Milkshake Prices, International Reserves, and the Mexican Peso

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ABSTRACT
Menu prices from 13 international restaurant franchises that operate in both El Paso and Ciudad Juárez are utilized to examine the behavior over time of the peso/dollar exchange rate. Parametric and nonparametric tests indicate that the price ratio alone provides a biased estimator for the exchange rate. In addition to the multiproduct price ratio, the empirical analysis also incorporates interest rate parity and balance of payments variables. The combination of unique microeconomic sample data with national macroeconomic variables illustrates one manner in which border economies provide information regarding the interplay of financial markets between Mexico and the United States.
Keywords: 1. price parity, 2. exchange rates, 3. Mexico, 4. United States, 5. border economics.

RESUMEN
A partir de los precios del menú de restaurantes de 13 franquicias internacionales que operan en El Paso y Ciudad Juárez se examina el comportamiento del tipo de cambio del peso. Pruebas paramétricas y no paramétricas indican que la relación de precios representa una medida sesgada para el tipo de cambio en términos estrictamente aritméticos. Además de la relación de precios de productos múltiples, el análisis empírico también incorpora tasas de interés de los dos países y una variable que refleja cambios en la balanza de pagos en México. La combinación de datos microeconómicos con datos macroeconómicos ilustra una de las maneras en que las economías fronterizas aportan información acerca de los nexos financieros entre México y Estados Unidos.
Palabras clave: 1. paridad cambiaria, 2. tipo de cambio, 3. México, 4. Estados Unidos, 5. economías fronterizas.

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INTRODUCTION[1]

Exchange rate studies that analyze geographic and commodity group data have become relatively common in recent years (Engel and Rogers, 1996, 2001). This is, in part, due to the popularity of analyzing "hamburger" currency indexes, which are based on widely consumed menu items served at popular franchise restaurants (Ong, 1997; Anonymous, 2002). It is also because this approach utilizes microeconomic data that were previously unavailable and that complement the traditional macroeconomic data sets that rely on aggregate price variables (Pakko and Pollard, 1996; Evans and Lyons, 2002).

This article utilizes cross-border menu price data for milkshakes, pizzas, steaks, and other items to examine the exchange rate behavior of the Mexican peso. The analysis takes advantage of a multicomponent price data set for international restaurants, which matches menu items found in the sister cities of El Paso, Texas, in the United States and Ciudad Juárez, Chihuahua, in Mexico. On its own, the cross-border restaurant price index has been found to provide a biased estimate of the exchange rate between the peso and the dollar (Fullerton and Coronado, 2001). Accordingly, the modeling strategy employed here goes beyond that implied by purchasing power parity (Balassa, 1964) to include elements suggested by interest rate parity and balance of payments hypotheses (Aliber, 1973; Blanco and Garber, 1986; Throop, 1993; Zhou and Mahdavi, 1996).

We begin with a brief overview of related exchange rate studies, which focus primarily on variants of purchasing power parity (PPP) and interest rate parity (IRP) models. These PPP studies include recent investigations of international food-price ratio comparisons to exchange rates. We then turn to a description of our data collection efforts and the theoretical models utilized to analyze the data. A geographically unique price ratio, based on a sample of approximately 70 menu prices collected monthly, is utilized as the PPP component. Interest rate information is calculated using 91-day Certificados de la Tesore-

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ría de la Federación (Cetes) in Mexico and 90-day Treasury Bills (T-Bill) in the United States. Balance of payments information is introduced by employing a ratio of international reserves to imports in Mexico. The article concludes with a summation of the empirical results and suggestions for future research.

LITERATURE REVIEW

In an era of variable, and occasionally volatile, exchange rates, their monitoring has come to occupy a central role in both corporate planning and public policy analysis. Efforts to reduce foreign exchange rate risk have increased the interest in studies addressing the determination of exchange rates. A large percentage of these studies rely upon PPP and IRP modeling frameworks (Marston, 1997). Short-run departures from PPP are fairly common, but a variety of studies report long-run evidence that favors different versions of this hypothesis (Jorion and Sweeney, 1996; Wu and Wu, 2001). Given its regional history of periodic financial instability, efforts to model Latin American exchange rates frequently rely on balance of payments information to augment the more widely used PPP and IRP frameworks (Blanco and Garber, 1986; Fullerton, Hattori, and Calderón, 2001).

Several well-known techniques are based on PPP frameworks. One common approach is to calculate trade-weighted real exchange rate indexes. Under that method, an index number greater than 100 indicates overvaluation and an index number below 100 points to currency undervaluation (Fuentes, 2002). A second popular technique deals with implied nominal exchange rate calculations based upon national price index movements relative to a specific base period (Cheung and Wong, 2000; Lara y Beltrán del Río, 2002). A third approach was introduced more than a decade ago by *The Economist* magazine: "Burgernomics" takes advantage of the existence of an international franchise restaurant menu to develop a simplified PPP index (Ong, 1997). The strategy relies on using the globally popular hamburger, a signature menu item produced in 120 countries, as the homogeneous comparison good. Although not intended to replace careful currency market analysis or more technically sophisticated monitoring devices, the burger index correctly signaled that the Euro would decline relative to the U.S. dollar following the introduction of the new currency in 1999 (Anonymous, 2002).

The popularity of the easy to understand burger index served as a catalyst for additional empirical efforts that make more extensive use of restaurant pricing patterns within the PPP framework. Michael Pakko and Patricia Pollard (1996), examining the reliability of PPP and burger indexes for 15 currencies relative to the U.S. dollar, found that the conditions for absolute PPP, under which ratios of national price indexes approximate exchange rates, do not hold in the short run. The relative version of PPP, which states that percent changes in the prices levels will lead to similar proportional changes for exchange rates, also does not hold in the short run. Potential explanations for those outcomes include barriers to trade, especially in agricultural products, causing prices of goods to differ across borders; variations in non-tradable-goods prices such as real estate and utilities, leading to generalized price differences among countries; oligopoly market structures contributing to further price misalignments between regions; current account imbalances; and productivity gaps, which also contribute to international price divergences. Those factors notwithstanding, Ong (1997) obtains results that indicate that a burger-based PPP index does hold in the long run.

Other authors have utilized larger baskets of goods and consumer price sub-indexes to examine evidence implied by a cross section of products (Fraser, Taylor, and Webster, 1991; Engel and Rogers, 1996, 2001; Jenkins, 1997). This branch of the literature highlights several factors that can cause pricing patterns to deviate across markets. In particular, distances and transportation costs are generally found to contribute directly to the magnitudes of price differences between regions (Chen and Finney, 2002). Those deviations are also found to be greater in cases where international borders also serve to intensify market-segmentation effects normally observed for metropolitan markets separated by distance. Differences in regional business cycles and industrial composition have also been identified as sources of temporary divergences between price patterns and exchange rates (Clark, Sawyer, and Sprinkle, 1997, 1999, 2001).

Additional factors can also affect price ratio comparisons between markets at different stages of development. Several studies (Balassa, 1964; Summers and Heston, 1991; Heston and Summers, 1996) argue that exchange rate conversions will overstate income estimates for higher income countries, such as the United States, and understate them for lower income nations, such as Mexico. Vikas Kakkar (2001) reports evidence that non-tradable price differentials play an important role in PPP deviations observed for the peso/dollar exchange rate. Also contributing to those numeric gaps are differing capital-labor ratios, menu costs, and taxes (Bhagwati, 1984; Rogers and Jenkins, 1995). As pointed out by Dornbusch (1976), currency market overshooting can also result from interest rate disparities combined with asset-market and goods-market adjustment differences. Given the above, it would not be surprising for price ratios for country pairs to differ from exchange rates.

Much of the evidence reported by Thomas Fullerton and Roberto Coronado (2001) corroborates the potential divergence between currency quotes and restaurant price ratios for Mexico and the United States. That study examined menu prices between franchise restaurants in El Paso, Texas, and Ciudad Juárez, Mexico. They sample priced for more than 72 menu items offered at 13 franchise restaurants found on both sides of the border.[2] In nearly two-thirds of the monthly observations, menu prices on the south side of the border were lower than would be anticipated based on a comparison to the peso/dollar exchange rate and the counterpart menu items in the United States. The restaurant price ratio was correlated with the exchange rate, but it provided a biased predictor for it. In that study, menu prices on both sides of the border changed frequently but in a manner apparently unrelated to variations in peso/dollar quotes. Some portion of the deviation between the price ratio and the exchange rate may have also resulted from the local-currency pricing effect, identified for Mexico by Charles Engel (2001).

Of course, PPP models represent only one approach to the analysis of currency markets. Many studies have reported at least partial evidence in favor of IRP modeling frameworks (Aliber, 1973; Gregory, 1987; Marston, 1997). With respect to the Mexican peso, Hoe E. Khor and Liliana Rojas-Suarez (1991) reported empirical results that support the uncovered IRP hypothesis. That study also highlighted difficulties that the Mexican government will likely face if it attempts to lower interest rates before attaining overall economic stability. Historically, financial disequilibria have played prominent roles in currency market volatility affecting the peso (Gil-Díaz and Carstens, 1996).

Several authors have examined factors that can cause developing country exchange rates to depreciate rapidly. Those studies generally incorporate as-

[2]The number of restaurants in the sample varied somewhat in response to menu changes in either or both cities and locale closures and openings.

pects of both PPP and IRP modeling strategies. A frequent approach employed for Latin American currencies includes balance of payments variables in the various model specifications (Blanco and Garber, 1986; Fullerton, Hattori, and Calderón, 2001). This article relies on a similar framework that utilizes a more extensive sample of the Fullerton and Coronado (2001) restaurant price ratio as the PPP component in the empirical analysis.

DATA AND METHODOLOGY

An elementary representation of one model that predicts movements in the peso by utilizing purchasing-power and interest-rate components is:

$$NEX_t = \beta_0 + \beta_1 PR_t + \beta_2 IR_t \quad (1)$$

where NEX_t is the nominal exchange rate between the peso and dollar in month t, PR_t is the price ratio between restaurant products in Mexico and the United States in month t, and IR_t is the interest rate ratio between Mexico and the United States for the same period. Variants of this basic formula have been employed in several earlier studies (Zhou and Mahdavi, 1996; Marston, 1997; Fullerton and Coronado, 2001).

The purchasing power parity component is calculated using the monthly ratio of menu prices from Ciudad Juárez and El Paso. The sample is based on menu price data obtained from a variety of cross-border franchise operations, including four hamburger chains, three pizza franchises, two fried chicken restaurants, two Mexican food establishments, one sandwich chain, and one upscale family restaurant. Two of the 13 companies are headquartered in Mexico; the rest are based in the United States. Data were collected by visiting the franchise pairs during the third week of each month from July 1997 through June 2001.

The comparison items are largely homogeneous. Because they are designed to be eaten quickly, these food items are not tradable goods in the classical sense. Indeed, it is illegal to bring pork products, fresh fruit, and fresh vegetables, which are used in many of the products included in the monthly sample, into the United States. Although the menu items are not tradable commodities, arbitrage opportunities exist in Ciudad Juárez because prices there are quoted in pesos, but payments are accepted in either currency. Separate evidence reported for Mexico, using national data series, indicates that deviations between the exchange rate and the price ratio are likely due to non-tradability (Kakkar, 2001). For the multiproduct restaurant price ratio discussed here, arbitrage pressures potentially serve to minimize the magnitudes and durations of any price inequalities that result from currency market shocks (Asplund and Friberg, 2001).

Using the raw data collected on both sides of the border, individual price ratios are then calculated by dividing the price in pesos by the price in dollars for each menu item. Statistical moments are also calculated for all of the monthly samples. The first means and variances are used to conduct t-tests for sample mean and exchange rate equality. Recent PPP studies (Fullerton and Coronado, 2001; Wu and Wu, 2001) indicate that the monthly data utilized in these samples may not follow a normal distribution. Given that, the third and fourth moments, skewness and kurtosis, are used to conduct chi-square tests for sample distribution normality (Bera and Jarque, 1981). When non-normal sample data are encountered, a nonparametric test is used to test for sample mean and exchange rate equality. The procedure, a Wilcoxon signed-rank test, is distribution free (Daniel, 1978). In cases where the exchange rate and price ratio series are equal, the β_2 regression coefficient estimated for the interest rate ratio in Equation (1) will likely be statistically indistinguishable from zero.

The interest rate variable shown in Equation (1) is the ratio of the yields for the 91-day Cetes to the 90-day T-Bill. (For Mexican interest rate data, see the Banco de México web site [www.banxico.org.mx]; for the U.S. interest rate data, see the Federal Reserve Bank of St. Louis website [www.stlouisfed.org].)

Balance of payments pressures occasionally play a role in Latin American currency markets (Blanco and Garber, 1986). To take that possibility into account, an import coverage ratio is introduced, which changes the basic model specification to:

$$NEX_t=\beta_0+\beta_1 PR_t+\beta_2 IR_t+\beta_3 ICR_t \tag{2}$$

In Equation (2) the import coverage ratio variable is calculated as the ratio of monthly international reserves in Mexico, net of gold deposits, to monthly imports of goods and services measured in U.S. dollars. (Data are available at www.banxico.org.mx or from the International Monetary Fund [2002].) The exchange rate is hypothesized to vary inversely with respect to the import coverage ratio variable, implying that β_3 will be less than zero.

EMPIRICAL RESULTS

Parametric and nonparametric statistical tests are conducted for equality between the average monthly price ratios and exchange rates. For the parametric approach, a standard t-test is conducted for equality between the arithmetic means of the price ratios and the average nominal exchange rate for every month of the sample. The 48-month sample included four episodes of relatively rapid nominal depreciation, during which the peso declined by 4% or more in a single month (November 1997, October 1998, May 1999, and June 2000). The peso also appreciated notably relative to the dollar in March 1999, July 2000, and April 2001 (table 1).

In 26 of the 48 months in the sample, the price ratio differed significantly from the corresponding exchange rate (table 2). In those 26 months, the price ratio always fell below the exchange rates. This implies that menu prices in Mexico are less expensive than counterpart prices in the United States, which may reflect labor-cost differentials and other variables, such as own-price and cross-price elasticities of demand between the two economies (Heston and Summers, 1996). In 22 of the 30 periods from January 1999 to June 2001, the price ratio did not differ significantly from the exchange rates. Although the apparent convergence of the two series is fairly impressive, the t-test employed assumes data normality. In order to examine whether the monthly binational restaurant data meet this requirement, a chi-square test is utilized (Bera and Jarque, 1981; Pindyck and Rubinfield, 1998).

The results of the chi-square test for normality of the monthly price data (table 3). In all but seven months, the null hypothesis of the price ratio normality is rejected at the 5% significance level. Consequently, a Wilcoxon signed-rank nonparametric test is introduced to minimize the risk of incorrect inference associated with the t-test results. The latter procedure is a distribution-free test and does not require assumptions regarding the density function of the variable examined (Daniel, 1978).

Results for the Wilcoxon signed-ranks test show that at the 5% significance level, the null hypothesis of mean price ratio equality with the average nom-

TABLE 1. *Monthly Data Set (July 1997-June 1999)*

Month	Exchange Rate, Mex$/US$	Price Ratio	Mexico Interest Rates (91- Día Cetes)	U.S. Interest Rates (90-Day T-Bills)	Interest Rate Ratio
1997					
July	7.89	6.64	19.40	5.05	3.84
August	7.79	6.35	20.15	5.14	3.92
September	7.79	6.32	20.51	4.95	4.14
October	7.88	6.37	19.91	4.97	4.01
November	8.26	6.65	22.01	5.14	4.28
December	8.15	6.68	19.88	5.16	3.85
1998					
January	8.25	6.89	19.37	5.04	3.84
February	8.49	7.00	19.63	5.09	3.86
March	8.62	6.88	20.76	5.03	4.13
April	8.50	6.87	19.47	4.95	3.93
May	8.61	6.77	18.85	5.00	3.77
June	8.91	7.13	20.99	4.98	4.21
July	8.90	7.06	21.82	4.96	4.40
August	9.96	7.43	25.22	4.90	5.15
September	10.11	7.67	41.90	4.61	9.09
October	10.15	7.84	37.53	3.96	9.48
November	9.94	8.04	34.30	4.41	7.78
December	9.87	8.50	34.35	4.39	7.82
1999					
January	10.17	8.81	32.27	4.34	7.44
February	9.94	9.15	28.72	4.44	6.47
March	9.52	9.41	23.86	4.44	5.37
April	9.29	9.34	21.05	4.29	4.91
May	9.75	8.98	21.02	4.50	4.67
June	9.49	9.08	21.35	4.57	4.67

TABLE 1. *Monthly Data Set (continued, July 1999-June 2001)*

Month	Exchange Rate, Mex$/US$	Price Ratio	Mexico Interest Rates (91- Día Cetes)	U.S. Interest Rates (90-Day T-Bills)	Interest Rate Ratio
1999					
July	9.38	9.01	20.78	4.55	4.57
August	9.37	8.90	21.49	4.72	4.55
September	9.36	9.05	21.34	4.68	4.56
October	9.65	9.19	20.30	4.86	4.18
November	9.36	9.10	18.68	5.07	3.68
December	9.51	9.19	17.65	5.20	3.39
2000					
January	9.48	9.10	17.43	5.32	3.28
February	9.41	9.24	16.44	5.55	2.96
March	9.29	9.04	14.46	5.69	2.54
April	9.40	9.01	14.37	5.66	2.54
May	9.52	8.74	15.58	5.79	2.69
June	9.96	8.84	16.61	5.69	2.92
July	9.36	8.91	14.62	5.96	2.45
August	9.23	9.00	15.71	6.09	2.58
September	9.41	9.24	16.15	6.00	2.69
October	9.64	9.38	17.06	6.11	2.79
November	9.41	9.57	18.01	6.17	2.92
December	9.57	9.51	17.41	5.77	3.02
2001					
January	9.67	9.30	18.50	5.15	3.59
February	9.70	8.94	18.07	4.88	3.70
March	9.62	8.73	16.47	4.42	3.73
April	9.35	8.93	15.40	3.87	3.98
May	9.10	9.10	12.61	3.62	3.48
June	9.15	9.28	10.27	3.49	2.94

TABLE 1. *Monthly Data Set (continued, July 1997-June 1999)*

Month	Mex. Int. Reserves (US$ Mil.)	Mexico Imports (US$ Bil.)	Import Coverage Ratio
1997			
July	24566		4.01
August	25841		4.22
September	26966		4.40
October	28102		4.59
November	27001		4.41
December	28797	73475.00	4.70
1998			
January	29186		4.23
February	29047		4.21
March	30118		4.36
April	31139		4.51
May	30968		4.49
June	30645		4.44
July	31679		4.59
August	29774		4.31
September	29266		4.24
October	30675		4.44
November	29766		4.31
December	31799	82816.30	4.61
1999			
January	31681		4.15
February	31494		4.12
March	31284		4.10
April	31470		4.12
May	31146		4.08
June	31346		4.10

TABLE 1. *Monthly Data Set (continued, July 1999-June 2001)*

Month	Mex. Int. Reserves (US$ Mil.)	Mexico Imports (US$ Bil.)	Import Coverage Ratio
1999			
July	32060		4.20
August	32067		4.20
September	32585		4.27
October	32268		4.22
November	31650		4.14
December	31782	91654.50	4.16
2000			
January	33643		3.58
February	33312		3.55
March	36371		3.87
April	34685		3.69
May	33566		3.57
June	32974		3.51
July	34323		3.65
August	32882		3.50
September	34108		3.63
October	35271		3.75
November	34690		3.69
December	35509	112735.04	3.78
2001			
January	39421		4.23
February	39106		4.20
March	40234		4.32
April	40309		4.33
May	40561		4.35
June	40759	111833.16	4.37

inal exchange rate is rejected in 35 of the 48 months (table 4). As in the case of the t-test results (table 2), the Wilcoxon signed-ranks tests fail to reject the null hypothesis only for periods in 1999, 2000, and 2001. That may imply that the initial evidence (Fullerton and Coronado, 2001) of exchange rate deviations from the price ratio PPP measure represent only temporary departures from the norm for the cross-border restaurant markets. If the two series are statistically equal to each other, it raises a question regarding shock dissipation or speed of realignment when currency shocks occur.

As numerous authors have pointed out (Zhou and Mahdavi, 1996; Marston, 1997), such temporary deviations from PPP may result from interest rate differentials between trading partners such as Mexico and the United States. Deviations from PPP may also result from balance of payments fluctuations (Blanco and Garber, 1986). Regression output, generated for an exchange rate equation that includes contemporaneous lags of the PPP restaurant price ratio, interest rate differential, and import coverage ratio variables, indicates that the coefficients for each of the regressors are statistically significant, but the coefficient for the interest rate ratio is greater than zero (table 5). This implies that if interest rates in Mexico rise relative to those in the United States, the peso will depreciate. That result runs counter to the hypothesized sign for β_2 discussed above. The equation in table 5 also includes a statistically significant autoregressive parameter at lag 1 to correct for serial correlation.

To confirm the results in table 5, 26 separate versions of Equation (2) involving up to four lags of the explanatory variables were also estimated. In 25 out of 26 regressions, the coefficient for the interest rate ratio was both positive and significant. Although counterintuitive, those outcomes confirm a positive relationship between the interest rate ratio and the exchange rate during the sample period studied. Several scholars have suggested that such a result may reflect monetary circumstances in Mexico in which upward interest rate movement reflects the inflationary consequences of peso depreciations. That possibility may warrant investigation once additional sample data become available (for additional similar arguments, see Banco de México, 1998).

Given the apparently robust results associated with table 5, several observations can be made with respect to the behavior of the currency market in Mexico. One is that the fairly strong linkage between the restaurant price ratio and the exchange rate reported by Fullerton and Coronado (2001) is confirmed. A second observation is that balance of payments shocks and other

TABLE 2. *Gossett t-Test for Price Ratio/Exchange Rate Equality (July 1997- June 1999)*

Month	Sample Size	Computed t-statistic	Critical Value	Decision
1997				
July	75	-5.58	1.667	Reject
August	75	-7.513	1.667	Reject
September	74	-8.211	1.667	Reject
October	73	-7.501	1.667	Reject
November	73	-7.685	1.667	Reject
December	73	-6.863	1.667	Reject
1998				
January	73	-6.528	1.667	Reject
February	73	-6.21	1.667	Reject
March	73	-7.217	1.667	Reject
April	73	-6.761	1.667	Reject
May	73	-10.078	1.667	Reject
June	72	-6.165	1.667	Reject
July	72	-6.939	1.667	Reject
August	72	-8.225	1.667	Reject
September	72	-8.437	1.667	Reject
October	72	-7.167	1.667	Reject
November	72	-6.324	1.667	Reject
December	72	-4.065	1.667	Reject
1999				
January	72	-3.711	1.667	Reject
February	72	-1.943	1.667	Reject
March	72	-0.234	1.667	Fail to Reject
April	72	0.106	1.667	Fail to Reject
May	90	-2.28	1.667	Reject
June	94	-1.186	1.667	Fail to Reject

TABLE 2. *Gossett t-Test for Price Ratio/Exchange Rate Equality (continued, July 1999-June 2001)*

Month	Sample Size	Computed t-statistic	Critical Value	Decision
1999				
July	94	-1.118	1.667	Fail to Reject
August	94	-1.515	1.667	Fail to Reject
September	94	-1.073	1.667	Fail to Reject
October	82	-1.452	1.667	Fail to Reject
November	82	-0.805	1.667	Fail to Reject
December	82	-1.036	1.667	Fail to Reject
2000				
January	81	-1.376	1.667	Fail to Reject
February	81	-0.403	1.667	Fail to Reject
March	81	-0.671	1.667	Fail to Reject
April	78	-1.180	1.667	Fail to Reject
May	81	-2.678	1.667	Reject
June	81	-3.970	1.667	Reject
July	81	-1.658	1.667	Fail to Reject
August	81	-0.867	1.667	Fail to Reject
September	81	-0.550	1.667	Fail to Reject
October	81	-0.808	1.667	Fail to Reject
November	81	0.5470	1.667	Fail to Reject
December	81	-0.195	1.667	Fail to Reject
2001				
January	74	-1.065	1.667	Fail to Reject
February	79	-3.288	1.667	Reject
March	86	-4.111	1.667	Reject
April	86	-1.886	1.667	Reject
May	86	-0.176	1.667	Fail to Reject
June	86	0.676	1.667	Fail to Reject

TABLE 3. *Jarque-Bera Chi-Square Test for Price Sample Normality (July 1997-June 1999)*

Month	**Sample Size**	**Computed JB-statistic**	**Critical Value**	**Decision**
		1997		
July	75	1.898	5.991	Fail to Reject
August	75	5.294	5.991	Fail to Reject
September	74	1.929	5.991	Fail to Reject
October	73	27.664	5.991	Reject
November	73	16.616	5.991	Reject
December	73	15.054	5.991	Reject
		1998		
January	73	18.865	5.991	Reject
February	73	119.388	5.991	Reject
March	73	126.558	5.991	Reject
April	73	127.693	5.991	Reject
May	73	1.925	5.991	Fail to Reject
June	72	99.076	5.991	Reject
July	72	141.138	5.991	Reject
August	72	110.016	5.991	Reject
September	72	20.697	5.991	Reject
October	72	23.488	5.991	Reject
November	72	42.416	5.991	Reject
December	72	39.504	5.991	Reject
		1999		
January	72	28.809	5.991	Reject
February	72	21.816	5.991	Reject
March	72	28.621	5.991	Reject
April	72	11.797	5.991	Reject
May	90	86.871	5.991	Reject
June	94	154.861	5.991	Reject

TABLE 3. *Jarque-Bera Chi-Square Test for Price Sample Normality (continued, July 1999-June 2001)*

Month	Sample Size	Computed JB-statistic	Critical Value	Decision
1999				
July	94	171.613	5.991	Reject
August	94	111.094	5.991	Reject
September	94	82.809	5.991	Reject
October	82	72.74	5.991	Reject
November	82	89.043	5.991	Reject
December	82	76.326	5.991	Reject
2000				
January	81	61.022	5.991	Reject
February	81	82.553	5.991	Reject
March	81	62.74	5.991	Reject
April	78	42.553	5.991	Reject
May	81	18.535	5.991	Reject
June	81	30.839	5.991	Reject
July	81	15.759	5.991	Reject
August	81	19.538	5.991	Reject
September	81	53.113	5.991	Reject
October	81	198.66	5.991	Reject
November	81	289.65	5.991	Reject
December	81	280.525	5.991	Reject
2001				
January	74	640.92	5.991	Reject
February	79	4.538	5.991	Fail to Reject
March	86	5.058	5.991	Fail to Reject
April	86	3.159	5.991	Fail to Reject
May	86	182.531	5.991	Reject
June	86	148.417	5.991	Reject

market developments contribute to periodic deviations from PPP-implied values of the peso. Perhaps unsurprisingly, the information reported in table 5 indicates that successful monitoring of the exchange rate in Mexico will involve a combination of PPP and other international financial measures. The cross-border restaurant price ratio seemingly offers one means by which this objective may be partially achieved.

The evidence indicates that the cross-border restaurant price index may help in predicting variations in the peso/dollar exchange rate. This may seem surprising given that it does not involve traded goods (Xu, 2003). It is important to remember, however, that arbitrage opportunities exist for border-region restaurant customers since both currencies can often be utilized for payment (Asplund and Friberg, 2001; Yoskowitz and Pisani, 2002). Because the data reported on in this article are exclusive to the border region, it would be helpful to assemble similar information for other points along the Mexico-U.S. border. Those efforts would allow panel estimates to be employed to examine deviations from parity and adjustment speeds to shocks (Fleissig and Strauss, 2000).

CONCLUSION

A variety of research efforts in recent years have utilized multinational franchise restaurant price comparisons with the objective of better understanding international currency valuations. Mixed evidence has been reported with respect to the outcomes from testing various versions of the purchasing power parity hypotheses. This article extends one of those earlier efforts, which had indicated that a basket of cross-border menu prices provides a biased estimator for the peso/dollar exchange rate between Mexico and the United States.

In addition to taking advantage of a larger, 48-month sample, the analysis also incorporates currency modeling strategies involving variables designed to reflect interest rate differentials between the two economies and balance of payments shocks that periodically affect Mexico. Estimation results confirm statistically significant relationships between the peso/dollar exchange rate and each of the three explanatory variables. However, the sign for the interest rate differential variable is the opposite of what was hypothesized. The signs

TABLE 4. *Wilcoxon Signed-Rank Test, Price Ratio/Exchange Rate Equality (July 1997-June 1999)*

Month	N	T-	T+	T-*	T+*	CV	Decision
1997							
July	75	2325.0	525.0	4.753	-4.753	1.96	Reject
August	75	2530.0	320.0	5.835	-5.835	1.96	Reject
September	74	2510.0	265.0	6.047	-6.047	1.96	Reject
October	73	2426.5	274.5	5.916	-5.916	1.96	Reject
November	73	2439.0	262.0	5.984	-5.984	1.96	Reject
December	73	2384.0	317.0	5.682	-5.682	1.96	Reject
1998							
January	73	2376.0	325.0	5.638	-5.638	1.96	Reject
February	73	2378.0	323.0	5.649	-5.649	1.96	Reject
March	73	2439.0	262.0	5.984	-5.984	1.96	Reject
April	73	2416.0	285.0	5.858	-5.858	1.96	Reject
May	73	2556.0	145.0	6.627	-6.627	1.96	Reject
June	72	2287.0	341.0	5.460	-5.460	1.96	Reject
July	72	2368.0	260.0	5.892	-5.892	1.96	Reject
August	72	2368.0	260.0	5.915	-5.915	1.96	Reject
September	72	2371.0	257.0	5.932	-5.932	1.96	Reject
October	72	2288.0	340.0	5.466	-5.466	1.96	Reject
November	72	2287.0	341.0	5.460	-5.460	1.96	Reject
December	72	2095.0	533.0	4.383	-4.383	1.96	Reject
1999							
January	72	2044.0	584.0	4.097	-4.097	1.96	Reject
February	72	1815.0	813.0	2.812	-2.812	1.96	Reject
March	72	1643.0	985.0	1.846	-1.846	1.96	Fail to Reject
April	72	1530.0	1098.0	1.212	-1.212	1.96	Fail to Reject
May	90	2888.0	1207.0	3.382	-3.382	1.96	Reject
June	94	2866.0	1598.5	2.391	-2.391	1.96	Reject

TABLE 4. *Wilcoxon Signed-Rank Test, Price Ratio/Exchange Rate Equality (continued, July 1999-June 2001)*

Month	N	T-	T+	T-*	T+*	CV	Decision
1999							
July	94	2849.0	1616.0	2.325	-2.325	1.96	Reject
August	94	3071.0	1394.0	3.162	-3.162	1.96	Reject
September	94	2817.0	1647.5	2.206	-2.206	1.96	Reject
October	82	2285.0	1118.0	2.698	-2.698	1.96	Reject
November	82	2205.0	1198.0	2.328	-2.328	1.96	Reject
December	82	2125.0	1278.0	1.958	-1.958	1.96	Fail to Reject
2000							
January	81	2152.0	1168.5	2.310	-2.310	1.96	Reject
February	81	1962.0	1359.0	1.150	-1.150	1.96	Fail to Reject
March	81	1869.0	1452.0	0.979	-0.979	1.96	Fail to Reject
April	78	1932.5	1148.5	1.946	-1.946	1.96	Fail to Reject
May	81	2319.0	1002.0	3.091	-3.091	1.96	Reject
June	81	2563.0	758.0	4.236	-4.236	1.96	Reject
July	81	2093.0	1228.0	2.030	-2.030	1.96	Reject
August	81	1941.0	1380.0	1.317	-1.317	1.96	Fail to Reject
September	81	1943.0	1378.0	1.326	-1.326	1.96	Fail to Reject
October	81	2040.0	1279.0	1.791	-1.791	1.96	Fail to Reject
November	81	1766.0	1555.0	0.495	-0.495	1.96	Fail to Reject
December	81	1937.0	1384.0	1.298	-1.298	1.96	Fail to Reject
2001							
January	74	1912.0	863.0	2.816	-2.816	1.96	Reject
February	79	2269.0	891.0	3.357	-3.357	1.96	Reject
March	86	2836.0	905.0	4.146	-4.146	1.96	Reject
April	86	2386.5	1354.5	2.216	-2.216	1.96	Reject
May	86	2195.0	1546.0	1.393	-1.393	1.96	Fail to Reject
June	86	1881.5	1859.5	0.047	-0.047	1.96	Fail to Reject

for the restaurant price ratio and import coverage ratio parameters are as hypothesized. The estimation outcomes indicate that a strict interpretation of the PPP model is not supported for this short-run data. Nominal price differentials, as measured by the sample of Mexico-U.S. cross-border franchise menu items, do play important roles in monthly exchange-rate variations.

Additional sampling will eventually allow for conducting a more complete set of tests. At present, the sample is not large enough to take advantage of a variety of time series techniques, such as error correction specifications, which would permit disentangling both short- and long-term factors that potentially affect this currency market. New sampling will also make possible testing with respect to the length of time required for price deviations to dissipate following movements in the peso/dollar exchange rate. Additional tests could also be performed if similar data are collected for other cities along the Mexico-U.S. border.

TABLE 5. *Regression Results for Empirical Version of Equation 2*

Dependent Variable: NEX, Mex$/US$ nominal exchange rate
Method: Nonlinear Least Squares
Sample (adjusted): 1997:08 2001:06
Included observations: 47 after adjusting endpoints
Convergence achieved after 8 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.854363	1.559758	5.035629	0.0000
PR	0.282225	0.126836	2.225125	0.0315
IR	0.162112	0.050742	3.194842	0.0027
ICR	-0.390169	0.192680	-2.024957	0.0493
AR(1)	0.674956	0.141979	4.753917	0.0000

R-squared	0.876700	Mean dependent var	9.260426
Adj. R-squared	0.864957	S.D. dependent var	0.624983
S.E. of regression	0.229670	Akaike info criterion	-0.004056
Sum squared resid	2.215434	Schwarz criterion	0.192768
Log likelihood	5.095317	F-statistic	74.65793
Durbin-Watson stat	2.230588	Prob (F-statistic)	0.000000
Inverted AR Roots	0.670001		

REFERENCE LIST

Anonymous, 2002, "Big MacCurrencies," *The Economist* (April 27), 76.

Asplund, Marcus, and Richard Friberg, 2001, "The Law of One Price in Scandinavian Duty-Free Stores," *American Economic Review* 91, 1072-83.

Aliber, Robert Z., 1973, "The Interest Rate Parity Theorem: A Reinterpretation," *Journal of Political Economy* 81, 1451-59.

Balassa, Bela, 1964, "The Purchasing Power Parity Doctrine: A Reappraisal," *Journal of Political Economy* 72, 584-96.

Banco de México, 1998, "Informe Anual 1998," Mexico City: Banco de México.

Bera, Anil, and Carlos Jarque, 1981, "Efficient Tests for Normality, Heteroscedasticity, and Serial Independence of Regression Residuals: Monte Carlo Evidence," *Economics Letters* 7, 313-18.

Bhagwati, Jagdish, 1984, "Why Are Services Cheaper in Poor Countries?" *Economic Journal* 94, 279-86.

Blanco, Herminio, and Peter M. Garber, 1986, "Recurrent Devaluation and Speculative Attacks on the Mexican Peso," *Journal of Political Economy* 94, 148-66.

Chen, Li-Hsueh, and Miles M. Finney, 2002, "The Effect of Transportation Cost and the Distribution of Production on Output Price Variation," *Southern Business & Economic Journal* 25, 143-52.

Cheung, Yin-Wong, and Clement Yuk-Pang Wong, 2000, "A Survey of Market Practitioners' Views on Exchange Rate Dynamics," *Journal of International Economics* 51, 401-19.

Clark, Don P., W. Charles Sawyer, and Richard L. Sprinkle, 1997, "The Value of the Southern Dollar," *Review of Regional Studies* 27, 185-93.

———. 1999, "Regional Exchange Rate Indexes for the United States," *Journal of Regional Science* 38, 149-66.

———. 2001, "El Valor del Dólar 'Texano'," *Comercio exterior* 51, 289-93.

Daniel, Wayne W., 1978, *Applied Nonparametric Statistics*, Houghton Mifflin: Boston, MA.

Dornbusch, Rudiger, 1976, "Expectations and Exchange Rate Dynamics," *Journal of Political Economy* 84, 1161-76.

Engel, Charles, 2001, "Optimal Exchange Rate Policy: The Influence of Price Setting and Asset Markets," *Journal of Money, Credit, and Banking* 33, 518-41.

Engel, Charles, and John H. Rogers, 1996, "How Wide is the Border," *American Economic Review* 86, 1112-25.

———. 2001, "Violating the Law of One Price: Should We Make a Federal Case Out of It?" *Journal of Money, Credit, and Banking* 33, 1-15.

Evans, Martin D. D., and Richard K. Lyons, 2002, "Order Flow and Exchange Rate Dynamics," *Journal of Political Economy* 110, 170-80.

Fleissig, Adrian R., and Jack K. Strauss, 2000, "Panel Unit Root Tests of Purchasing Power Parity for Price Indices," *Journal of International Money and Finance* 19, 489-506.

Fraser, Patricia, Mark P. Taylor, and Alan Webster, 1991, "An Empirical Examination of Long-Run Purchasing Parity as a Theory of International Commodity Arbitrage," *Applied Economics* 23, 1749-59.

Fuentes, Juan Pablo, 2002, "Venezuela," *DRI-WEFA* *Latin America Economic Outlook* (First Quarter), 11.1-11.39.

Fullerton, Thomas M. Jr., and Roberto Coronado, 2001, "Restaurant Prices and the Mexican Peso," *Southern Economic Journal* 68, 145-55.

Fullerton, Thomas M. Jr., Miwa Hattori, and Cuauhtémoc Calderón, 2001, "Error Correction Exchange Rate Modeling Evidence for Mexico," *Journal of Economics and Finance* 25, 358-68.

Gil-Díaz, Francisco, and Agustín Carstens, 1996, "One Year of Solitude: Some Pilgrim Tales about Mexico's 1994-1995 Crisis," *American Economic Review* (Papers and Proceedings) 86, 164-69.

Gregory, Allan W., 1987, "Testing Interest Rate Parity and Rational Expectations for Canada and the United States," *Canadian Journal of Economics* 20, 289-305.

Heston, Alan, and Robert Summers, 1996, "International Price and Quantity Comparisons: Potential Pitfalls," *American Economic Review* (Papers and Proceedings) 86, 20-25.

International Monetary Fund, 2002, *International Financial Statistics*, Database and Browser CD_ROM (June), Washington, DC: IMF Publication Services.

Jenkins, Michael A., 1997, "Cities, Borders, Distances, Non-Traded Goods and Purchasing Power Parity," *Oxford Bulletin of Economics and Statistics* 59, 203-13.

Jorion, Phillipe, and Richard Sweeney, 1996, "Mean Reversion in Real Exchange Rates: Evidence and Implications for Forecasting," *Journal of International Money and Finance* 15, 535-50.

Kakkar, Vikas, 2001, "Long Run Real Exchange Rates: Evidence from Mexico," *Economics Letters* 72, 79-85.

Khor, Hoe E, and Liliana Rojas-Suarez, 1991, "Interest Rates in Mexico, The Role of Exchange Rate Expectations and International Creditworthiness," IMF *Staff Papers* 38, 850-71.

Lara, Juan, and Abel Beltrán del Río, 2002, "Síntesis," Ciemex-WEFA, *Perspectivas económicas de México* 34 (March), 1.1-1.15.

Marston, Richard C., 1997, "Test of Three Parity Conditions: Distinguishing Risk Premia and Systematic Forecast Errors," *Journal of International Money and Finance* 16, 285-303.

Ong, Li Lian, 1997, "Burgernomics: The Economies of the Big Mac Standard," *Journal of International Money and Finance* 16, 865-78.

Pakko, Michael R., and Patricia S. Pollard, 1996, "For Here or To Go?" *Federal Reserve Bank of St. Louis Review* 78 (January/February), 3-21.

Pindyck, Robert S. and Daniel L. Rubinfeld, 1998, *Econometric Models and Econometric Forecasts*. Boston: McGraw Hill.

Rogers, John H., and Michael Jenkins, 1995, "Haircuts or Hysteris? Sources of Movements in Real Exchange Rates," *Journal of International Economics* 38, 339-60.

Summers, Robert, and Alan Heston, 1991, "The Penn World Table (Mark 5): An Expanded Set of International Comparisons," *Quarterly Journal of Economics* 106, 327-68.

Throop, Adrian W., 1993, "A Generalized Uncovered Interest Parity Model of Exchange Rates," *Federal Reserve Bank of San Francisco Economic Review* (Number 2), 3-16.

Wu, Jyh-Lin, and Shaowen Wu, 2001, "Is Purchasing Power Parity Overvalued?" *Journal of Money, Credit, and Banking* 33, 804-12.

Xu, Zhenhui, 2003, "Purchasing Power Parity, Price Indices, and Exchange Rate Forecasts," *Journal of International Money and Finance* 22, 105-30.

Yoskowitz, David W., and Michael J. Pisani, 2002, "Penetration of the Mexican Peso into U.S. Retail Operations: An Examination of Texas Firms Along the Mexican Border," *Journal of Borderlands Studies* 17, 53-62.

Zhou, Su, and Said Mahdavi, 1996, "Simple vs. Generalized Interest Rate and Purchasing Power Parity Models of Exchange Rates," *Quarterly Review of Economics and Finance* 36, 197-218.