The Prudence of Mexican Consumers

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Abstract: The ENIGH household surveys are used to investigate the strength of the precautionary motive in Mexico, using pseudo-panel methods to obtain estimates of the coefficient of relative prudence for Mexican consumers. The method provided accounts for the aggregation problems arising from unequally-spaced surveys. The low levels of prudence found can help explain why consumers had insufficient savings to smooth consumption during the peso crisis. Differences in prudence may also explain the low household savings rates in Mexico compared to the high savings rates in East Asian countries such as Taiwan.

Keywords: prudence, pseudo-panel, aggregation.

Resumen: Un pseudo-panel de la ENIGH fue empleado para estimar la intensidad de los motivos precautorios para México a través de la prudencia relativa. La metodología presentada soluciona los problemas del conjunto de las encuestas irregulares. El nivel bajo de la prudencia puede ayudar a explicar la razón que los hogares mexicanos no tuvieron bastante ahorros para allanar su consumo durante la crisis del peso. Además, la diferencia en la prudencia puede explicar la tasa baja de ahorros en México comparado con Taiwán.

Palabras clave: prudencia, pseudo-panel, conjunto.

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I. Introduction

Following the forced devaluation of the peso on December 20, 1994, Mexico faced a severe economic crisis. Real GNP per capita fell 9.2 percent in 1995 and mean manufacturing wages fell by 21 percent over the 1994-96 period.[1] This was but the largest in a series of recurring crises which have plagued the Mexican economy over the last twenty-five years. In each of these crises, consumption has sharply contracted, indicating that households have been unable to smooth their consumption over these crisis periods, due in many cases to insufficient levels of saving. Given the volatile macroeconomic environment in Mexico, households are exposed to sizeable levels of non-insurable risk. The importance of this income uncertainty for saving behaviour is determined by the strength of the precautionary motive. This paper calculates the first estimates of the intensity of the precautionary motive for Mexico, measured by the coefficient of relative prudence. We find relatively low levels of prudence in Mexico, which helps explain the low levels of saving and lack of consumption smoothing during crises in Mexico.

Precautionary saving in response to risk requires convexity of the marginal utility function. Kimball (1990) showed that the intensity of the precautionary saving motive can be measured by relative prudence, which depends on the third derivative of the utility function. Dynan (1993) showed that a second-order Taylor expansion of the consumer's first-order optimization condition enables one to estimate these coefficients of prudence using panel data, and obtains low levels of prudence for the United States. In Mckenzie (2001a), we show how dynamic pseudo-panel techniques can be employed to estimate prudence with repeated cross-sections, finding levels of relative prudence between eight and thirteen for Taiwan. These high levels of prudence explain the rapid consumption growth and high savings rate in Taiwan.

The 1984, 1989, 1992, 1994 and 1996 years of the Encuesta Nacional de Ingreso-Gasto de los Hogares (ENIGH) household survey are used to estimate relative prudence in Mexico. As these surveys are unequally-spaced, estimation of prudence involves further complications from aggregation, which this paper is the first to address. To our knowledge, these are the only estimates of prudence

[1] source: Real wage changes reported in Lustig (1998, p. 193).

for a Latin American country, and together with the Taiwan estimates, are the only prudence measures available for any developing country. We obtain estimates of the coefficient of relative prudence between two and three for Mexican households, which is much lower than the high levels of prudence found in Taiwan. This difference in precautionarity between the two countries may help explain the inter-country saving rate differentials, and more generally may shed light on differences in saving rates between Latin America and East Asia.

The remainder of the paper is organized as follows. Section 2 provides further detail on Mexico's macroeconomic performance over the period 1984-96. Section 3 describes the ENIGH survey data, and examines changes in household consumption over the sample period. Section 4 estimates relative prudence in Mexico, while Section 5 concludes the paper.

II. Mexico's Macroeconomic Performance 1984-96

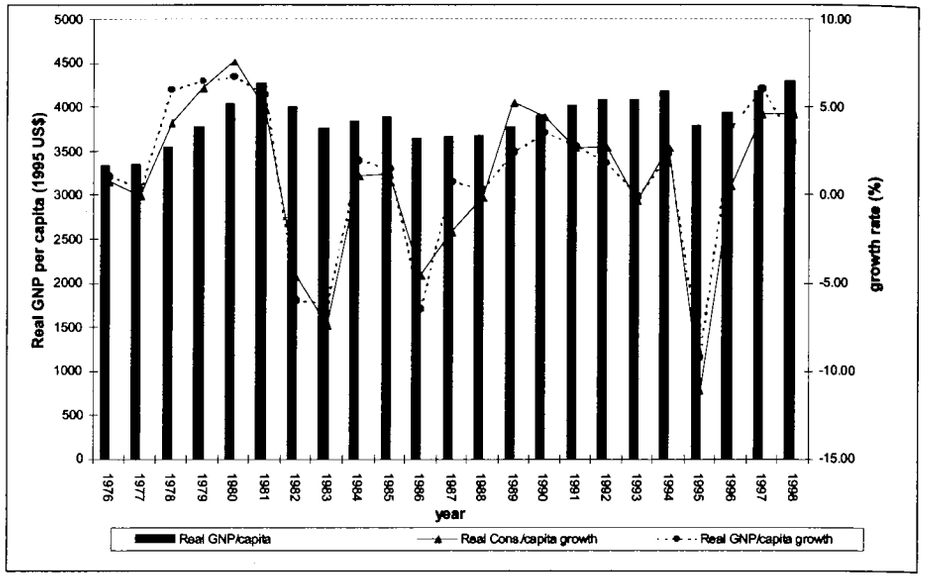
Figure 1 plots the level of real GNP per capita, and annual growth rates in real GNP per capita and real private consumption per capita in Mexico over the period 1976-98.[2] The overall stagnation of the economy is seen by the fact that the level of real GNP per capita only first rose above the 1981 level in 1998. Private consumption growth tracks GNP per capita growth closely over time, and there is not much evidence of consumption smoothing over the income shocks. In particular, in 1995 real private consumption per capita fell by 11%, which was more than the 9.2% fall in real GNP per capita.

The four years 1996-2000 saw GDP grow at an average of 5.1% per year, and inflation fall below ten percent. However, real GDP only grew 0.1% in the first three quarters of 2001,[3] and the slowdown of the United States economy makes the short-term outlook for Mexico's economy less rosy. Analysis of the responsiveness of consumption to macroeconomic shocks in the past may help predict the possible consequences of these events.

[2] source: World Bank (2000).

[3] source: Instituto Nacional de Estadística, Geografía e Informática (INEGI) webpage *http://www.inegi.gob.mx/estadistica/ingles/economia/fieconomia.html*, accessed january 17, 2002.

Figure 1. Mexican Macroeconomic Perfomance 1976-98



III. The ENIGH Survey Data

Household surveys of income and expenditure in Mexico have been carried out at irregular intervals since 1950, however only the surveys from 1984 onwards are comparable.[4] We use five rounds of the *Encuesta Nacional de Ingreso-Gasto de los Hogares* (ENIGH). The size of the survey varies from year to year, being 4,735 households in 1984, 11,535 in 1989, 10,530 in 1992, 12,815 in 1994 and 14,042 in 1996. The surveys contain extremely detailed information about the expenditure of each household, together with information on income after taxes and social security contributions, capital expenditure, and demographic variables. Information is also available on non-monetary expenditure, such as auto-consumption. A household is defined as a group of people who habitually reside in the same dwelling and who are sustained by common expenditure on food (INEGI, 1998).

We compute non-durable consumption by subtracting the following expenditures from total consumption: expenditures on

[4] Earlier surveys were taken at different times of the year, by different government bodies, and used different sampling techniques. See Székely (1998) for further discussion of the earlier surveys.

furniture and household appliances, leisure and entertainment equipment including audiovisual and photographic equipment, vehicles and orthopedic and therapeutic items. This definition closely follows that used by Attanasio and Székely (1998) and Villagómez and Soberón (1999). Following Villagómez and Soberón (1999), we deflate the data using the CPI from the month of September in each survey year. We use the monthly consumer price index provided by the Banco de Mexico to convert the data to 1994 pesos. Inflation has been high over the sample period, with annualized rates above 20 percent for all but the 1992-94 period. Sensitivity analysis to the choice of price index is contained in Mckenzie (2001b).

As the surveys are repeated cross-sections, rather than a genuine panel, we follow cohorts rather than individuals over time. The econometric consequences of this will be discussed in the next section. Cohorts are defined by the age (and education) of the household head, so for example we compare households with heads aged 30 in the 1984 survey to households with 35 year old heads in the 1989 survey, heads aged 38 in the 1992 survey, etc. The household head in the ENIGH surveys is defined as the person recognized as the head by the household members (INEGI, 1998). We exclude households where the head has not resided in the household for three months prior to the interview, and where the head is not reported. We restrict our empirical analysis to households with heads aged 30-65 years old, which mitigates many concerns associated with the effects of changing headship, differential migration, and differential mortality by age group.[5] We standardize household consumption and income by the number of adults[6] and the number of adult equivalents (defined as the number of adults plus half the number of children) in order to control for the large variability in household size.

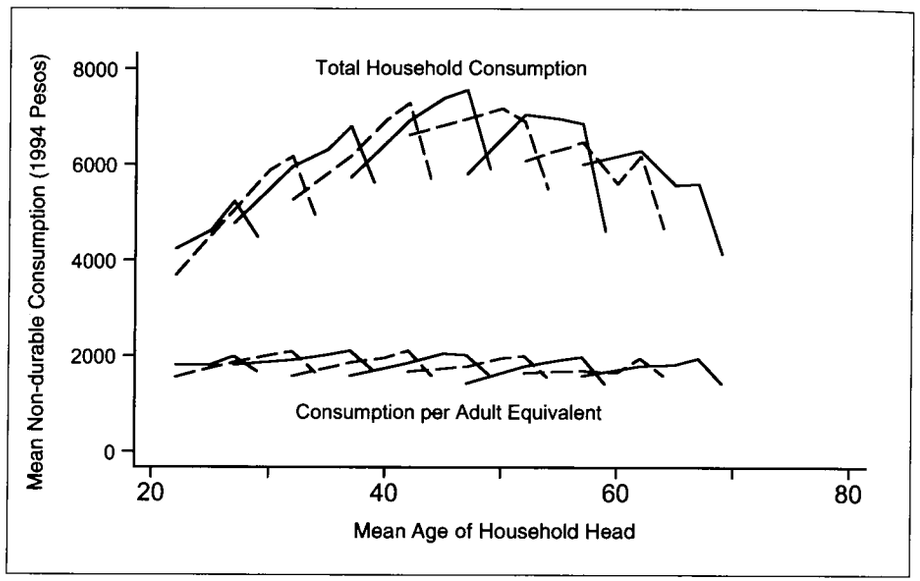
Figure 2 plots mean household and per adult equivalent non-durable consumption, by 5-year birth cohort, against the age of the household head. Household consumption shows the standard inverse-U shape, rising until the head reaches age 50, and declining thereafter. Per adult equivalent consumption is much flatter, reflecting the effect of accounting for family size changes over the

[5] Detailed analysis of the determinants of household headship and changes in household composition over the life-cycle is provided in Mckenzie (2001b).

[6] Individuals aged 18 and above.

lifecycle. The effects of the peso crisis are clearly seen, with consumption and income falling for all cohorts over the 1994-96 period. As with the aggregate data, the level of consumption does not seem to have been greatly smoothed when income falls. In Mckenzie (2001c) we show that although insufficient savings prevented households from smoothing the level of consumption, they reacted to the crisis by changing the composition of their consumption, reducing the expenditure shares of durables and non-essential items.

Figure 2: Mexican Household Consumption
by 5-year Birth Cohort 1984-96



The data can be more finely partitioned through grouping individuals by both the birth year and the educational level of the household head, assuming that educational attainment remains fixed over time. Six levels of educational attainment are considered: no schooling; incomplete primary schooling (1-5 years of primary education); completed primary education; junior high (1-3 years of post-primary education); high school; and college and above. There are clear differences across birth cohorts, with higher levels of educational attainment reached by the younger cohorts. For all birth year-education cohorts, the peso crisis still results in consumption falling between 1994-96.

IV. Estimating Prudence

Let $c_{it+1}=log(C_{it+1})$ be the logarithm of non-durable consumption per adult equivalent for household i in period $t+1$. Then, using the approximation $(C_{it+1}-C_{it})/C_{it} \approx c_{it+1}-c_{it}$, we have from equation (4) of Dynan (1993, p.1106), that a second-order Taylor expansion of the consumer's first-order condition gives:

$$E_t\left[c_{it+1}-c_{it}\right]=\frac{1}{\xi}\left(\frac{r_t-\delta}{1+r_t}\right)+\frac{\rho}{2}E_t\left[\left(c_{it+1}-c_{it}\right)\right], \qquad (1)$$

where $\rho = -CU'''/U''$ is the coefficient of relative prudence under a constant relative risk aversion (CRRA) utility function $U(C)=(1-\gamma)^{-1}C^{(1-\gamma)}$, r_t the real after-tax interest rate, E_t the time preference rate and E_t the conditional expectation based on all information available at time t. For positive values of ρ, higher expected consumption growth, reflecting higher precautionary saving, is associated with higher squared consumption growth (reflecting greater uncertainty). Under rational expectations, one can rewrite equation (1) in terms of realized consumption:

$$c_{it+1}-c_{it}=\frac{1}{\xi}\left(\frac{r_t-\delta}{1+r_t}\right)+\frac{\rho}{2}\left(c_{it+1}-c_{it}\right)^2+\varepsilon_{it+1} \quad \text{or}$$

$$g_{it+1,t}=\frac{1}{\xi}\left(\frac{r_t-\delta}{1+r_t}\right)+\frac{\rho}{2}g_{it+1}^2+\varepsilon_{it+1}, \qquad (2)$$

where $g_{it+1,t}$ is the growth rate of consumption between period $t+1$ and period t. The error term, ε_{it+1}, is correlated with $g_{it+1,t}^2$, and so Dynan (1993) uses instrumental variables to estimate a version of this equation. Valid instruments are variables which are correlated with consumption uncertainty, but which are not taste shifters affecting consumption growth. Dynan uses the occupation, industry and education of the household head and the number of earners in the household as instruments. In McKenzie (2001a) we show how this equation can also be estimated using a pseudo-panel constructed from annual repeated cross-sectional surveys.

The ENIGH surveys are not collected annually, and so we must adapt equation (2) to allow for this. Adding the equations for $g_{it+1,t}$

and $g_{it+2,t+1}$ together gives the corresponding equation for two-year consumption growth:

$$g_{it+2,t} = \frac{1}{\xi}R + \frac{\rho}{2}\left[g^2_{it+1,t} + g^2_{it+2,t+1}\right] + \varepsilon_{it+1} + \varepsilon_{it+2}$$
$$= \frac{1}{\xi}R + \frac{\rho}{2}g^2_{it+2,t} + v_{it+2} \qquad (3)$$

where $R = \left(\frac{r_t - \delta}{1+r_t}\right) + \left(\frac{r_{t+1} - \delta}{1+r_{t+1}}\right)$ and $v_{it+2} = \varepsilon_{it+1} + \varepsilon_{it+2} - \rho g_{it+2,t+1}g_{it+1,t}$.

The error term v_{it+2} in the equation for two-year consumption growth, $g_{it+2,t}$, now contains the unobserved cross-product term $\rho g_{it+1,t}g_{it+2,t+1}$, which is likely to be correlated with $g^2_{it+2,t}$. Furthermore, if $g_{it+2,t+1}$ and $g_{it+1,t}$ are of opposite signs, as would be the case using the years 1992, 1994 and 1996 in Mexico, then $g^2_{it+2,t}$ undermeasures the amount of uncertainty faced by consumers. The reason such a term is not present in equation (2) is that the derivation of (2) implicitly assumes that consumption preferences are defined over one-year periods. Clearly this is an arbitrary assumption, and if the relevant time period for consumption planning is six-months, then yearly data is prone to the same aggregation effect. Generalizing to the *s-period* growth rate $g_{it+s,t}$, we have similarly:

$$g_{it+2,t} = \frac{1}{\xi}\sum_{j=1}^{s}\left(\frac{r_{t+1-j} - \delta}{1+r_{t+1-j}}\right) + \frac{\rho}{2}g^2_{it+s,t} + v_{it+s}$$
$$v_{it+s} = \sum_{j=1}^{s}\varepsilon_{it+j} - \frac{\rho}{2}\sum_{j=1}^{s}\sum_{k\neq j}^{s}g_{it+j,t+j-1}g_{it+k,t+k-1} \qquad (4)$$

If one assumes that two-years is the relevant time period for defining consumption preferences, then equation (2) could be estimated using the 1992, 1994 and 1996 surveys. It does not seem desirable to assume that two-years is the consumption planning period, and additionally we would like to use all of the data span available to examine prudence.[7] Under the identifying assumption

[7] The longer the time period, the more accurately is actual consumption growth likely to measure risk.

that the instruments for $g_{it+2,t}^2$ are uncorrelated with taste shifters affecting consumption growth, then these instruments will still be valid for equations (3) and (4), as they will be uncorrelated with the cross-product terms $g_{it+j,t+j-1}g_{it+k,t+k-1}$.

As the ENIGH surveys do not form a panel, we do not observe consumption growth rates, $g_{it+s,t}$, at the individual level. Instead, we must aggregate equation (4) further by summing over individuals within the same cohort. This enables estimation to occur using growth in cohort mean consumption. Let

$$\bar{c}_{k(t+s),t+s} = \frac{1}{n_k}\sum_{i=1}^{n_k}c_{it+s}$$

denote mean log consumption for the individuals sampled from cohort k at time $t+s$. Then adapting the derivation in Appendix 3 of Mckenzie (2001a) to the unequally-spaced case, the equation to be estimated at the cohort level is, for cohort k at time $t+s$:

$$\bar{c}_{k(t+s),t+s} - \bar{c}_{k(t),t} = \alpha_k + \frac{1}{\xi}\sum_{j=1}^{s}\left(\frac{r_{t+1-j} - \delta}{1+r_{t+1-j}}\right) + \frac{\rho}{2}\left(\bar{c}_{k(t+s),t+s} - \bar{c}_{k(t),t}\right)^2 + \omega_{k(t+s),t+s} \qquad (5)$$

The intercept, α_k, captures average individual-specific uncertainty, while the coefficient of relative prudence, ρ, is identified from variation in cohort-level uncertainty. As discussed above, due to the possible presence of both aggregation effects and taste shifters, the error term $\omega_{k(t+s),t+s}$ is likely to be correlated with squared consumption growth, necessitating the use of instrumental variables.

Equation (5) is estimated with the ENIGH data using three sets of instruments in order to obtain estimates of the relative prudence parameter ρ.[8] Cohorts are defined by the household head's educational level and five-year birth cohort. Squared consumption growth between periods t and $t+s$ is instrumented using period t variables: the proportion of the cohort in each industry and occupation; the proportion of households in the cohort having

[8] Estimation was carried out in STATA. Verbeek and Nijman (1992) find that pseudo-panels can be treated as genuine panels if the cohort sizes n_k are at least 100, which is the true on average here (the mean cohort size is 159), and so equation (5) can be estimated using standard instrumental variables with cohort dummy variables.

multiple earners; and the mean interest and rent income earned by members of the cohort in period t (a proxy for initial assets). This instrument set corresponds closely with those used by Dynan (1993), who also used the education of the household head-used here in defining cohorts. All regressions include cohort dummies for the α_k terms. In addition, time dummies are included to capture the interest rate terms and other time effects. As an alternative,[9] we explicitly construct the

$$\sum_{j=1}^{s}\left(\frac{r_{t+1-j}-\delta}{1+r_{t+1-j}}\right)$$

terms using the International Monetary Fund's IFS annual Mexican deposit rate deflated by Consumer Price inflation, and assuming that δ is .02.[10]

Table 1 summarizes the results. The results of the first-stage regression of squared consumption growth on the instruments[11] show that the instruments explain a large part of the cohort level variability of consumption, with the R^2 statistics ranging between .57 and .73. However, apart from the cohort dummies, only for the industry proportions can we reject the hypothesis that their coefficients are equal to zero. Dynan (1993) experienced similar problems, although with much lower R^2 statistics in the first stage.

In the second stage, explicit inclusion of the interest rate terms results in estimates of $1/\xi$ with a negative sign. As ξ is the coefficient of relative risk aversion, this would seem to indicate that households are risk-seeking. However, the negative coefficient reflects the fact that real interest rates were highest between 1994 and 1996, due to the *peso crisis,* at the same time as consumption growth was negative. The omission of time dummies therefore accounts for the negative sign of ξ. The overidentification tests reveal that in two out of three cases we can reject the overidentifying restrictions for this specification. We therefore prefer the specification which includes time dummies. The

[9] As the measured interest rate varies only over time, we can not include both time dummies and the interest rate term.

[10] Using the average cost of funds, or money market interest rate instead, and changing the assumed discount rate had little effect on the results. The choice of δ=.02 corresponds with the quarterly rate of .005 chosen by Dynan (1993).

[11] The cohort and year dummies are also included in this regression.

Table 1: Estimation of the Prudence of Mexican Consumers
unit of analysis: education x 5-year birth cohort

A: Basic Results	*with time dummies*			*r modelled explicity*		
	(1)	*(2)*	*(3)*	*(1)*	*(2)*	*(3)*
	First-stage E-test p-values					
Instruments						
Occupation	0.368	...	...	0.110	...	...
Industry	0.003	0.070	...	0.002	0.060	...
Multiple Earners	0.581	0.870	0.490	0.256	0.136	0.676
Initial Asset income	0.198	0.379	0.397	0.268	0.334	0.331
First-stage R^2	0.731	0.701	0.620	0.693	0.662	0.570
	Second Stage Coefficients and Standard Errors					
Sum of (r-delta)/(1+r) terms	...	...	...	-0.07	-0.10	-0.05
				(0.04)	(0.05)	(0.11)
Squared Consumption Growth	1.25	1.69	1.63	1.03	1.52	0.71
	(0.66)	(0.64)	(1.67)	(0.78)	(0.83)	(2.08)
Implied Relative Prudence	2.5	3.4	3.3	2.1	3.0	1.4
	(1.3)	(1.3)	(3.3)	(1.6)	(1.7)	(4.2)
Test of overidentifying restrictions p-value:	0.938	0.947	0.819	0.021	0.479	0.089

B: Results allowing prudence to differ across educational groups	*Relative Prudence Coefficient (Standard Error)*		
Education Level	*(1)*	*(2)*	*(3)*
No Schooling	3.1	3.2	2.6
	(1.0)	(0.9)	(2.2)
Incomplete Primary	2.9	3.7	3.8
	(0.9)	(0.9)	(2.1)
Complete Primary	1.4	2.4	3.6
	(0.9)	(1.1)	(2.0)
Junior High	-0.1	1.4	1.7
	(0.9)	(1.2)	(1.9)
High School	1.8	2.2	4.2
	(1.0)	(1.0)	(2.9)
Higher Education	0.9	0.9	1.3
	(0.6)	(0.6)	(1.2)
P-value for F-test of equality across education levels:	0.058	0.059	0.447

NOTES: All regressions also include cohort dummies. Corrected standard errors are in parentheses.

overidentification tests here show that one cannot reject the restrictions at any standard significance level. Point estimates place the coefficient of relative prudence[12], ρ, between 2.5 and 3.4, showing that cohorts which face more risk save more.

These point estimates for prudence are greater than those of Dynan (1993), whose estimates for the USA are all less than unity. Her analysis uses quarterly data over a single year, which may be too short a period to accurately measure consumption risk. Our estimates for Mexico do lie within the range of values implied by other studies of risk aversion, and are notably much lower than the levels of relative prudence estimated for Taiwan in Mckenzie (2001a).

IV.1. Liquidity Constraints and Prudence by Education Group

Dynan (1993) considers the possibility that estimation of the coefficient of relative prudence may be biased by the inclusion of liquidity-constrained consumers. She notes that liquidity-constrained consumers will have faster consumption growth than non-constrained consumers, as the constraints force them to defer consumption by accumulating assets as a buffer stock against fluctuations in income. If labour income shocks are persistent and liquidity-constrained agents consume their current income, then they will have also have less variable consumption than permanent-income consumers. As the first-order condition, from which equation (1) is derived, is not satisfied for these liquidity-constrained consumers, their presence may cause the estimates of prudence to be biased downwards. Estimating prudence separately for high-wealth and low-wealth subsamples, Dynan obtains larger estimates of prudence for the high-wealth households, but can still not reject the hypothesis that ρ is zero.

The ENIGH surveys only collect asset income received in the current year, and do not collect information on previous asset income or asset stocks. This prevents the identification of high-wealth households over time. Even if we are willing to assume that the group of households with a given level of asset income in year t are the same group of households with asset income in period $t+s$,

[12] This is simply twice the coefficient on the instrumented squared consumption growth.

only 4-6 percent of households report having any asset income in the ENIGH surveys. Székely (1998) discusses measurement of access to credit in Mexico, and concludes that many of the methods used in the literature to test for liquidity constraints are not possible with the ENIGH data. Access to credit varies dramatically across educational levels, with less than 0.5 percent of households with unschooled heads having a credit card, compared to up to 42 percent of households whose heads have college education.[13]

The education level of the household head seems to be one of the best proxies for access to the formal credit markets, and has the added advantage that it can be used to identify cohorts over time. In part B of Table 1, we augment equation (5) to allow the estimated coefficient of prudence to differ across educational levels.[14] Point estimates of prudence are mostly higher for the lower education levels, which are the households most likely to be liquidity-constrained. The point estimate of relative prudence for those with higher education is 0.9, and only for households with no schooling and with incomplete primary schooling do we reject that relative prudence is *zero*. An F-test rejects at the 10 percent level the null hypothesis of equality of prudence coefficients across educational groups.

This analysis is suggestive only, as all education cohorts may have a substantial number of liquidity constrained members. It is also possible that prudence may differ by educational level, so that the parameter estimates reflect the joint effects of liquidity constraints and heterogeneity in prudence across education cohorts. A second potential source of bias is the presence of subsistence consumers, who simply consume all their income each period. The first order condition for consumption does not hold for this group of consumers, and instead equation (4) measures the relationship between their income growth and income volatility. As the education and the likelihood of being a subsistence consumer[15] are highly correlated, the estimates of relative prudence for the high education households are much less likely to be affected by this concern.

[13] Author's calculations from the 1994 ENIGH.

[14] That is, the coefficient on squared consumption growth is allowed to differ across education groups.

[15] A subsistence consumer is one for whom the survival constraint binds, causing the consumer to need to consume all their income each period. See Székely (1998, p. 223) who defines subsistence consumers in Mexico as those below the poverty line.

V. Conclusions

Our estimates of the coefficient of relative prudence find a low precautionary savings intensity in Mexico. Low levels of prudence can help explain why households had insufficient savings to smooth their consumption during Mexico's recurring economic crises, and additionally may play an important role in explaining differences in savings rates between Mexico and the high saving East Asian economies such as Taiwan. Estimation of prudence for other developing countries should now be possible with the pseudo-panel methods presented here, and would appear to be an important step towards explaining cross-country differences in saving rates. Further work should also consider how institutions and social norms impact on preferences and hence the extent to which they determine prudence.

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