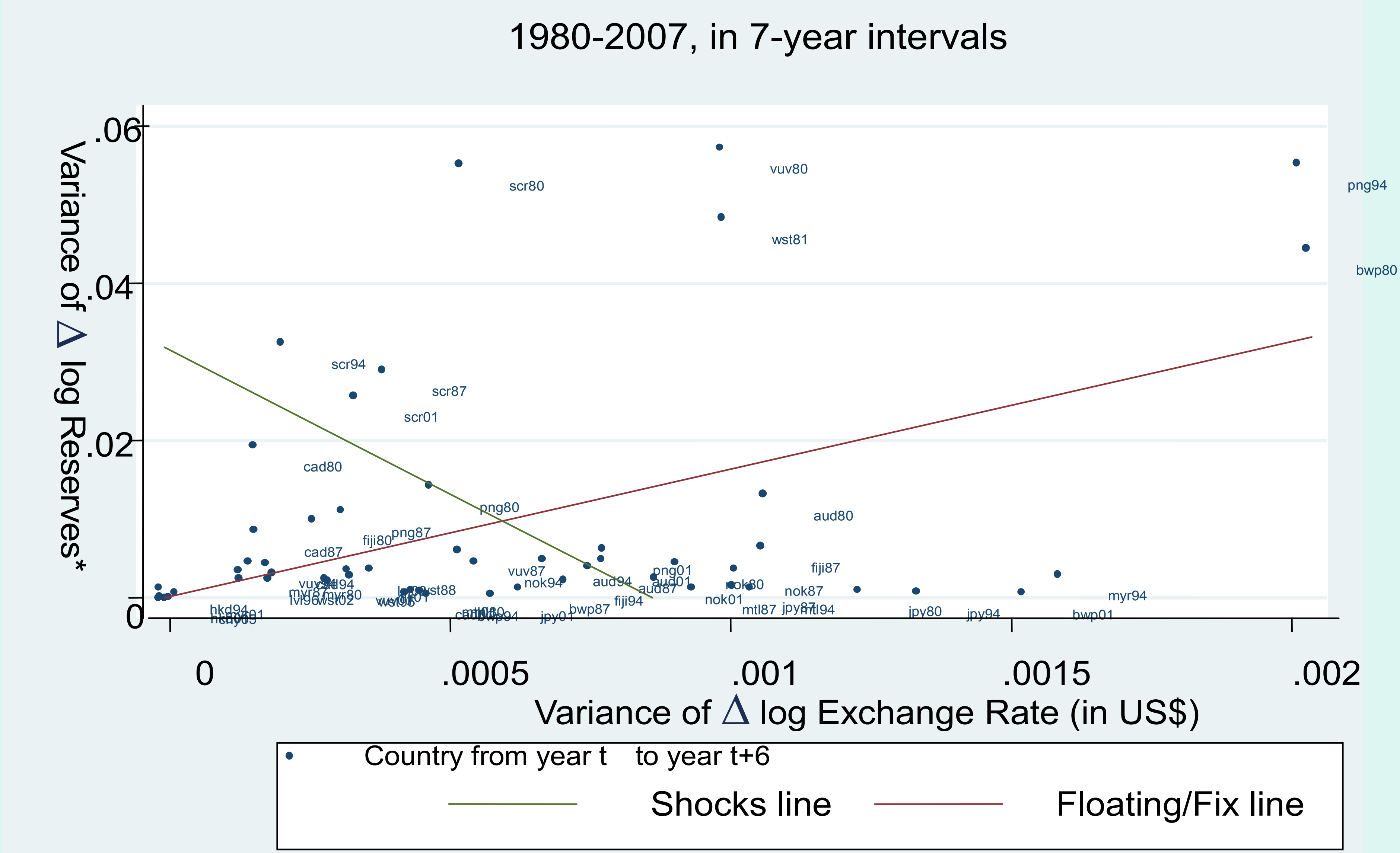
- Null Hypotheses: Close fit => a peg.
  - Coefficient of 1 on \$ => \$ peg.
  - Or significant weights on other currencies => basket peg.
- ***But*** if the test rejects tight basket peg, what is the Alternative Hypothesis?

A preliminary look at the data

- First set of countries examined:
  - 9 small countries that have been officially identified by the IMF as following basket pegs:
    Latvia, Papua New Guinea, Botswana, Vanuatu, Fiji, W.Samoa, Malta & the Seychelles.
  - 4 known floaters:
    Australia, Canada and Japan.
  - 3 peggers of special interest:
    China, Hong Kong & Malaysia.

- Within the period 1980-2007,
- variances of ΔE & Δ *Reserves* are computed for 7-year intervals
  - The aim in choosing this interval: long enough to generate reliable estimates of the parameters, and yet not so long as inevitably to include major changes in each country's exchange rate regime.
- All changes are logarithmic.
- We try subtracting imputed interest earnings from reported Δ *Reserves* to get intervention.

Figure 1: Comparison of Reserve Variability Vs. Exchange Rate Variability



Lessons from Figure 1

1. The folly of judging a country's exchange rate regime – the extent to which it seeks to stabilize the value of its currency – by looking simply at variation in the exchange rate.
   E.g. Var(ΔE) for 1980-86 A\$ > 2001-07 ¥.
   But not because the A\$ more flexible.
   It is rather because Australia was hit by much larger shocks.
   One must focus on Var(ΔE) *relative to* Var(ΔRes)

2. Countries that specialize in mineral products tend to have larger shocks.

Lessons from Figure 1, continued

3. Even countries that float use FX reserves actively. E.g., Canada in the 1980s.

4. A currency with a firm peg (e.g., Hong Kong) can experience low variability of reserves, because it has low variability of shocks.

   The low variability in international demand for the HK$ must result from the stability & credibility that the currency board has itself achieved.

Distillation of technique to infer flexibility

- When a shock increases international demand for korona, do the authorities allow it to show up as an appreciation, or as a rise in reserves?
- We frame the issue in terms of Exchange Market Pressure (EMP), defined as % increase in the value of the currency plus % increase in reserves (or monetary base, or M1).
- EMP appears on the RHS of the equation and the % increase in the value of the currency appears on the left,
  - a coefficient of 0 signifies a fixed E (no changes in the value of the currency),
  - a coefficient of 1 signifies a freely floating rate (no changes in reserves) and
  - a coefficient somewhere in between indicates a correspondingly flexible/stable intermediate regime.

A limitation of papers that estimate flexibility

- They sometimes have choose arbitrarily the major currency in terms of which flexibility and stability are to be defined.
- The $ is the most common choice.
  - This is fine for some countries.
  - But for Europe, the € is more relevant.
  - And for others -- in Asia/Pacific, the Middle East & parts of Africa -- the relevant foreign currency is neither the $ nor the € , but some basket.
- It would be better to let the data tell us what is the relevant anchor for a given country, rather than making the judgment a priori.

The technique that estimates basket weights

- Assuming the value of the home currency is determined by a currency basket, how does one uncover the currency composition & weights? This is a problem to which OLS is unusually well suited.
  We regress changes in the log of ***H***, the value of the home currency, against changes in the log values of the candidate currencies.
- Algebraically, if the value of the home currency **H** is pegged to the values of currencies $X1$, $X2$, … & Xn, with weights equal to $w1$, $w2$, … & wn, then

$$\Delta \log H(t) = c + \sum w(j)\,[\Delta \log X(j)] \qquad (1)$$

- If the exchange rate is truly governed by a strict basket peg, then we should be able to recover the true weights, $w(j)$, precisely, so long as we have more observations than candidate currencies; and the equation should have a perfect fit.

The question of the numeraire

- Methodology question: how to define “value” of each currency.[1]
- In a true basket peg, the choice of numeraire currency is immaterial; we estimate the weights accurately regardless. [2]
- In practice, few countries take their basket pegs literally enough to produce such a tight fit. One must then think about non-basket factors in the regression (EMP, the trend term, error term): Are they better measured in terms of one numeraire or another?
- In this paper we choose as numeraire the SDR
- We also check how much difference the numeraire choice makes.
  - by trying the Swiss franc as a robustness check
  - and in Monte Carlo studies

[1] Frankel(1993) used purchasing power over a consumer basket of domestic goods as numeraire; Frankel-Wei (1995) used the SDR; Frankel-Wei (1994, 06), Ohno (1999), and Eichengreen (2006) used the Swiss franc; Bénassy-Quéré (1999), the $; Frankel, Schmukler and Luis Servén (2000), a GDP-weighted basket of 5 major currencies; and Yamazaki (2006), the Canadian $.

[2] assuming weights add to1, and no error term, constant term, or other non-currency variable.

Synthesis equation

$$\Delta \log H(t) = c + \sum w(j)\, \Delta[\log X(j, t)] + \beta \{\Delta \log EMP(t)\} + u(t) \qquad (2)$$

where $\Delta \log EMP(t) \equiv \Delta[\log H(t)] + [\Delta \log Res(t)]$.

We impose $\sum w(j) = 1$, implemented by treating £ as the last currency.

Table 2 reports OLS estimates.

- Some additional currencies that had basket pegs in the past (Chile, Indonesia, Kuwait, Norway, Thailand…)
- 4-year sub-samples estimated for each country

One concern: endogeneity of the exchange market pressure variable

- One would prefer to observe changes in the international demand for the home currency known to originate in exogenous shocks.
- In the case of countries that specialize in the production of mineral or agricultural commodities, there is a ready-made IV: changes in the price of the commodity on world markets.
- Accordingly, Tables 3 repeat the synthesis estimation technique, but for the commodity producers it uses changes in the world price of the commodity in question as an IV for changes in EMP.

Findings

First we test out the synthesis technique on some known $ peggers

- RMB (Table 2.5):
  
  - a perfect peg to the dollar during 2001-04 ($ coefficient =.99, flexibility coefficient insignificantly different from 0, & $R2$=.99).
  - In 2005-07 the EMP coefficient suggests that only 90% of increased demand for the currency shows up in reserves, rather than 100%;
    but the $ weight and $R2$ are as high as ever.
- Hong Kong $ (Table 2.8):
  
  - close to full weight on US$,
    0 flexibility, & perfect fit.

To address endogeneity of EMP, we use commodity prices as IV

- Malaysian ringgit (Table 2.11) OLS.
  - Only in 1996-99 is there evidence of exchange rate flexibility (Asia crisis).
  - During 2000-03 there is a perfect peg to the $ (coefficient $ R2 both =1).
  - In 2004-07 the peg is still fairly strong, but here the weight of the US$ falls to .6, partially replaced by the Singapore $ (weight = .4) .
- IV = prices of tin & semiconductors (Table 3.6)
  - Again, a perfect $ peg during 2000-03,
  - followed by shift to a basket consisting of an average of the US $ + the Singapore $.

Another commodity-producing pegger

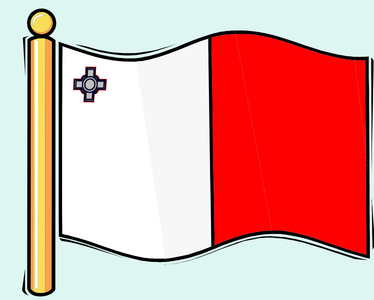
- Kuwaiti dinar shows a firm peg throughout most of the period: a near-zero flexibility parameter, & $R2 > .9$ (IV estimates in Table 3.5; IV= price of oil).
- A small weight was assigned to other currencies in the 1980s basket,
- but in the 2nd half of the sample, the anchor was usually a simple $ peg.

A first official basket pegger

which is on a path to the €

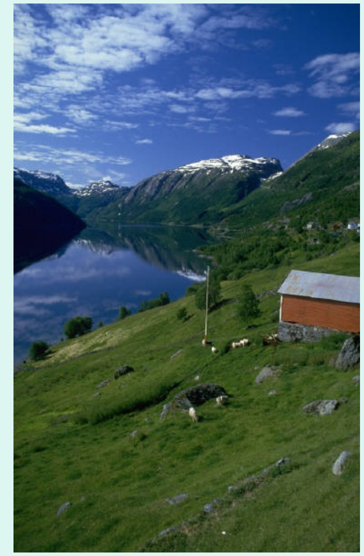
- The Latvian lat (Table 2.10)
  - Flexibility is low during the 1990s, and has disappeared altogether since 2000. R2 > .9 during 1996-2003.
  - The combination of low flexibility coefficient and a high R2 during 2000-03 suggests a particularly tight basket peg during these years.
  - Initially the estimated weights include .4 on the $ and .3 on the ¥, but both decline over time. There is a weight of .3 on the DM up until 1999, which is then transferred to the €:
    .2 in 2000-03 and .5 in 2004-07.

A 2nd official basket pegger
also on a path to the €



- The Maltese lira (Table 2.12)
  - a tight peg during 1984-1991 and 2004-07 (low flexibility coefficient & high R2).
  - During 1980-2003, weight on the $ is .2 -.4.
  - During 1980-1995, the European currencies garner .3-.4, the £ .2-.3 & the ¥ .1.
  - At the end of the sample period, the weight on the € rises almost to .9.

3rd official basket pegger

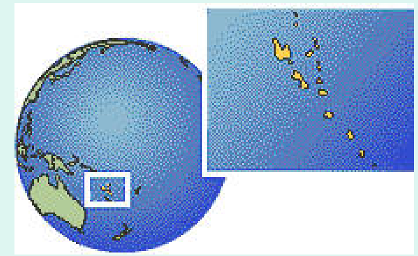


- Norwegian kroner (Table 2.14)
  - The estimates show heavy intervention.
  - Weights are initially .3 on the $ and .4 on European currencies (+ perhaps a little weight on ¥ & £).
  - But the weight on the European currencies rises at the expense of the $, until the latter part of the sample period shows full weight on the € and none on the $.
  - Table 3.8 uses the world oil price as IV for EMP, with results similar to OLS.

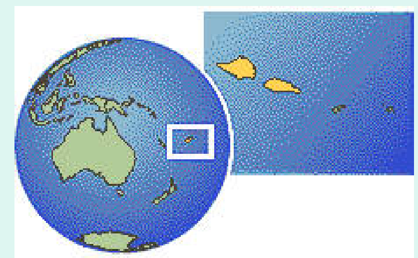
4^{th} official basket pegger

- Seychelles rupee (Table 2.17)
  - confirms its official classification, particularly in 1984-1995: not only is the flexibility coefficient essentially 0, but R2 > .97.
  - Estimated weights: .4 on the $,
.3 on the European currencies,
.2 on the ¥ and
.1 on the £.
  - After 2004, the $ weight suddenly shoots up to .9 .

2 Pacific basket peggers



- Vanuatu (Table 2.19)
  - relatively low exchange rate flexibility and a fairly close fit.
  - The estimates suggest roughly comparable weights on the $, ¥, €, and £ .



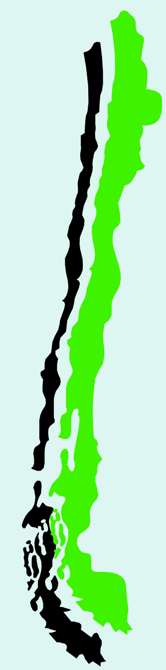
- Western Samoa (Table 2.20)
  - heavy intervention during the first 3 sub-periods,
  - around a basket that weights the $ most , and the ¥ 2nd.
  - After 1992, there is more flexibility.
  - The weights in the reference basket during 2000-2003 are similar to the earlier period, except that the € now receives a large significant weight (.4).

A BBC country,

rare in that it announced explicitly the parameters:

basket weights, band width and rate of crawl.

- **Chile** in the 1980s & 1990s (Table 2.4)
  - $R^2 > .9$.
  - The $ weight is always high, but others enter too.
  - Significant downward crawl 1980-99.
- Estimates qualitatively capture Chile's
  - shift from $ anchor alone in the 1980s, to a basket starting in 1992.
  - move to full floating in 1999.



Chile, continued

- But the estimates do not correspond perfectly to the policy shifts of 1992 & 1999
- Possible explanations for gap between official regime and estimates include:
  - De facto ≠ de jure
  - Endogeneity of the EMP variable
    - can be addressed by IV (price of copper) in Table 3.3.
    - At least the spurious coefficient on the ¥ in the mid-1980s disappears.
  - Parameter changes more frequent than the 4-year sub-periods.
    - The Chilean authorities announced 18 changes in regime parameters (weights, width, and rate of crawl) during the 18-year period 1982 -1999.
    - The difficulty is that we have only monthly data on reserves, for most countries => it is not possible to estimate meaningful parameter values if they change every 12 months on average.

Floaters

- Australian $ (Table 2.1)
  - The coefficient on EMP shows less flexibility than one would have expected, given that the currency is thought to have floated throughout this period.
  - Perhaps the problem is endogeneity of EMP.
  - World commodity prices are a natural IV. (Table 3.1)
  - For each sub-period, the estimated flexibility coefficient is indeed higher than it was under OLS, but still far below 1.

Recurrent finding: IV estimate on EMP is higher than OLS estimate
(but lower in significance)

- Floaters: IV estimates for Canadian $, as with A$, show flexibility parameters in each sub-period higher than they were under OLS, but surprisingly insignificant statistically.
- IV also raises flexibility coefficient for Intermediate regimes:
  - Thailand (Table 3.11) IV = price of rice
  - W.Samoa (Table 3.12) IV = price of coconuts.

Extensions

- Allow coefficients to vary over time, even within the 4-year sub-samples (Tables 4.1-4.10) ;
- Relax constraint that [$\Delta logH$] and [$\Delta\ logRes$] enter with the same coefficient (Tables 5.1-5.8);
- Insert Δ *I*nterest rate alongside Δ Reserves & $\Delta\ E$ (Tables 6.1-6.5) ;
- Check for robustness with respect to the numeraire unit used to define currency values: Sw.franc vs. SDR (Table 7)

Monte Carlo study on fabricated currency regimes

- Two kinds of flexibility
  - Leaning ½ -way against the wind of EMP fluctuations (Table 8.1)
  - Or else constrained to remain in a 5% band (Table 8.2)
- Two anchors
  - $ peg
  - Basket: 1/3 $, 1/3 €, 1/3 ¥
- The synthesis technique generally gives the right answer.

Monte Carlo exchange rate under simulated basket+band regime

(with parameters from Papual New Guinea)