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Restaurant Prices and the Mexican Peso

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Abstract

Of prime interest to border economies is exchange rate performance and currency valuation. Commonly used tools for this task include purchasing power parity (PPP) nominal benchmarks and inflation adjusted trade-weighted indices. The latter have the advantage of relying upon commonly available international macroeconomic data, but overlook microeconomic information that may offer additional insight to issues surrounding exchange rate policy debates. Other efforts have utilized small samples of international product price comparisons to shed light on currency valuation questions. This paper develops one such tool by repeated sampling of prices charged for identical menu items sold at restaurant franchises in El Paso, Texas and Ciudad Juárez, Chihuahua. A battery of statistical tests indicate that the international currency value of the peso consistently differed from the exchange rate implied by the border region restaurant price ratios in 1997, 1998, and 1999.

Keywords: Exchange rates, purchasing power parity, international price comparisons

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1. Introduction

Balance of payment concerns facing Latin American economies have caused international currency valuations to receive ongoing scrutiny throughout the past decade and a half. Given its importance to regional economic performance, border areas between countries such as the United States and Mexico, Canada and the United States, Colombia and Venezuela, and Ecuador and Colombia also monitor exchange rate developments very closely. Typically, one of two types of monitoring tools have been utilized for formal econometric work in this branch of international economics, nominal purchasing power parity (PPP) indices and trade-weighted real exchange rates. Both of the latter rely on easily obtained macroeconomic data.

A widely cited exception to those macroeconomic data approaches is published quarterly by *The Economist* magazine utilizing hamburger prices from a well-known restaurant corporation with worldwide franchises. The research at hand develops a similar tool utilizing a variety of international restaurant franchises with operations in El Paso, Texas and Ciudad Juárez, Chihuahua on the border between the United States and Mexico. More than seventy signature menu item prices are sampled every month in order to develop an exchange rate measure based on the so-called law of one price hypothesis. Parametric and nonparametric statistical testing is then conducted to examine whether the border restaurant price ratio bears any relationship to the exchange rate value of the peso over the 36-month sample period for which data are available (July 1997 - June 2000).

Section 2 of the paper includes a literature review. Data and methodology are described in the third section. Section 4 provides an empirical analysis of the results. Concluding remarks and suggestions for future research are included in the final section.

2. Literature Review

Exchange rate monitoring has become a staple of international corporate and public policy analysis in the two-plus decade period subsequent to the demise of the Bretton Woods fixed exchange rate system. A common approach is the measurement of trade-weighted real exchange rates designed for country risk analysis and balance of payments pressure gauging. Such indexes will generally indicate overvaluation with respect to a pre-selected base with values in excess of 100 and undervaluation with values below 100 (Batten and Belongia 1986; Fullerton 1989). Another practice is the calculation of theoretical nominal exchange rates under a PPP approach (Beltrán del Río 1999). The latter are often popular among financial market analysts because they are defined in the actual units in which trades are conducted.

International restaurant franchise menu pricing has given rise to a new empirical variant on the law of one price in recent years. *The Economist* magazine runs a periodic comparison of hamburger prices to nominal exchange rates for a group of twenty-plus countries (*The Economist* 1998). Hamburger prices in local currency units are divided by a corresponding dollar price. Whenever the resulting price ratio is higher than the exchange rate, it implies that the local currency is overvalued. When the ratio is below the prevailing exchange rate, it implies the opposite. The popularity of this readily identifiable index has spawned several subsequent studies that study both geographic and

time series characteristics and implications of the approach. While Cumby (1996) and Ong (1997) find fairly good evidence in favor of the hamburger index, Pakko and Pollard (1996) conclude that non-tradability and institutional factors cause it to perform unreliably.

A growing number of studies examine the PPP principle using data that involve more than one product and take into account geographic factors such as distance (Engel and Rogers 1996; Parsley and Wei 2000). In one such effort, James Gerber sampled individual menu items from seven restaurants in San Diego and Tijuana (Regents 1997). Results reported therein indicate that the implied valuation for an exchange rate will vary significantly depending on which menu item is selected for comparison. Jenkins (1997) utilizes price data for 22 separate goods and services consumer price indices for six sets of cities in the United States and Canada. Evidence is uncovered that indicates that deviations between implied and actual exchange rates may arise due to menu costs, taxes, and non-tradability. Similar results have also been reported for a cross section of products in the United Kingdom (Fraser, Taylor, and Webster 1991). Geographic commercial factors may also cause at least temporary deviations between regional price comparisons and national exchange rates (Clark, Sawyer, and Sprinkle 1997, 1999, 2000). Differences in industrial composition and concomitant effects on business cycle phase responses generally contribute to such divergences.

There are other reasons why regional and national price ratios may frequently deviate from prevailing exchange rates. Currency market overshooting can result from interest rate disparities combined with asset market and goods market adjustment differences (Dornbusch 1976). Sluggish price movements, menu costs, and non-tradability may also prevent cross border price comparisons from matching exchange rates in a statistical sense (Rogers and Jenkins 1995). Given these considerations, it would not be surprising to discover that the sample data collected in El Paso and Ciudad Juárez do not generate overwhelming support for the PPP hypothesis. The latter possibility is especially relevant due to the fact that three years of data represent a fairly short sample for examining what is generally regarded as a long-run characteristic of frictionless currency markets.

Income level disparities may also contribute to divergences between restaurant price ratio data and currency values. Comparative price levels for identical products generally vary with national income levels (Summers and Heston 1991; Heston and Summers 1996). This may result in part from an interaction between capital-labor ratios and service prices (Bhagwati 1984). Despite rapid growth in recent years, Mexico is still a developing country with lower per capita income than the United States. If food prices in Mexico are simply lower than they are on the north side of the river, then the price ratio reported below would naturally tend to fall below the average nominal rate each month in a statistically consistent manner.

Differences in labor productivity, such as those that exist between Mexico and the United States, can also lead to price ratio deviations relative to PPP estimates. The latter may cause non-traded goods prices to vary across countries such that national economies with higher productivity levels will face higher costs of production. Consequently, price indices and ratios that contain non-traded components can easily exhibit persistent deviations from what would be expected under the law of one price (Balassa, 1964;

Samuelson 1964). As noted by Pakko and Pollard (1996) and Ong (1997), restaurant meals contain both tradable commodities and non-tradable labor services. If labor immobility allows cross-border labor productivity differentials to persist, then restaurant price ratios can easily deviate from nominal exchange rate measures.

Given all of the above, it would be surprising if PPP continuously holds for any particular group of goods over extended periods of time. That does not rule out, however, the possibility of eventual PPP convergence whenever deviations occur (Cumby 1996; Rogoff 1996). Much of the empirical work in this area uncovers evidence in favor of convergence periods of approximately three-to-five years in a large number of currency market settings (Diebold, Husted, and Rush 1991; Cheung and Lai 1994). Among other possibilities, shipping costs and border impediments have been found to play roles in the delay in adjustments between exchange rates and retail prices such as those sampled herein (Obstfeld and Rogoff 2000; Parsley and Wei 2000).

Previous Latin American research has pointed to a potentially important role for PPP specifications in modeling nominal exchange rate movements, especially for free- and parallel-market currency quotes (Fullerton 1993a,b). Some of the empirical success documented in those studies may be attributable to relatively persistent inflationary gaps with major trading partners (Rogoff 1996). Extended periods of fixed nominal exchange rates followed by large-scale devaluations may also contribute to the favorable in-sample results in such efforts (Lewis 1995). Whether similar patterns for the peso/dollar exchange rate emerge using cross-section microeconomic data is studied below.

3. Data and Methodology

One line of inquiry that is still open to question is whether differences between implied and prevailing exchange rates are statistically significant. While some studies to date indicate that international menu price ratios are frequently close to actual currency values, these casual observations are generally not subjected to formal hypothesis tests. To do so in a robust manner probably requires multiple franchise product comparisons subject to repeated sampling over time. Fortunately, it is possible to collect data meeting those conditions in large borderplex regions such as El Paso and Ciudad Juárez.

Because of the collective size of the sister cities on the Rio Grande, it is possible to collect price data for identical products without resorting to consumer price index measures as Jenkins (1997) was forced to do. More than 72 separate menu items are sampled during the third week of every month at multiple restaurants. Because there have been several closures as well as new inaugurations during the course sample period in question, the number of products utilized has varied. The exact day on which the sampling is conducted also changes in response to research assistant examination schedules at the University of Texas at El Paso. Included in the sample are hamburger restaurant chains, chicken franchises, pizza chains, one steak house franchise, a sandwich eatery, an upscale family grill, and one authentic taco chain. The latter is the only entity in the sample with corporate headquarters in Mexico instead of the United States. A separate franchise organization, also headquartered in Mexico, was dropped from the sample when it closed all of its operations in Ciudad Juárez but left open its units on the north side of the border. Also dropped at various points from the sample due to operating

unit closures on the south side of the river were an ice cream shop, a fast food pastry house, and a hot dog eatery.

Step one is transcription of the individual menu item prices from the various restaurants in both respective cities. Ratios are then constructed in terms of peso prices relative to their counterparts in dollars. Statistical moments are then calculated for the implied exchange rate observations in each sample. Skewness and kurtosis estimates for the third and fourth moments are used to calculate Jarque-Bera statistics for probability distribution inference. Finally, monthly average exchange rate data are also collected from secondary source material according to availability and timeliness. Common information sets are used by both organizations (for examples, see Trevizo, 1998, and www.banxico.mx.org).

The null hypothesis tested each month is the following,

Ho: $P_{cj} / P_{ep} = Nex$ vs. Ha: not Ho.

Variables used in the null hypothesis include the nominal price of the menu items in nominal pesos, P_{cj} , the nominal prices of the menu items in nominal dollar terms, P_{ep} , and the monthly average nominal peso per dollar exchange rate, Nex.

To formally examine the hypothesis of price ratio - exchange rate equality, both parametric and nonparametric statistical tests are utilized. The former impose stochastic distribution assumptions that occasionally fail to be satisfied. The latter require fewer characterizations regarding the mathematical nature of the underlying data generating process. At present, sample data are available for the thirty-six month period between July 1997 and June 2000.

As mentioned above, a number of recent studies report evidence in favor of intertemporal convergence to currency values that would be expected under the law of one price. Earlier evidence indicates that the time elapsed until convergence is attained, approximately three-to-five-years, is longer than the sample collected to date. For that reason, formal examination of the intertemporal convergence hypothesis for the peso/dollar exchange rate is not attempted. To at least partially address this possibility, various pieces of evidence regarding overall trends in the sample are presented. They include graphical presentation of the data, a simple correlation coefficient, a regression test of prediction bias for the exchange rate using the restaurant price ratio, and a brief review of the sources of change in the menu price ratio.

4. Empirical Results

The parametric test conducted is a standard t-test for equality between the arithmetic means of the monthly price ratios and the corresponding average monthly exchange rates. Type-one error significance is selected at the 5-percent level. The thirty-six month sample includes several episodes of relatively rapid nominal depreciation for the peso versus the dollar. Examples include November 1997, June 1998, August 1998, and January 1999. In the period under question, there are also several months during which the peso appreciated against the dollar in both real and nominal terms. Notable examples of the latter include December 1997, April 1998, and March 2000. Accordingly, the sample range covers a fairly interesting period for the currency market in Mexico.

Results for the t-tests appear in Table 1. In 23 of the 36 months for which sample data are available, the price ratios differ significantly from the corresponding exchange rates. In each of those cases, the restaurant price ratio falls below the prevailing nominal exchange rate. Such a pattern potentially indicates that restaurant meals are simply less expensive in Mexico than in the United States. Given that PPP is regarded as a long-run property for exchange rates, that the data include at least short-term departures from a strict interpretation of the law of one price is not surprising.

Not all of the test statistics shown in Table 1 run counter to the PPP hypothesis. For most of 1999 and the early part of 2000, it was not possible to reject the null hypothesis of statistical equality between the restaurant price ratios and the monthly peso/dollar exchange rates. Numerical agreement between the price ratio with the currency market data raises interesting possibilities, but it should be recalled that the Gossett t-test assumes data normality. To examine whether the normality assumption is met, Jarque-Bera tests are also conducted. Results for these tests are reported in Table 2. In all but 4 instances, the null hypothesis of price ratio data normality is rejected. Because this calls into question the significance of the results in Table 1, additional nonparametric testing regarding price ratio and exchange rate equality is conducted.

The principal culprit behind non-normality in the various monthly samples is kurtosis. In some instances, the histogram tails are relatively heavy. In other instances, the distribution is bi-modal. Skewness, also known as distribution asymmetry, is not problematic. Given that, a Wilcoxon signed-rank test can be utilized to test the null hypothesis of monthly sample price ratio mean equality with the peso/dollar exchange rate (Daniel, 1978). Given that all of the sample sizes are greater than 25, the distribution for the Wilcoxon test statistic is approximately standard normal. Results for this test are reported in Table 3.

Using a 5-percent significance level, the null hypothesis of mean restaurant price ratio equality with the average nominal exchange rate for the peso is rejected in 30 of the 36 monthly samples. As is the case with the parametric t-test, all of the instances in which the Wilcoxon test supports the PPP hypothesis occur in 1999 and 2000. Because nonparametric support is more limited, a strong PPP definition is probably not applicable to the peso/dollar exchange rate over the short sample period in question.

It is possible, however, that the law of one price does hold over the long-run for Mexico and the United States. If the monthly test statistics reported in Tables 1 and 2 reflect only short-term deviations relative to the international valuation of the Mexican currency, then the evidence implies that the peso was consistently undervalued throughout 1997 and 1998. This possibility is line with other exchange rate index calculations conducted on the basis of national price index movements (Beltrán del Río 1999). While additional monitoring and testing will be necessary to confirm this inference, the restaurant price index may provide a useful means for reducing currency market uncertainty between these large trading partners.

It is also possible, however, that national income differentials and other forces reviewed above prevent sub-aggregate price parity for restaurant menu items between Mexico and the United States. Such an eventuality is not formally examined in this paper and additional sampling will be required to do so in an econometrically valid manner. If the latter condition holds, it does not negate the usefulness of the ratio, but alters the

interpretation associated with its movements since the franchise measure would then tend to consistently fall below an equilibrium nominal exchange rate. Such a scenario implies that the peso may have become overvalued in 1999 and 2000, the period during which both tests implied at least occasional equality between the price ratio and the exchange rate.

Table 4 contains summary information regarding overall trends in exchange rate and price ratio movements for the period in question. While it is not yet possible to determine whether the restaurant price measure should consistently remain above or below the nominal exchange rate, at least partial evidence is provided that movements the two variables are somewhat related to each other. The simple correlation coefficient for the two series is 0.765. The menu price ratio is not, however, an unbiased predictor of the currency market. Linear regression of the nominal exchange rate against the price ratio yields an intercept term that is significantly different from zero and a slope coefficient that is significantly different from unity.

As noted by Cumby (1996), temporary deviations away from purchasing parity can be overcome via a combination of exchange rate movements and relative price changes. Figure 1 illustrates that the two series under consideration frequently follow different paths. Table 5 lists the numerical values for both variables as well as the number of changes observed each month for menu prices sampled on each side of the border. As might be expected in a competitive market structure in which firms manage multiple inventory categories comprised by perishable inputs, frequent price adjustments occur in both cities. Possibly reflective of a less stable price environment with a higher overall rate of inflation, menu prices vary more often in Ciudad Juárez than in El Paso, but the latter pattern is not universally held across all months in the sample. It is not feasible to discern any readily apparent relationship between the numbers of price adjustments and monthly currency market changes.

5. Conclusion

Much attention has been devoted in recent years to the implications of franchise restaurant price comparisons for identical menu items with respect to international currency valuations. Theoretical arguments have also been presented to support and to reject strict interpretations of the PPP hypothesis. Empirical evidence has emerged on both sides of the issue. The latter have mainly, however, relied upon data sets that are limited to a small number of menu items and are not monitored over time.

This paper attempts to shed additional light on this question by repeated price sampling and comparison for more than 70 identical products marketed by nine international restaurant franchises with operations on both sides of the United States - Mexico border. Both parametric and nonparametric hypothesis tests provide evidence that the peso/dollar exchange rate has frequently differed in a statistically significant manner from values suggested by the law of one price in recent years. Limited evidence that favors PPP is also uncovered by both testing methodologies. Due to the short-term nature of the data sets, 36 months at present, additional sampling is warranted.

Cointegration testing will become possible once sufficient data are available to examine the long-run relationships between the series described above (Taylor 1988;

Hakkio and Rush 1991). Such modeling will shed light on whether the two series considered herein are linked in a statistically reliable manner. It will also make it possible to ascertain in what manner, if any, movements in the nominal exchange rate are tracked by the price ratio. If the restaurant price ratio does so in a reliable manner, it potentially offers a microeconomic counterpart to the standard macroeconomic index measures generally utilized to monitor currency market developments between the peso and the dollar. Eventual testing of the intertemporal convergence hypothesis will also become viable as more information is assembled.

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Table 1
Price Ratio Exchange Rate Equality Tests

Month	Sample Size	Computed t-statistic	Critical Value	Decision
JUL97	75	-5.580	1.667	Reject Ho
AUG97	75	-7.513		Reject Ho
SEP97	74	-8.211		Reject Ho
OCT97	73	-7.501		Reject Ho
NOV97	73	-7.685		Reject Ho
DEC97	73	-6.863		Reject Ho
JAN98	73	-6.528	1.667	Reject Ho
FEB98	73	-6.210		Reject Ho
MAR98	73	-7.217		Reject Ho
APR98	73	-6.761		Reject Ho
MAY98	73	-10.078		Reject Ho
JUN98	72	-6.165		Reject Ho
JUL98	72	-6.939		Reject Ho
AUG98	72	-8.225		Reject Ho
SEP98	72	-8.437		Reject Ho
OCT98	72	-7.167		Reject Ho
NOV98	72	-6.324		Reject Ho
DEC98	72	-4.065		Reject Ho
JAN99	72	-3.711	1.667	Reject Ho
FEB99	72	-1.943		Reject Ho
MAR99	72	-0.234		Accept Ho
APR99	72	0.106		Accept Ho
MAY99	90	-2.280		Reject Ho
JUN99	94	-1.186		Accept Ho
JUL99	94	-1.118		Accept Ho
AUG99	94	-1.515		Accept Ho
SEP99	94	-1.073		Accept Ho
OCT99	82	-1.452		Accept Ho
NOV99	82	-0.805		Accept Ho
DEC99	82	-1.036		Accept Ho
JAN00	81	-1.376	1.667	Accept Ho
FEB00	81	-0.403		Accept Ho
MAR00	81	-0.671		Accept Ho
APR00	78	-1.180		Accept Ho
MAY00	81	-2.678		Reject Ho
JUN00	81	-3.970		Reject Ho

Table 2
Jarque-Bera Chi-Square Tests for Price Ratio Data Normality

Month	Sample	Computed JB-stat.	Critical Value	Decision
JUL97	75	1.898	5.991	Accept Ho
AUG97	75	5.294		Accept Ho
SEP97	74	1.929		Accept Ho
OCT97	73	27.664		Reject Ho
NOV97	73	16.616		Reject Ho
DEC97	73	15.054		Reject Ho
JAN98	73	18.865	5.991	Reject Ho
FEB98	73	119.388		Reject Ho
MAR98	73	126.558		Reject Ho
APR98	73	127.693		Reject Ho
MAY98	73	1.925		Accept Ho
JUN98	72	99.076		Reject Ho
JUL98	72	141.138		Reject Ho
AUG98	72	110.016		Reject Ho
SEP98	72	20.697		Reject Ho
OCT98	72	23.488		Reject Ho
NOV98	72	42.416		Reject Ho
DEC98	72	39.504		Reject Ho
JAN99	72	28.809	5.991	Reject Ho
FEB99	72	21.816		Reject Ho
MAR99	72	28.621		Reject Ho
APR99	72	11.797		Reject Ho
MAY99	90	86.871		Reject Ho
JUN99	94	154.861		Reject Ho
JUL99	94	171.613		Reject Ho
AUG99	94	111.094		Reject Ho
SEP99	94	82.809		Reject Ho
OCT99	82	72.740		Reject Ho
NOV99	82	89.043		Reject Ho
DEC99	82	76.326		Reject Ho
JAN00	81	61.022	5.991	Reject Ho
FEB00	81	82.553		Reject Ho
MAR00	81	62.740		Reject Ho
APR00	78	42.553		Reject Ho
MAY00	81	18.535		Reject Ho
JUN00	81	30.839		Reject Ho

Table 3
Wilcoxon Signed-Rank Tests for Price Ratio Exchange Rate Equality

Month	Sample	W(-)stat.	W(+)stat.	Critical	Decision
JUL97	75	4.753	-4.753	1.960	Reject Ho
AUG97	75	5.835	-5.835		Reject Ho
SEP97	74	6.047	-6.047		Reject Ho
OCT97	73	5.916	-5.916		Reject Ho
NOV97	73	5.984	-5.984		Reject Ho
DEC97	73	5.682	-5.682		Reject Ho
JAN98	73	5.638	-5.638	1.960	Reject Ho
FEB98	73	5.649	-5.649		Reject Ho
MAR98	73	5.984	-5.984		Reject Ho
APR98	73	5.858	-5.858		Reject Ho
MAY98	73	6.627	-6.627		Reject Ho
JUN98	72	5.460	-5.460		Reject Ho
JUL98	72	5.892	-5.892		Reject Ho
AUG98	72	5.915	-5.915		Reject Ho
SEP98	72	5.932	-5.932		Reject Ho
OCT98	72	5.466	-5.466		Reject Ho
NOV98	72	5.460	-5.460		Reject Ho
DEC98	72	4.383	-4.383		Reject Ho
JAN99	72	4.097	-4.097	1.960	Reject Ho
FEB99	72	2.812	-2.812		Reject Ho
MAR99	72	1.846	-1.846		Accept Ho
APR99	72	1.212	-1.212		Accept Ho
MAY99	90	3.382	-3.382		Reject Ho
JUN99	94	2.391	-2.391		Reject Ho
JUL99	94	2.325	-2.325		Reject Ho
AUG99	94	3.162	-3.162		Reject Ho
SEP99	94	2.206	-2.206		Reject Ho
OCT99	82	2.698	-2.698		Reject Ho
NOV99	82	2.328	-2.328		Reject Ho
DEC99	82	1.958	-1.958		Accept Ho
JAN00	81	2.310	-2.310	1.960	Reject Ho
FEB00	81	1.415	-1.415		Accept Ho
MAR00	81	0.979	-0.979		Accept Ho
APR00	78	1.946	-1.946		Accept Ho
MAY00	81	3.091	-3.091		Reject Ho
JUN00	81	4.236	-4.236		Reject Ho

Table 4
Nominal Exchange Rate and Price Ratio Trends

1. Simple Correlation Coefficient $Rho_{nex,npr} = 0.765$

2. Regression Test for Predictive Bias Ho: $b_0 = 0.0,\ b_1 = 1.0$

Nex = 5.103368 + 0.503665*Npr
(8.617) (6.920)

Adjusted R-squared	= 0.573	Log likelihood	= -23.454
F-statistic	47.885	Schwarz criterion	1.502

Table 5
Monthly Average Exchange Rate and Price Ratio Data

Month	Exch Rate	Price Ratio	CJ Price Changes	EP Price Changes
JUL97	7.89	6.64	NA	NA
AUG97	7.79	6.35	27	20
SEP97	7.79	6.32	15	21
OCT97	7.88	6.37	14	10
NOV97	8.26	6.65	34	18
DEC97	8.15	6.68	0	7
JAN98	8.25	6.89	25	5
FEB98	8.49	7.00	4	5
MAR98	8.62	6.88	7	6
APR98	8.50	6.87	0	1
MAY98	8.61	6.77	12	3
JUN98	8.91	7.13	17	6
JUL98	8.90	7.06	5	2
AUG98	9.96	7.43	30	0
SEP98	10.11	7.67	23	30
OCT98	10.15	7.84	15	13
NOV98	9.94	8.04	15	24
DEC98	9.87	8.50	65	72
JAN99	10.17	8.81	28	2
FEB99	9.94	9.15	50	16
MAR99	9.52	9.41	58	10
APR99	9.29	9.34	19	8
MAY99	9.75	8.98	29	28
JUN99	9.49	9.08	12	14
JUL99	9.38	9.01	13	8
AUG99	9.37	8.90	64	38
SEP99	9.36	9.05	21	7
OCT99	9.65	9.19	27	0
NOV99	9.36	9.10	15	1
DEC99	9.51	9.19	9	4
JAN00	9.48	9.10	18	11
FEB00	9.41	9.24	39	1
MAR00	9.29	9.04	12	43
APR00	9.40	9.01	46	28
MAY00	9.52	8.74	6	6
JUN00	9.96	8.84	6	14