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THE SMOOTHED EXCHANGE RATE APPROACH TO PARITY ADJUSTMENT

By

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INTRODUCTION

Because the delegates to the Bretton Woods conference had lived through the tariff and devaluation wars of the 1920's and 1930's coupled with large scale domestic unemployment, their desire for exchange rate stability is quite understandable. Therefore, by Article IV, Section 5(a), a large change in a parity was authorized only to correct a fundamental disequilibrium. This criterion was interpreted as including not only a disequilibrium, as measured by reserve movements, but also any situation where a potential disequilibrium was hidden by trade and exchange restrictions. Unfortunately, this approach to adjusting parities has proved incapable of promoting prompt and smooth parity adjustments that take into account emerging trends in payments disequilibria. The attitude of the IMF member countries has been one of reluctance towards parity adjustments on the part of reserve currency countries. R. N. Cooper [7] illustrates the problem by showing the high rate of attrition of finance ministers involved in a devaluation.

In recent years there have been a number of proposals to allow limited flexibility of exchange rates. Explicit in all these approaches is a mistrust of a freely floating exchange rate regime. We define a freely floating exchange rate regime as one where absolutely no central bank intervention occurs. As soon as any one central bank intervenes it becomes a system with limited exchange rate flexibility even though there is no coherent overall plan of action being implemented. All too often inter-

vention is carried out on an ad hoc basis. The proposals for limited exchange rate flexibility share a common underlying motive which is a systematization of the intervention pattern.

Advocates of freely floating exchange rates generally claim that management of the exchange rates is unnecessary since the forward market can provide insurance against exchange losses. However, existing forward markets cover only up to six or possibly nine months. Beyond a year they do not exist and they are unlikely to develop. On the other hand most international transactions involve medium and long term contracts. Their terms, as in raw material contracts, are usually open-ended so that they provide little basis for projecting long term foreign exchange needs even if the horizon of forward markets were not so short. This means that the forward market cannot provide the insurance function ascribed to it. Stated in these terms the exchange rate issue is one of comparing the relative advantages (or disadvantages) of a privately organized insurance system that has failed to develop adequately as opposed to one with some form of government involvement. Insuring international trade against currency losses while protecting domestic employment falls reasonably within the realm of government activity. The real question, then, is how can a government best devise a system that dampens short-run fluctuations, while preserving a built-in long-run flexibility to avoid the cumulative payments imbalances which have discredited fixed exchange rates.

First we need to construct some easily measurable criteria

that would tell by how much to alter the parities on a regular basis. Two classes of criteria have been proposed, quantity indicators based on levels and/or rates of change of reserves and price indicators based on observed changes in parities. In section II we summarize and compare current proposals of both types. In section III we present a technique for constructing an indicator to provide the direction and amount of change that should take place in the parity structure. After that, in section IV, we extend our proposal to provide an adaptive rate of parity change to respond to rapid underlying economic changes which would eventually create a fundamental disequilibrium with a smaller rate of maximum change.

II. Summary of some recent approaches to exchange rate flexibility

The need for an adjustment mechanism in cases of foreign payments imbalances has always been recognized, even under the strict Bretton Woods System. In fact, the agreement reached at Bretton Woods was an attempt at a compromise between divergent views on ensuring adequate adjustment of par values whenever needed. In his biography of Keynes, Sir Roy Harrod gives an account of the Keynes-White debate on this issue. Having seen unemployment and economic stagnation generated by the gold standard, Keynes wanted to preserve a country's ability to pursue full employment policies. But he also emphasized the need for an

equilibrating mechanism in cases of payments imbalances. In fact, Keynes was the first one to propose an objective criterion to trigger the adjustment process. To avoid unreasonable postponement of adequate equilibrating measures by member countries, he proposed to give the Governing Board of the Clearing Union wide powers to enforce the desired changes. The objective criterion chosen by Keynes was a quantity indicator, namely the debit (or credit) balance of a member measured as a percentage of its quota in the Clearing Union. These views did not prevail to any great extent. They were rejected and replaced by a completely subjective criterion: adjustments of a member's currency par value were to be made only in cases of "fundamental disequilibrium" and the final decision rested completely in the hands of each individual member country. It is true that there is nothing in the Articles of Agreement preventing any member country from adjusting its parity more often than has actually happened. But the fact remains that the reluctance to take such steps, especially in surplus countries, caused the continuation of payments imbalances of major proportions, resulting finally in heavy short term speculation forcing the change.

It is to avoid these defects that tentative solutions have been proposed in the last decade. They define (1) objective criteria of external payments imbalances and (2) mechanisms to correct such imbalances gradually. There are a variety of features which differentiate them from each other. Most of these proposals agree on increasing the frequency of parity adjustments, to either daily, weekly or monthly changes. They differ on the

pivot with which they choose to measure each currency's parity. Conceptually, many choices are available: gold, the American dollar, S.D.R.'s or any other national monetary unit. Even though all these proposals agree on the need for an objective criterion of disequilibrium, they vary as to the nature of this criterion. Two alternatives are open. One can use either a quantity indicator based on the level or change in a country's international reserves or a price indicator based on some measure of the trend in the market exchange rate (spot and forward) for a country's currency. Finally, these proposals differ on the proposed adjustment method, to be used whenever one of the above criteria has been triggered. We now examine in more detail the major proposals

John Black [3,4] suggests that "the registered par rate of any currency against gold be made equal to the daily average of market rates over some past period, such as a year." Expanding on this idea of using some trend figure as a guide for central bank intervention on foreign markets he proposes that "monetary authorities be required to keep actual market rates within a price range of $\pm$ 100b%." Here b represents the agreed upon fraction of the parity of each currency that is used to define the band. To obtain consistent cross rates if a pivot is not used, he also suggests the use of a geometric mean. That is, if we denote the parity around which

we set the band as $\bar{a}$, we set $\bar{a} = \sqrt[n]{a_1 \cdot a_2 \cdots a_n}$ where $a_1, \ldots, a_n$ are the parities of one currency in terms of any other currency for the past n periods. The choice of the averaging period and of the width of the (moving) band is a matter for international negotiations. The calculation and updating of the average is supposed to be quite frequent, even daily if possible.

J. Carter Murphy [29] proposes first the use of a "single common denominator, such as gold, for exchange rate stabilization calculations." Second, he further proposes that a daily moving average of open market gold prices over, say, a year be used to adjust currency parities. Here again national banking authorities are to cooperate to keep the registered par value of their respective currencies within some narrow band around this par-value. Gradual parity adjustment is possible because the par value would follow movements in market rates.

The German Council of Experts Proposal [9] suggests the use of a further price criterion, namely the relative price indices indicating the evolving price disequilibria between domestic and foreign prices. This suggestion is reminiscent of the old "purchasing power parity" theory. The shortcomings of that theory have been fully developed by Balassa [1], and need not be reiterated here.

The first two proposals provide a consistent and rational way to adjust parities in a smooth fashion while responding to recorded past market rates. The use of a progressive automatic adjustment mechanism makes the system much better equipped to discourage short term speculation. If the (moving) band is narrow enough, an upper bound is provided on the expected rate of return of any speculator. And, interim financing in the form of swap arrangements, is made worthwhile as each country knows that a parity adjustment is necessarily forth coming. The automaticity of the system provides a safeguard for all participants in such swap agreements. The asymmetry of surplus countries being able to hold outlonger than deficit countries forcing the later to face the brunt of the adjustment problems no longer exists.

Now we turn to proposals based on quantity indicators. J. E. Meade [27] is the first one after Keynes to suggest linking parity changes and movements in reserves. He suggests that each member country sign a binding agreement whereby it agrees to support the gold price of its currency to maintain it within some specified band. However, the level of this band is allowed to vary by some small maximum amount in any one month. Depreciation or appreciation of each currency is gradually undertaken under this band constraint, whenever a "substantial" loss (accumulation) of monetary reserves occurs. Unliminted interim financing allows the system to carry out this progressive adjustment and thus discourage one-way speculation. R. N. Cooper [6] in a similar proposal suggests

the idea of a completely automatic adjustment method be abandoned. "Changes in parity would be presumptive rather than mandatory." However, each country thus requesting the benefit of the doubt ultimately has to justify its decision to the IMF; and if its actions are indefensible it could be penalized by withholding sources of balance-of-payments support or imposing "exchange equalization" duties against its products. Instead of linking parity changes to changes in reserves over a specified time period, another possibility is to define a "normal reserves level" and request parity adjustment whenever actual reserves of a member country falls outside the band of reserves considered normal. This is in essence, the fork proposal put forth by R. Triffin [33] in 1969.

Most recently Ugo Sacchetti [31] has suggested that instead of using the level or changes in a country's foreign reserves an index of the overall asset position of a country, called its net foreign asset position (NFA) be constructed. The proposal is that a the end of a given accounting period (month, quarter, year) the changes in a country's foreign assets be calculated. These changes originate in the foreign asset position of the central bank, the banking system and the private sector at large. The size and composition of the observed change serve as a basis of discussion to decide on the appropriate parity adjustment for the currency involved. As in Cooper [7] the process of adjustment, however, would remain under the complete control of the national monetary authorities with no automatic adjustment. For a more thorough discussion of the above proposals other than Sacchetti's see Underwood [35].

The use price indicators is based on the theory that prices are informationally efficient. That is, the one number given by the parity of two currencies reflects all the information on the relative strengths of the two national economies. This is reasonable since the exchange rate is the only number that can control the relative competitiveness of two economies. However, this approach has a major fault. Price indicators reflect an international concensus only if no single dominant force with respect to any currency manipulates the parity within the band Indeed, if this were to happen the parity would wind up reflecting only the opinions of the central bankers. This problem is somewhat but not wholly mitigated by the fact that excessive intervention by a central bank would eventually be detected.

The proposals with respect to quantity indicators to a great extent reduce this problem of price indicators in that central bank market activities will be reflected in the composition of reserves. However, the quantity indicators are subject to manipulation if they are not sufficiently broad. Also, the more inclusive the definition of reserves the more they call for extensive accounting requirements. If one defines reserves as gold, S.D.R's cash and foreign bank deposits held by a country's monetary authority, there is the possibility of artifically lowering a reserve position by investing some of these assets in short-term or even medium-term securities. This behavior by some foreign central banks has been common in the recent past.*

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*It has recently been disclosed that the Japanese Central Bank has U.S. Treasury bill holdings of over $10 billion which is twice as much as the most liberal estimates previously discussed.

This problem still exists if we attach different weights to different assets as is done in the NFA indicator (this is done because some categories of assets are more accurately measured than others). Closing such loop-holes would call for difficult negotiations.

Another major concern is the timeliness of the information. If a more complete index like the NFA is used, information from the private sectors is not readily available and, even if available, it is difficult to collate with any frequency. Also, if the private sector date is from a different time period than the public, then manipulations can disguise the true foreign asset position of a country. At the very best we can hope to monitor quantity indicators weekly and for more accurate information, monthly or even quarterly date would have to be used. This lag would greatly reduce the amount of flexibility and early responsiveness we hope to build into the system. A further discussion of the relative merits of the two approaches may be found in Sacchetti [30].

Whether we wish to use a quantity or price indicator to assess balance of payments developments, we have to ask the following question. To the extent that our ultimate goal is to correctly "forecast" emerging balance of payments disequilibria, can we say that the above proposals provide an accurate forecasting mechanism? The real issue is whether such systems can cope with large-scale disturbances in international payments. Clearly if the maximum crawling rate if fixed at 2% per annum, whereas major structural changes in the balance of payments call for a parity

change of say 5% per annum, no such system of gliding parities can eventually restore payments equilibrium. We need to devise a system which automatically adjusts its degree of crawling to the perceived need based on appropriately weighted past market rates. Cooper's remarks on the kinds of disturbances which can be handled through his gliding parity proposal are worth mentioning at this point, for they apply to all such proposals:

> (1) gradual shifts in the patterns of demand, as incomes grow and tastes change, toward or away from the products of individual countries;
> (2) gradual changes in international competiveness or other supply conditions, such as might arise from exhaustion of natural resources or from small differential rates of change in labor costs due in turn to different national choices regarding tolerable increases in money wages;
> (3) modest influences on trade positions due to alterations in national policies, for example, rates of indirect taxation and corresponding border-tax adjustments.

The following conditions are prerequisites for the long-term functioning of any parity system:

(1) It should not be asymmetric. By that, we mean that it should avoid treating any one currency as a privileged currency. Each currency should be subjected to the same market forces as any other currency.

(2) It should incorporate appropriate incentives to take advantage of speculative behavior, otherwise the speculator will always win as he has done in the past. The proper role of the speculator is to integrate not only the past history and current events but also to estimate future trends and be willing to act on the basis of his convictions. Any system that is unable to react

to predicted future trends is liable to be buffeted by speculators who are using information to its full economic value. This is the essential truth that is recognized by the proponents of freely floating exchange rates.

(3) To be able to promote the growth of international ventures, the system needs some short-run stability in parities.

(4) The system should be able to respond smoothly and automatically to structural changes which occur at a rapid, but not catastrophic rate.

(5) The mechanism of change must be able to accept large once and for all changes that are a response to a crisis.

Satisfying condition (1) is only a matter of choosing the proper pivot (Williamson [42]). However, this issue is separate from the mechanism for adjusting parities except in Black's proposal. One of the indirect consequences of condition (2) is to rule out automatic quantity indicators as the sole mechanism to assess balance of payments developments. Consider the following analogy. If one were to apply quantity indicators to the evaluation of common stock, that is, valuing it solely on annual earnings per share measured by the last four reported quarters, one would expect to see the common stocks selling at the same price-earning ratio before, during and after a boom. Historically this has not happened because of the influence of anticipated future earnings on the price of the stock. All of the above quantity indicators are based on past balance of payments performance instead of expected future performance and therefore do not take account of an anticipated structural changes such as those brought on by the Arab oil boycott.

As for the third condition on short-run stability all of the recent proposals are designed with this in mind. The room for improvement lies in the handling of the fourth condition. This condition calls for a system with good forecasting accuracy based on an analysis of developing trends as reflected by foreign exchange market behavior. The fifth condition is easily met by the quantity indicator approach, but the moving average approaches need ad hoc rules to adjust to a large discrete change in parities.

The question to be answered is then: how can we make use of the activity of speculators on foreign exchange markets to "guide" the process of overall evaluation of a given currency. Their role is to assume the risks of predicting and betting on future trends in the various national economies. In that sense they perform an informational task which is a service to any individual nation as opposed to a threat. For it not to be a threat, the buying and selling of currencies should take place among speculators who have different views of the trends of each currency, instead of the transactions taking place between speculators with a unanimous view of the trends and the central bank reflecting views that are necessarily biased.

III. Mechanism To Insure Smooth Parity Adjustments

In smoothing out daily fluctuations in exchange rates, the moving average techniques of J. Black and J. Carter Murphy are adequate. However, more sophisticated techniques are currently available and are widely used in operations research. The most common technique to handle such problems is exponential smoothing. Before we go into the advantages of this approach let us work through its mechanics.

Assume that at the end of day t we observe a parity P_t of a currency with respect to our pivot. Essentially P_t is a random variable whose mean $\overline{P}_t$ is our unknown underlying equilibrium parity. We wish to find an estimate of $\overline{P}_t$, denoted $\hat{\overline{P}}_t$, using only P_t and $\hat{\overline{P}}_{t-1}$, our estimate of the underlying equilibrium parity from the day before, $\overline{P}_{t-1}$. $\hat{\overline{P}}_t$ may then be used as an estimate of the equilibrium parity for the next day, time t+1. Our proposed estimation procedure is

$$\hat{\overline{P}}_t = AP_t + (1-A)\hat{\overline{P}}_{t-1},$$

where A is a "smoothing constant" between 0 and 1. If A is small, our estimate of $\overline{P}_t$, emphasizes our previous estimate $\hat{\overline{P}}_{t-1}$, whereas if A is large, most of the weight falls on the results of currency trading behavior on day t.

At first glance, one may think that this approach would cause large fluctuations in our estimate of the underlying parity because it seems to involve only two numbers. However, let us expand this first-order recurrence relation by substituting for $\hat{\overline{P}}_{t-1}$ a similar equation for that estimate in terms of P_{t-1} and $\hat{\overline{P}}_{t-2}$

$$\hat{\overline{P}}_t = AP_t + (1-A)\left[AP_{t-1}+(1-A)\hat{\overline{P}}_{t-2}\right]$$

$$= AP_t + A(1-A)P_{t-1} + (1-A)^2\hat{\overline{P}}_{t-2}$$

Continuing this expansion we find,

$$\hat{\overline{P}}_t = AP_t + A(1-A)P_{t-1} + A(1-A)^2P_{t-2} +\ldots+ A(1-A)^nP_{t-n} +$$

$$(1-A)^{n+1}\hat{\overline{P}}_{t-n-1}$$

When n is large, $(1-A)^{n+1}$ becomes negligibly small, and the sum of weights for the actual history of parity values is

$$A \sum_{i=0}^{n} (1-A)^i \simeq 1$$

since the sum of a geometric series

$$\sum_{i=0}^{\infty} h^i = \frac{1}{(1-h)} \quad \text{if} \quad |h|<|.$$

Thus exponential smoothing is similar to a moving average with weights which decrease exponentially with the age of the data. The larger the value of A, the more weight is placed on current trading experience and the more our estimate $\hat{\bar{P}}_t$ fluctuates. Note that we need only keep one piece of data in order to calculate each new forecast.

To see how to control the maximum annual rate of change, we work through an example. We assume that the currency is allowed to fluctuate in a band of $\pm$ 2% around $\hat{\bar{P}}_t$ and that we want to restrict the rate of change of $\hat{\bar{P}}_t$ to be 3% per year with 250 trading days per year. The maximum rate of change occurs when P_t is at the edge of the band for each of those 250 trading days, that is,

$$P_t = 1.02\hat{\bar{P}}_t$$

and

$$\begin{aligned}\hat{\bar{P}}_{t+1} &= AP_t + (1-A)\hat{\bar{P}}_t \\ &= A \times 1.02P_t + (1-A)\hat{\bar{P}}_t \\ &= (1.02A + 1 - A)\hat{\bar{P}}_t \\ &= (.02A + 1)\hat{\bar{P}}_t.\end{aligned}$$

Because of our 250 days of trading assumption, the maximum change for a year is

$$\hat{\bar{P}}_{t+250} = (.02A + 1)^{250}\hat{\bar{P}}_t.$$

Allowing a 3% change in $\hat{\bar{P}}_t$ per year means

$$\hat{\bar{P}}_{t+250} = 1.03\hat{\bar{P}}_t,$$

or

$$1.03\hat{\bar{P}}_t = (.02A + 1)^{250}\hat{\bar{P}}_t.$$

On cancelling $\hat{\bar{P}}_t$ and solving for A we have

$$A = \frac{\sqrt[250]{1.03} - 1}{.02}$$

We now use logarithms to solve this expression and find

$$A = \frac{1.00012 - 1}{.02}$$

$$= .006 .$$

The most obvious advantage of exponential smoothing over a moving average approach is the ease with which anyone can update $\hat{\bar{P}}_t$ without retaining a large amount of data. But more importantly, when a large discrete change in parity is made necessary by some basic political developments such as after the riots in France in 1968, $\hat{\bar{P}}_t$ is all that must be altered by agreement rather than having a surrogate to the moving average until the period of time covered by the moving average is composed entirely of P_t's after the time of the discrete change in parity. Next, the decreasing exponential weights represent a natural decay in the value of past information. The first and last days included in a moving average of one year are equally weighted by $\frac{1}{250}$, although P_{t-250} is certainly less relevant in estimating $\bar{P}_t$ than P_t since the speculators have been able to learn a lot more about the status of various currencies between time t-250 and time t. Whereas, with exponential smoothing, we have P_t weighted by A and P_{t-250} weighted by $A(1-A)^{250}$ and

P_{t-400} weighted by $A(1-A)^{400}$ and so on. Finally, the parameters of band width and A in exponential smoothing are more rapidly set when it is considered desirable to allow different currencies different maximum rates of change against the pivot.

IV. Modifying Expotential Smoothing

In this section we alter the expotential smoothing technique in two ways. First within the framework of a price indicator we show how to build in a response to disequilibria that are involving more rapidly than the maximum response of the system. Next, we show how to integrate price and quantity indicates to take advantage of the virtues of both techniques.

If long term structural changes are occuring in an economy at a rapid rate, the maximum allowable rate of change may be too slow and a massive disequilibrium can build up over time. Exponential smoothing allows us to have an adaptive response to this sort of disequilibrium. This is necessary for instance, for economies that make the transition from underdeveloped to developed very rapidly. For example, the Japanese economy developed through a vertical integration process that demanded heavy imports of capital equipment to expand production and to manufacture semi-finished goods to be re-exported. As soon as the vertical integration of the stages of production from raw to finished goods was complete, the need for imports relative to the level of exports dropped dramatically. The yen shifted very quickly from an over-valued currency to an undervalued currency. To deal with such cases it is important to build in a response to this problem in any flexible exchange rate regime without a crisis being precipitated by a large discrete change in parities.

The choice of the smoothing constant A in the exponential smoothing mechanism determines the speed of response of the system to perturbations in parities. If there is no change in the world economies, and if there were no central bank intervention, the influences changing P_t on a day to day basis would be completely random disturbances. This would lead us to expect P_t to have a pattern of fluctuation evenly distributed around $\hat{\bar{P}}$. However, if P_t is consistently near an edge of the band aroung $\hat{\bar{P}}_t$ this can be taken as an indication of some underlying disequilibrium being corrected or some form of central bank intervention. Having P_t uncomfortably close to an edge for an extended period of time indicates $\hat{\bar{P}}_t$ is consistently underestimating or underestimating $\bar{P}_t$ if no country is trying to improve its competitive position. For now we assume there is no central bank manipulation to devalue competitively.

In exponential smoothing we have a choice in the amount of smoothing we desire. We can trade off fluctuations in $\hat{\bar{P}}_t$ and the responsiveness of the system to changing conditions. We can resolve this problem by constantly monitoring the performance of the system and building in an automatic response that adapts to the gradual buildup of a disequilibrium. What can be done is to agree on a measure of when P_t is too near the edge of the band for too long and from this measure, trigger a change in A so

that the maximum possible change in parity over a period of time is increased. This approach obviates the need to choose a different A for each country because the system can then automatically adapt to the needs of each individual nation at no disadvantage to any other country.

Let $$e_t = \frac{P_t - \hat{\bar{P}}_t}{\hat{\bar{P}}_t},$$

that is, $100e_t$ is the percentage difference between $\hat{\bar{P}}_t$ and P_t. If our band around $\hat{\bar{P}}_t$ is 100b%, we have

$$0 \leq |e_t| \leq b.$$

Divide this band into n sub-bands $b_1,\ldots,b_{n-1}$ where

$$b_0 = 0 < b_1 < b_2 <\ldots< b_{n-1} < b_n = b.$$

We then associate an A_i with each b_i and A_n with b, where

$$0 < A_1 < A_2 <\ldots< A_n.$$

That is, we get a faster response with each A_i the larger i.

We now record the pattern of the e_t's. If the e_t's are close to $\pm$ b, we know we want a faster response to change. One reasonable criterion would be to say that if e_t has been consistently above b_{i-1} for a month but with at least one e_t below b_i during this month, then we choose A_i as our smoothing constant. Subsequently whenever e_t drops below b_i, then we return to a lower A_j where $j < i$. This allows a country to manipulate the rate of change in its parity by intervention in the foreign exchange markets without being able to

competitively devalue. By a massive intervention on only one day per month, a country can lower the maximum rate of change of its parity. A country, however, can increase the actual rate of change only by continuous intervention. Intervention can, nonetheless, reduce the maximum possible rate of change only to that determined by A, so change can still take place and the country can profit from the existing parity structure only in the short term.

Any number of different smoothing rates are possible as well as any number of bands. The intervals $[b_{i-1}, b_i]$ may be equal, or any other pattern may be chosen such as

$$b_1 = \frac{1}{2}b,\ b_2 - b_1 = \frac{1}{4}b \text{ and so on.}$$

This approach provides the kind of built-in adaptive device which is needed to avoid the risk of having a system which is able to integrate only gradual changes in international trade factors while breaking down whenever more rapid structural changes have occurred. In that way, the limitations that Cooper sees in systems of parity adjustments are no longer applicable. The only change that cannot be quickly adapted to is that caused by a massive crisis with large international repercussions.

To deal with the problem of competitive devaluation, we now integrate quantity indicators with price indicators. By having the information from a quantity indicator the misbehavior of any nation becomes readily apparent. (However, the major concern with quantity indicators is timeliness and accuracy). The more complete the indicator such as the NFA the less likely it could be manipulated to disguise gains or losses in reserves. However,

completeness aggravates timeliness. The major virtue of price indicators is their immediacy, allowing for a quick response to international events before reserves are affected.

One way to integrate the two approaches is to use an indicator such as the NFA each quarter to change $\hat{\bar{P}}_t$ on a discretionary basis and to use exponential smoothing between quarters. If a country is found to have entered the currency markets to induce a devaluation, its reserve position will have improved dramatically. The resulting discretionary adjustment in $\hat{\bar{P}}_t$ would be turned into a large foreign exchange loss penalizing the noncooperative country. If a country's market actions were consistent with the quantity indicator discritionary changes would be highly unlikely, Finally, a less complete quantity indicator constructed on a more regular basis can help in guiding the exchange market decisions of central banks. The result is that the two approaches to adjustment reinforce each other. Quantity indicators protect against secret manipulation of price indicators and price indicators allow for increasing the time between quantity measurements. The quantity indicators can be more carefully constructed with the use of a larger number of elements in the index. Finally, it should be emphasized that this integration is most feasible with this price indicator because ad hoc procedures are necessary to adjust parities with the other price indicators discussed previously.

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