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CONVERTIBILITY RISK, DEFAULT RISK, AND THE MEXDOLLAR ANOMALY

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Abstract

In Rogers (1992a,b) I put forth the convertibility risk hypothesis in order to explain the anomalous negative relationship between the expected rate of Mexican peso depreciation and the ratio of Mexdollars to peso denominated demand deposits. Recently, Gruben and Welch (1994) examine the effect of deteriorating bank loan quality on the variables I consider. Using a cointegration framework, the authors find (i) a negative relationship between non-performing loans and the dollarization ratio and (ii) the conventional positive relationship between expected peso depreciation and dollarization. The first result suggests an additional factor influencing money demand in Mexico. The second result is evidence against my convertibility risk hypothesis. Further analysis indicates that there is some evidence in favor of Gruben and Welch's first result, but that the preponderance of evidence runs counter to their second result.

Convertibility Risk, Default Risk, and the Mexdollar Anomaly

John H. Rogers[1]

I. Introduction

In Rogers (1992a,b) I put forth the "convertibility risk hypothesis" to explain an anomalous relationship in Mexican data during the period 1978-85. The apparent anomaly can be seen in Figure 1 from the plots of the expected rate of peso depreciation (forward discount) and the dollarization ratio -- the ratio of Mexdollars (dollar-denominated demand deposits held in Mexican banks) to peso deposits. The dramatic rise in expected peso depreciation and equally dramatic drop in the dollarization ratio runs counter to the predictions of standard currency substitution models. Formal estimation, using either VARs [Rogers (1992b)] or cointegration equations, single-equation OLS estimates, and error-correction models [Rogers (1992a)], always produces a statistically significant, negative relationship between the dollarization ratio and expected depreciation. In thinking how this anamoly could come about, and what additional factors might overturn this result, I considered oil prices, imports, and foreign exchange reserves, all of which were associated with an economic hypothesis. None of these factors overturned the original negative relationship, which I took as evidence in favor of the "convertibility risk hypothesis". I also estimated analogous models for Canadian data, which resulted in the conventional relationships, in order to bring out the contrast with the Mexican data.

Motivated by recent theoretical work, Gruben and Welch (1994) examine the effect of deteriorating bank loan quality. Using a cointegration framework, the authors find (i) a negative relationship between non-performing loans and the dollarization ratio and (ii) the conventional positive relationship between expected peso depreciation and dollarization. The first result suggests an additional factor influencing money demand in Mexico. The second result is evidence against my

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convertibility risk hypothesis. In this note I find some evidence in favor of Gruben and Welch's first result, but that the preponderance of evidence runs counter to their second result.

II. Empirical Estimates of Dollarization in Mexico

In order to bring out the contrast between the estimates of Gruben-Welch (1994) and Rogers (1992a), replication is vitally important. The most obvious way for Gruben and Welch to have begun the task of replication would be to take my estimated model and add the non-performing loans ratio variable to it. Equation 5.2M, the "workhorse" or building block model in Rogers (1992a), would have been the place to start. Gruben and Welch chose an alternative empirical strategy, which I address below, but had they done the above, they would have found that the anomaly is not overturned. Using data on the non-performing loans ratio kindly provided to me by Gruben and Welch (this series is also displayed in Figure 1), I estimated the following models using OLS.

I first re-estimated (5.2M) from my paper starting in 1979 to conform with the Gruben/Welch data set. The results, displayed in the first column of Table 1 indicate that there is a negative and significant relationship between changes in the dollarization ratio, ΔMM, and lagged changes in expected peso depreciation, ΔEM (IM is the 3-month Mexican Treasury bill rate). In the second column I estimate this model adding 4 lagged changes of the non-performing loans ratio, $\Delta\Theta$. The coefficients on ΔEM remain negative and significant, while the coefficients on $\Delta\Theta$ are insignificant.

Gruben and Welch (1994) assert that changes in the non-performing loans ratio should affect Mexdollar holdings but not peso demand deposits, because the Bank of Mexico can act as a lender of last resort for peso deposits but not Mexdollars. Hence, Gruben and Welch estimate models for the numerator and denominator of the dollarization ratio separately. In Rogers (1992a) I also estimate models for Mexdollar and peso demand separately, because the convertibility risk hypothesis predicts that there should be a larger effect of expected depreciation on Mexdollars than on peso deposits (see Figure 1 for plots of real Mexdollar deposits and real peso deposits).

The results for changes in real Mexdollar deposits, the numerator, are in columns 3 and 4 of Table 1, while the results for changes in real peso demand deposits are in columns 5 and 6. Adding the non-performing loans ratio to the basic model has no effect on the sign or significance of the expected depreciation variables in the Mexdollar demand equation. There is, however, more of an effect from adding non-performing loans to the peso demand equation (e.g., the third lag is significant at 7%), in contrast to the arguments in Gruben and Welch. With or without the non-performing loans variable, there is a larger effect of expected depreciation on Mexdollars than on peso deposits.

Table 1; Estimates of Rogers' (1992a) Dollarization Models
With and Without Gruben and Welch's (1994) Non-Performing Loans Variable

Indep. / Dep. Variable	ΔMM	ΔMM	ΔNUM	ΔNUM	ΔDEN	ΔDEN
ΔEM(t-1)	-4.55 (2.08)	-4.46 (2.27)	-3.67 (2.58)	-4.07 (2.63)	0.89 (0.88)	0.40 (0.79)
ΔEM(t-2)	-7.15 (1.23)	-6.54 (1.96)	-5.99 (1.56)	-5.91 (2.30)	1.21 (0.73)	0.63 (0.82)
ΔIM(t-3)	-1.99 (0.41)	-1.97 (0.47)	-1.43 (0.55)	-1.39 (0.60)	0.55 (0.29)	0.59 (0.29)
ΔIM(t-4)	2.32 (0.67)	2.47 (0.80)	1.87 (0.79)	1.83 (0.88)	-0.49 (0.29)	-0.64 (0.29)
ΔΘ(t-1)	--	0.48 (2.74)	--	1.43 (3.42)	--	0.95 (1.73)
ΔΘ(t-2)	--	-2.52 (4.63)	--	-1.19 (4.82)	--	1.33 (1.50)
ΔΘ(t-3)	--	0.89 (2.16)	--	3.53 (2.92)	--	2.64 (1.41)
ΔΘ(t-4)	--	-0.87 (2.42)	--	-0.54 (2.83)	--	0.33 (0.95)
Adj. R^2	.67	.65	.57	.55	.03	.03

Notes: The estimation period is 1/79-10/85. Standard errors in parenthesis have been corrected for heteroscedasticity using White's (1980) correction. Four interaction dummy variables are included in all regressions. These are D1*MM, D2*MM, D1*EM, and D2*EM, where D1 is unity for the months 1/82-3/82, D2 is unity for the months 7/82-9/82, MM is the dollarization ratio and EM is the expected rate of depreciation. The dummies are always highly significant, negative in the regressions for MM and NUM, and positive in the regressions for DEN; results are not reported in order to save space. Adding any combination of the 4 lags of ΔΘ makes no significant difference to the results.

The clear message is that the anomalous sign on lagged expected depreciation remains, even when the non-performing loans ratio is included in the basic regression. This is true of all estimates I undertook in Rogers (1992a). Consider my error-correction model, whose estimate Gruben and Welch reproduce in their Table 1. Adding two lags of $\Delta\Theta$ to this equation gives:[2]

$$\Delta MM_t = \underset{(1.44)}{-4.68\Delta EM_{t-2}} \underset{(0.54)}{- 1.35\Delta IM_{t-3}} \underset{(0.62)}{+ 1.91\Delta IM_{t-4}} \underset{(0.80)}{- 4.13\, ECM_{t-1}} \underset{(0.13)}{- 0.14\Delta OILP_{t-2}} \underset{(0.09)}{- 0.29\Delta FR_{t-1}}$$

$$\underset{(0.11)}{- 0.25\Delta FR_{t-2}} \underset{(0.04)}{- 0.02\Delta\Theta_{t-1}} \underset{(0.04)}{- 0.01\Delta\Theta_{t-2}} \underset{(14.2)}{- 124.3\, D1{*}EM} \underset{(2.92)}{- 24.9\, D2{*}EM} \underset{(0.03)}{- 0.27\, D1{*}MM} \underset{(0.07)}{- 0.14\, D2{*}MM}$$

Adj. $R^2 = .68$

Replicating Gruben and Welch's Results

Rather than starting with my OLS estimates and building from there, Gruben and Welch chose to look for possible cointegration relationships among the relevant variables, and to estimate vector error-correction models. I have two general points to make with respect to the strategy. The first focuses on my attempts to replicate their results. The second point questions the appropriateness of modeling the variables as cointegrated in the first place.

Assuming that the variables of interest are I(1) [more on this below], Johansen's (1988) maximal eigenvalue and trace tests are used by Gruben and Welch to determine the number of cointegrating vectors in their 5-variable systems. In their Table 3 Gruben and Welch present results for the system containing real peso balances, expected depreciation, output, domestic interest rate, and the non-performing loans ratio: (DEN, EM, YM, IM, Θ). In Table 4, an analogous examination is done for the system with real Mexdollar balances (NUM in my notation) replacing DEN.

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[2]Adding any combination of 4 lags of $\Delta\Theta$ makes no significant difference. Nor is there any effect on the sign or significance of either lagged ΔEM or lagged $\Delta\Theta$ from dropping FR from the model. The non-performing loans ratio is insignificant even when expected depreciation is dropped from the model, although the fit of that model is quite poor.

Although Gruben and Welch have done a nice job describing their results, I believe they have overlooked two important aspects of them. First, consider their test for the number of cointegrating vectors, r, for the system with real Mexdollars. Using either the trace (T) or maximum eigenvalue (M) test, Gruben and Welch reject at 10% not only the null hypothesis that $r=0$, but also the null hypotheses that $r=1$, 2, 3 and 4. Thus, taking these test statistics as they are suggests that there are zero independent unit roots among the five variables. I return to this point below. My second comment, regarding the need to adjust the test statistics using the correction suggested by Cheung and Lai (1993), takes us to the opposite extreme. Consider Gruben and Welch's system with real Mexdollar balances, which is the more interesting case as concerns both my paper and theirs, and the adjusted test statistics reported in Table 2 below. According to the (adjusted) test statistics reported by Gruben and Welch, there is no cointegration in the five-variable system.

Table 2; Johansen's Test for Cointegration

NUM, EM, YM, IM, Θ	$r=0$	$r\leq1$	$r\leq2$	$r\leq3$	$r\leq4$
Adjusted G-W Stats. (T)	58.4	34.8	20.1	8.08	2.07
Adjusted G-W Stats. (M)	23.7	14.7	12.0	6.02	2.07
My Replication (T)	65.6#	37.6	16.5	5.71	0.39
My Replication (M)	28.0	21.0	10.8	5.32	0.39

Notes: A (#) denotes significant at 10%. Rows 1 and 3 contain the trace test statistics. The null is that there are no more than r cointegrating vectors in the system (or 5-r distinct unit roots), while the alternative is that there are 5 cointegrating vectors. Critical values for (n-5) equal to 1,2,3,4,5 are 3.76, 15.5, 29.7, 47.2, 68.5 (95%) and 2.69, 13.3, 26.8, 44.0, 64.8 (90%). The maximum eigenvalue test statistics appear in rows 2 and 4. The null is that there are not r cointegrating vectors; the alternative is that there are $r+1$ cointegrating vectors. Critical values are 3.76, 14.1, 21.0, 27.1, and 33.5 (95%); and 2.69, 12.1, 18.6, 24.7, and 30.9 (90%). These are taken from Table 1 of Osterwald-Lenum (1992). Statistics are calculated using the Cheung and Lai (1993) correction. Following Gruben and Welch, six lags were used in the tests.

I display my attempt to replicate the results of Gruben and Welch in rows 3 and 4 of Table 2. Both the maximum eigenvalue test and the trace test indicate that there is no evidence of cointegration at 5%, although the null hypothesis that r=0 can be rejected at 10% according to the trace test.[3] These results cast serious doubt on the findings of Gruben and Welch, which depend crucially on the variables being cointegrated. There is potential danger in this, however, because cointegration is an explicitly long-run concept, and we are dealing with a relatively short sample period (1/79-10/85).

Structural Breaks, Unit Roots Tests, and Cointegration

In both Rogers (1992a) and Gruben and Welch, conventional tests for unit roots are undertaken. Both papers conclude that the variables of interest are integrated of order 1. As is quite conventional, the unit roots test results are then used to justify consideration of the cointegration relationships that may be present. As noted above, Gruben and Welch's results are based on their treatment of the variables as cointegrating. There is no point belaboring the issues concerning the low power of conventional unit roots tests. I simply point out that I have become quite convinced that several of the important series are not unit roots, but instead contain a structural break around the time of the 1982 crisis. It is this break which makes these series appear non-stationary.

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[3]It should be noted that the uncorrected test statistics suggest the presence of two cointegrating vectors, which is consistent with Gruben and Welch's finding of more than one such vector. Gruben and Welch report the estimated cointegration vector associated with the largest eigenvalue. As they highlight in the paper, the sign on expected depreciation is the conventional positive sign. One is left to wonder, however, what is the relationship between expected depreciation and real Mexdollar balances according to the other estimated cointegration vector(s)? According to my estimates of the system (NUM, EM, YM, IM, Θ), there is one cointegration vector with the conventional positive sign (1, -172.2, -8.58, 10.8, -0.26) and one with the anomalous sign (1, 20.4, -0.81, 8.62, -0.78). I find the same result when I estimate the system with the dollarization ratio instead of NUM. There is no a priori reason to choose either of these estimates as the cointegrating vector associated with real Mexdollar demand.

Perron's (1989) tests provide very strong support for this conclusion with respect to tests on MM, EM, NUM, and possibly Θ as well. I test for a unit root in all of the series using both Perron's "Model A", which allows a one-time break in the intercept, and his "Model C", which allows a one-time break in both the intercept and slope. Tests statistics for several break dates are given in the cells of Table 3. I report results for Model C only; there are no major differences between these and the results for Model A.

Table 3: Perron's Test for Unit Roots

Variable / Break Date	MM	EM	Θ	NUM	DEN	FR
5/82	-3.46	-4.99**	-4.57*	-3.48	-2.12	-2.73
6/82	-4.81*	-5.34**	-4.93**	-4.70*	-1.55	-1.97
7/82	-8.11**	-5.25**	-3.58	-8.06**	-1.14	-0.91

Notes: The test statistics are from estimating Perron's Model C, allowing for a one-time structural break on the indicated date. A (**, *, #) indicates rejection of the unit root null at 1%, 5%, and 10%, respectively.

Tables 2 and 3 indicate that we should be very careful about treating the system of variables studied by Gruben and Welch as cointegrating. The results point to the increased attention that should be given to treatment of the variables around the time of the 1982 crisis, as in several of the specifications in Rogers (1992a). During this episode, at least, there is undeniably a strong negative correlation between expected peso depreciation and the dollarization ratio (or real Mexdollar balances), as can be seen in Figure 1.

III. Conclusions

Two general results emerge from Gruben and Welch's (1994) study of dollarization in Mexico. Their first result suggests that the ratio of non-performing loans is an additional factor influencing money demand in Mexico. The second result, that there is the conventional positive relationship between expected peso depreciation and dollarization once the effect of the non-performing loans ratio is accounted for, is evidence against the convertibility risk hypothesis put forth in Rogers (1992a,b).

In this note I have shown that there is some evidence in favor of Gruben and Welch's first result. Indeed, Gruben and Welch's lender-of-last-resort hypothesis is a complementary, and more detailed, exposition of a hypothesis put forth concerning the role of foreign reserves (see Rogers (1992a), page 311). The complementarity of our approaches is natural, in light of the close relationship between non-performing loans and foreign reserves. As seen in Figure 1, at the end of 1981, foreign reserves begin to drop precariously, while the non-performing loans ratio begins to rise sharply. Each series peaks at the end of 1982. However, I also show that the preponderance of evidence runs counter to their second result. Hence, I would argue, the best explanation for the Mexdollar "anomaly" is one that relies heavily on the presence of convertibility risk in the minds of Mexdollar holders.

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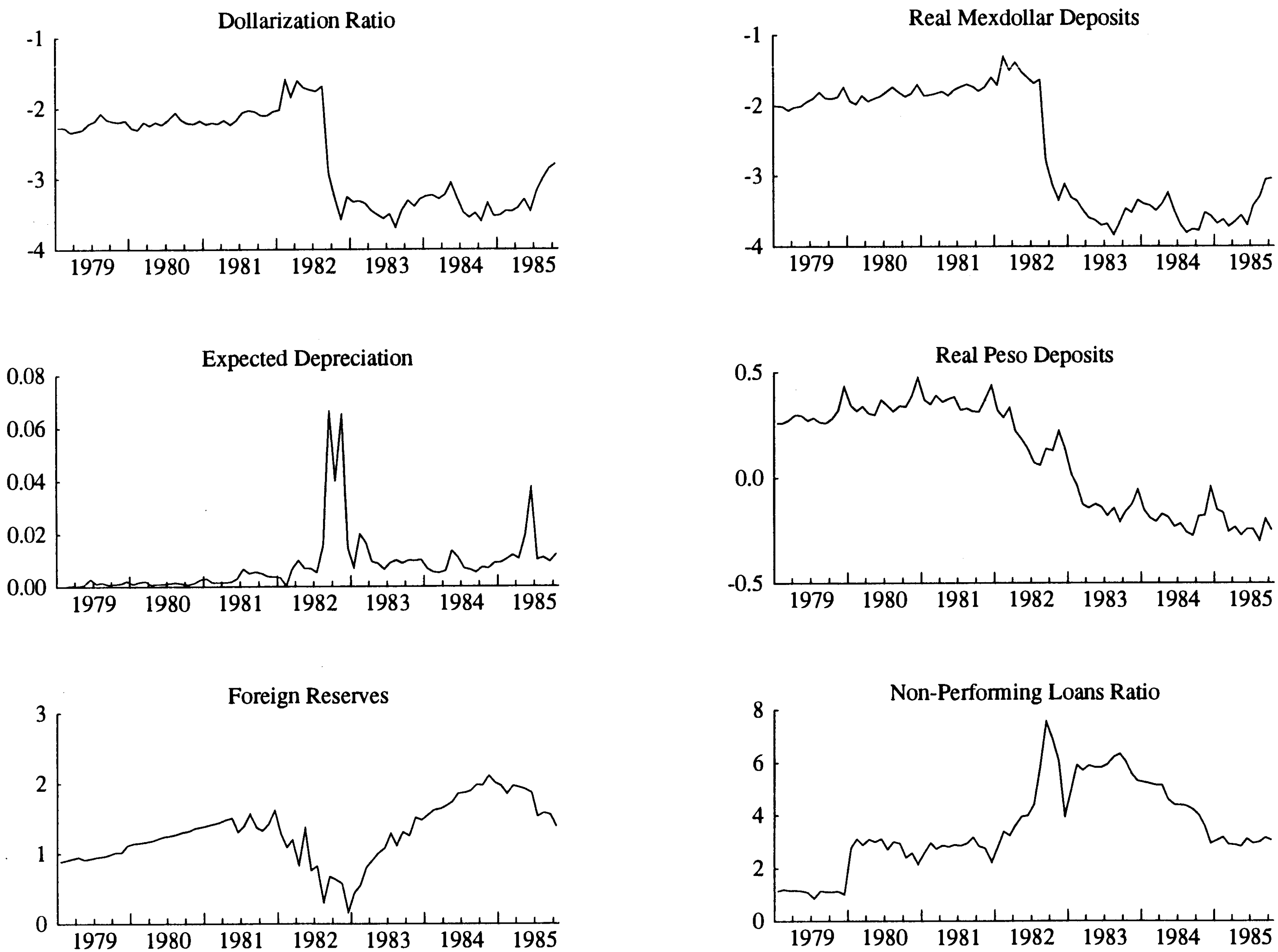
Figure 1: Plots of the Variables



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