Imperfect Knowledge Expectations, Uncertainty Adjusted UIP and Exchange Rate Dynamics: A Comment

David H. Papell
University of Houston

1.   Introduction

Twenty-five years have passed since the rational expectations hypothesis (REH) became the dominant paradigm of modern macroeconomics. Over that time, criticisms of the REH have centered on two issues: the tension between the REH and individual rationality and the poor empirical performance of models employing the REH for explaining the behavior of variables, in particular exchange rates, determined in asset markets. The paper by Frydman and Goldberg (this volume) is an ambitious attempt to synthesize and extend this research.

The paper has two objectives: to develop a theory of expectations consistent with individual rationality and to develop a model consistent with empirical regularities involving exchange rates. In pursuit of the first objective, the concept of imperfect knowledge expectations (IKE), which in turn is an extension of the idea of theories consistent expectations (TCE), is developed and shown to be consistent with rationality of individual agents. Towards the second objective, the concept of uncertainty adjusted uncovered interest parity (UAUIP) is developed and combined with IKE to provided an alternative to the usual rational expectations (RE) and uncovered interest parity (UIP) solution to the Dornbusch-Frankel (DF) monetary model of exchange rate dynamics. The authors claim that their augmented model sheds new light on the exchange rate disconnect, purchasing power parity (PPP), and excess returns puzzles.

The thrust of my comments is that the paper is more successful in satisfying the first than the second objective. Moreover, tension between the two objectives is unavoidable. In a world of imperfect knowledge, individual rationality necessitates that the formation of expectations incorporates non-fundamental factors. This implies a degree of indeterminacy that is, by definition, not quantifiable. But if the degree of indeterminacy is not quantifiable, IKE cannot produce restrictions that can be tested against TCE and/or RE. While this has implications for the ability of the augmented model to explain exchange rate dynamics, it also has implications that go far beyond the particular model or empirical puzzle.

2. Imperfect Knowledge Expectations and Uncertainty Adjusted UIP

Following Dornbusch (1976), models of exchange rate dynamics have typically incorporated both rational expectations and uncovered interest parity. These models produce very strong predictions for real exchange rates that do not stand up well to empirical scrutiny. Frydman and Goldberg develop a theory of real exchange rate dynamics that relaxes both RE and UIP.

Their concept of imperfect knowledge expectations builds upon earlier work on theories consistent expectations, originated in a paper by Frydman and Phelps (1990) and developed in a series of papers by the authors. The idea of TCE is to model expectations as being *qualitatively* consistent with a *variety* of economic models, while RE would be *quantitatively* consistent with a *single* model. While TCE incorporates imperfect knowledge, it is restricted to imperfect knowledge of the true economic model. The contribution of IKE is to extend the scope of the imperfect knowledge to "atheoretical

components based on technical trading and other rules of thumb as well as other subjective assessments concerning the movement of the average opinion."[1]

Imperfect knowledge expectations are clearly a step forwards in consistency with individual rationality. Imperfect knowledge of economic agents clearly extends beyond uncertainty regarding the true model, and the incorporation of atheoretical components makes sense. Moreover, as the authors clearly demonstrate, RE cannot be consistent with individual rationality because agents have to both solve the "scientific" problem, finding the correct model, and have to take account of the actions of others. This necessarily involves a degree of indeterminacy that goes beyond what can be accounted for by TCE.

Imperfect knowledge expectations are not, however, clearly a step forward in explaining empirical regularities. With TCE, the scope of imperfect knowledge is limited to a variety of models. Using standard econometric techniques, likelihood ratio tests with overidentifying restrictions, one can construct nested tests to compare models with RE and TCE. In Papell (1997), I estimate DF models of exchange rate dynamics with RE and TCE, and reject the RE restrictions in favor of the TCE specification. With IKE, the scope of imperfect knowledge is unlimited and nested tests cannot be constructed to compare IKE with either TCE or RE. In the absence of such tests, the concept of IKE is not empirically falsifiable.

The concept of uncertainty adjusted uncovered interest parity uses myopic loss aversion to motivate deviations from UIP. Using the PPP exchange rate as a benchmark level, an equation is derived that relates deviations from UIP to deviations from PPP. This equation is similar to the imperfect capital mobility specification in Frenkel and

---

[1] Frydman and Goldberg (this volume).

Rodriguez (1982) although, as noted by the authors, the imperfect capital mobility

specification is more restrictive.

3.   Exchange Rate Dynamics and the PPP Puzzle

Models of exchange rate dynamics in the DF tradition involve explaining

deviations from PPP. The consensus view is that, while PPP holds in the long run for

post-1973 real exchange rates, mean reversion is slow. A common measure of the speed

of mean reversion is the half-life of PPP deviations, the time it takes for a shock to

dissipate by 50%. Rogoff (1996) describes a "remarkable consensus" of between 3-5

years for half-lives of PPP deviations, "seemingly far too long to be explained by nominal

rigidities". He characterizes the "PPP Puzzle" as the difficulty in reconciling the high

volatility of short-term real exchange rates with extremely slow convergence to PPP.

What do we know about convergence to PPP? Figure 1 depicts the real

mark/dollar exchange rate from 1973 to 1998, using quarterly data and national consumer

price indexes. The figure is drawn so that an increase represents a real appreciation of

the dollar (or depreciation of the mark). It is apparent that the mark/dollar rate cannot be

characterized by one convergence experience. While there are "long swings" in the

exchange rate, most notably over the 1980-1987 period, there are also "short swings" in

the early 1970s and 1990s.

What is the magnitude of the PPP puzzle? Murray and Papell (2002) analyze

half-lives of PPP deviations over the post-Bretton Woods floating exchange rate period.

We estimate Augmented Dickey-Fuller regressions for a number of real exchange rates

with the U.S. dollar as the numeraire currency,

$$q_t = c + a q_{t-1} + \sum_{i=1}^{k} y_i D q_{t-i} + u_t.$$ (1)

where q is the (logarithm of the) real exchange rate. An approximate measure of the half-life can be calculated as $\ln(0.5)/\ln(\alpha)$, while an exact measure can be calculated from the impulse response function.

Using approximately median unbiased estimation methods, which correct for the downward bias in least-squares estimates in Equation (1), we calculate point estimates and confidence intervals for half-lives of PPP deviations. For the mark/dollar rate, the point estimate of the half-life calculated from the impulse response function is 3.03 years, just within Rogoff's "consensus". The lower bound of the 95% confidence interval, however, is 1.24 years while the upper bound is infinite.[2] These confidence intervals are consistent with almost any type of real exchange rate behavior. Looking at the lower bounds, the fast speed of convergence to PPP is consistent with models based on nominal rigidities. Looking at the upper bounds, the absence of convergence to PPP is consistent with a unit root in the real exchange rate.

The standard DF model with rational expectations does not account for either the varying pattern of long and short swings or the evidence on half-lives of PPP deviations found in the data. What do we learn by augmenting the DF model with IKE and UAUIP? The augmented model can, in principle, account for virtually any pattern of real exchange rate dynamics. One example emphasized by the authors is that, by making appropriate case-by-case assumptions regarding revision of expectations, the model can produce both long and short swings. I would also conjecture that, again by making assumptions regarding expectations revision, the model could be consistent with extremely wide confidence intervals for half-lives of PPP deviations.

---

[2] The estimates for other countries are similar. In particular, they all have an infinite upper bound.

Does this paper help "solve" the PPP puzzle? While, in contrast with the DF model with RE and UIP, the augmented model is consistent with a wide variety of movements around PPP, it does not provide a quantifiable explanation for the different experiences. Why was there an eight-year "long" swing in the real exchange rate starting in 1980, followed by a three-year swing, followed by a one-year "short" swing? While the model can provide an *ex post* justification based on factors such as "atheoretical components" and "myopic loss aversion", it cannot provide a falsifiable explanation. Put differently, I cannot see any type of movement around PPP that is inconsistent with the model. Unless restrictions are placed on the scope of the indeterminacy, I am not optimistic that this approach can contribute to our understanding of the PPP and other puzzles in international finance.

## 4.	Individual Rationality and Empirical Falsifiability

While the objectives of the paper are to develop a theory of expectations consistent with individual rationality and to develop a model that can account for empirical regularities involving exchange rates, these objectives are not weighted equally. The paramount concern of the authors is consistency with individual rationality. Given the primacy of that concern, non-quantifiable factors necessarily enter into agents' expectations functions, leading inexorably to indeterminacy. As the authors write, "*empirically relevant* models of economic phenomena in which expectations play a key role are very likely to involve free parameters arising from agents' expectations."

I do not believe that we should be willing to sacrifice empirical falsifiability on the altar of individual rationality. There is a crucial distinction between TCE, where the indeterminacy is quantifiable and nested tests can be conducted to differentiate between

models, and IKE, where the indeterminacy is not quantifiable and nested tests cannot be run. In my view, *non-falsifiable* models incorporating free parameters arising from agents' *non-quantifiable* expectations cannot be empirically relevant. If inconsistency with individual rationality is the price that must be paid to produce models that can be rejected, then it is a price worth paying.

References

Dornbusch, R. (1976), "Expectations and Exchange Rate Dynamics," *Journal of Political Economy*, *84*, 1161-1176.

Frenkel, J. and C. Rodriguez (1982), "Exchange Rate Dynamics and the Overshooting Hypothesis," *International Monetary Fund Staff Papers*, 29, 1-30.

Frydman, R. and E. S. Phelps (1990), "Pluralism of Theories Problems in Post-Rational-Expectations Modeling," paper presented at the 1990 Siena Summer Workshop on Expectations and Learning.

Murray, C., and D. Papell (2002) "The Purchasing Power Parity Persistence Paradigm," *Journal of International Economics*, *56*, 1-19.

Papell, D. (1997) "Cointegration and Exchange Rate Dynamics," *Journal of International Money and Finance*, 16, 445-460.

Rogoff, K. (1996) "The Purchasing Power Parity Puzzle," *Journal of Economic Literature*, *34*, 647-668.
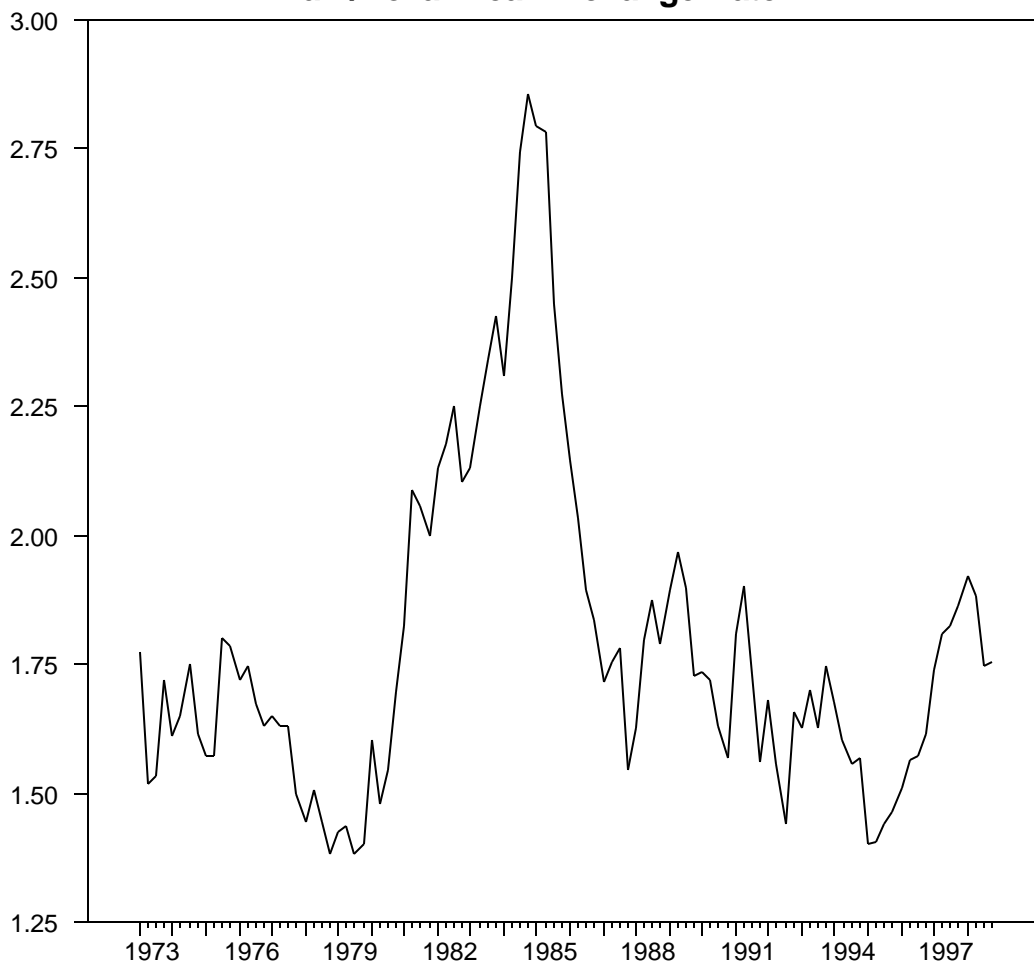
Mark/Dollar Real Exchange Rate

Figure 1