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The Adjustment of Consumption to Income Changes Across Chinese Provinces

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This paper examines a key stochastic implication of the canonical version of the permanent income model that new information about future income should give rise to an adjustment in consumption equal in magnitude to the adjustment in permanent income. Using data from 29 Chinese provinces, the empirical results are consistent with the model.

Key Words: Chinese provinces; Consumption; Permanent Income.
JEL Classification Number: E21.

1. INTRODUCTION

China has achieved remarkable economic growth since its reform and opening up in 1978, averaging close to 10 percent annually in the past three decades or so. As a result, per capita income has increased considerably from US$195 in 1978 to US$3121 in 2011 (World Development Indicators,

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2012). Yet China's consumption as a share of GDP has declined steadily over the years, and stood at around 36 percent in 2011 compared to the world average of 60 percent. This seemingly paradoxical phenomenon has raised important questions such as: Why do Chinese households consume so little? How does Chinese household consumption respond to changes in income? Is the standard neoclassical consumption theory applicable to the Chinese economy?

To date, there appears to be relatively few empirical studies on household consumption behavior in China.[1] Many of the existing studies have focused on data in the earlier period of China's reform (i.e., in the 1980s) when major changes in policies may not have been fully implemented and hence, affected household incomes. Notably Chow (1985) estimates a model consisting of a consumption function and an investment function using Chinese aggregate time series data from 1953-1982. He finds that the data support Hall's (1978) version of the permanent income hypothesis in that no lagged variables apart from lagged consumption are able to predict current consumption. Wang (1995) uses cross-section household survey data to examine the relationship between permanent income and wealth accumulation among Chinese households. She reports that households do indeed behave according to the permanent income model. Kraay (2000) investigates the effects of income innovation on consumption across provinces of China from 1978-1989. He finds that the lack of formal consumer credits mechanisms in rural areas does not hinder rural households from smoothing their consumption in the face of large income shocks. Moreover, he notes that consumption behavior of rural households is in accord with the predictions of standard intertemporal models of consumption while those of urban households do not. Meng (2003) utilizes survey data collected in 1999 to examine whether urban Chinese households are capable of smoothing their consumption under significant income shocks. She finds support for the consumption smoothing hypothesis and that households tend to have a strong motive for precautionary saving. More recently, Chow (2010) extends his earlier study by estimating a macroeconomic model using data over the period of 1978 to 2006. He reaffirms his previous findings that fluctuations of aggregate consumption in China are consistent with the stochastic version of the permanent income model. In particular, he finds that in a regression of current consumption on lagged consumption and current income, the coefficient of lagged consumption is insignificantly different from one and the coefficient of income and other lagged variables are insignificantly different from zero.

[1]Many studies have focused on the so-called "Chinese saving puzzle". See, for example, Modigliani and Cao (2004), Kuijs (2006), Horioka and Wan (2007), and Chamon and Prasad (2010).

This paper extends and builds on previous research by examining the extent to which household consumption in China behaves in a manner consistent with the permanent income hypothesis (PIH). A key implication of PIH is that new information about future income should give rise to an adjustment in consumption equal in magnitude to the adjustment in permanent income. Thus far, there are no empirical studies assessing the validity of this implication in China at the national or provincial level despite the recent availability of data.[2] Consequently, we test this implication using an empirical methodology proposed by DeJuan, Seater and Wirjanto (2004, 2010) to time series data from 29 Chinese provinces over the period 1980-2008. Our results provide some support for the PIH. Indeed, we find that consumption respond significantly to news about future income, and that the magnitude of the adjustment in consumption is systematically positively related to that of permanent income across provinces in China.

Research into the consumption behavior of Chinese households is of importance for several reasons. First, there are theoretical implications from this type of study, as a good understanding of the consumption behavior of a large developing country such as China will help determine the relevance and applicability of consumption theories. Second, it has practical policy implications for China. Domestically, how to formulate government policies such as tax and welfare policy to rebalance the economy from an export-oriented to a domestic consumption-oriented has been of great interest to policy makers for quite some time. Internationally, the persistent global trade imbalance has been widely debated in recent years and is often considered as being fundamentally associated with the imbalance in saving in China and the U.S. Thus, a clear understanding of China's consumption and saving behavior is at the heart of several major policy issues. Finally, it is important to the well-being of households in China. Neoclassical consumption theory suggests that households should smooth consumption over time in order to maximize their welfare. An ability to identify factors that lead to deviation from the prediction of this theory, for example, could have important implications to households' welfare.

The remainder of this paper is structured as follows. In Section 2, we present a simple but standard intertemporal model of consumption. Section 3 discusses the data and estimation results. Section 4 concludes the paper.

[2]Indeed, there are only a few studies on household consumption using Chinese province-level data. Xu (2008) examines the extent of consumption risk-sharing among provinces. Du, He and Rui (2011) study channels of interprovincial risk-sharing in China. Xu (2009) tests whether closed-economy constraint can explain the excess sensitivity of consumption to changes in income. Curtis and Nelson (2011) use consumption data from national account rather than household survey to study regional consumption risk-sharing. Other studies that utilized province level data focused mainly on household saving behavior. See, for example, Qian (1988), Kraay (2000), and Horioka and Wan (2007).

2. MODEL AND EMPIRICAL SPECIFICATION

A fundamental implication of the permanent income hypothesis can be seen in the following intertemporal optimization model of consumption. Following Hall's (1978) seminal paper, the model starts with the classic Fisherian postulate that households in province i, with rate of subjective time preference parameter ρ, choose a consumption path in order to maximize the expected discounted value of their lifetime utility subject to an intertemporal budget constraint:

$$\max_{C_{i\tau}} {}_t \left[\sum\nolimits_{\tau=t}^{\infty} \left(\frac{1}{1+\rho} \right)^{\tau-t} u(C_{i\tau}) \right] \tag{1}$$

subject to

$$\sum_{\tau=t}^{\infty} \left(\frac{1}{1+r} \right)^{\tau-t} {}_t(C_{i\tau}) = (1+r)A_{it} + \sum_{\tau=t}^{\infty} \left(\frac{1}{1+r} \right)^{\tau-t} {}_t(Y_{i\tau}) \tag{2}$$

where C is consumption, ${}_t$ is a mathematical expectation operator conditional on information available at time t, $u(.)$ is an instantaneous utility function which is assumed to be an increasing and concave function of C, r is the real rate of interest, A is assets, and Y is labor income. If households can borrow and lend freely at a real interest rate r, then optimal consumption behavior is characterized by the intertemporal first-order condition, also known as the Euler equation:

$$u'(C_{i,t}) = \left(\frac{1+r}{1+\rho} \right) {}_t[u'(C_{i,t+1})] \tag{3}$$

Equation (3) states that, at the optimum, the disutility from giving up a unit of consumption in the current period must equal to the expected utility gained from future consumption. Given that the expected value of the marginal utility may differ from its realization, equation (3) can be written as

$$u'(C_{i,t+1}) = \left(\frac{1+\rho}{1+r} \right) u'(C_{it}) + \eta_{t+1} \tag{4}$$

where η_{t+1} is a stochastic term which is unforecastable at period t when expectations are formed rationally, i.e., ${}_t(\eta_{t+1}) = 0$. To simplify matters, we assume that the utility function is quadratic and that the real rate of interest is equal to the rate of subjective time preference. With these assumptions, equation (4) can be rewritten as

$$C_{i,t+1} = C_{it} + \eta_{t+1} \tag{5}$$

Equation (5) presents Halls (1978) well-known result that consumption follows a first-order Markov process. As such, the level of consumption in period t is the optimal forecast of the level of consumption in period $t+1$.

Repeated substitution of (5) into the intertemporal budget constraint (2) yields the following solution for consumption to the above maximization problem:

$$C_{it} = Y_{it}^P = \left(\frac{r}{1+r}\right)\left[(1+r)A_{it} + \sum_{\tau=t}^{\infty}\left(\frac{1}{1+r}\right)^{\tau-t} {}_t(Y_{i\tau})\right] \tag{6}$$

Thus, households in province i set their optimal consumption C_{it} equal to the estimate of their permanent income Y_{it}^P, where Y_{it}^P is defined as the annuity value of the discounted expected lifetime resources.

An implication arising from (6) is that

$$\Delta C_{it} = \Delta Y_{it}^P \tag{7}$$

where Δ is the difference operator and the theoretical form of ΔY_{it}^P, as first noted by Flavin (1981), is:

$$\Delta Y_{it}^P = \left(\frac{r}{1+r}\right)\sum_{\tau=t}^{\infty}\left(\frac{1}{1+r}\right)^{\tau-t} ({}_t - {}_{t-1})(Y_{i\tau}) \tag{8}$$

What do (7) and (8) tell us about the evolution of consumption and permanent income over time? First, the adjustment in consumption should be equal to that of permanent income. Second, as shown in (8), the adjustment in permanent income is driven by new information that give rise to a revision in expectations of future income. If no new information becomes available, then permanent income is constant such that $Y_{it}^P = Y_{it+1}^P$ and hence, $C_{it} = C_{i,t+1}$ and from equation (5), $\eta_{t+1} = 0$.

To obtain an empirically estimable expression for ΔY_{it}^P, we specify a forecasting equation for income. As is standard in the literature, let ΔY_{it} be a stationary autoregressive moving average process with the form:

$$A_i(L)\Delta Y_{it} = B_i(L)\varepsilon_{it} \tag{9}$$

where $\Delta Y_{it} = Y_{it} - Y_{it-1}$, $A_i(L) = \sum a_{ij}L^j$, $B_i(L) = \sum b_{ij}L^j$, L is the lag operator, a_i and are vectors of autoregressive and moving average coefficients respectively, and ε_{it} is current income innovation. Applying (9) to (8), Flavin (1981), Hansen and Sargent (1981) and Deaton (1992) have shown that

$$\Delta Y_{it}^P = \frac{1 + \sum_{\tau=1}^{\infty}\frac{b_{i\tau}}{(1+r)^{\tau}}}{1 - \sum_{\tau=1}^{\infty}\frac{a_{i\tau}}{(1+r)^{\tau}}} \cdot \varepsilon_{it} = \chi_i(r, b_i, a_i) \cdot \varepsilon_{it} \tag{10}$$

where χ_i denotes the amount of the adjustment in permanent income resulting from an income innovation ε_{it}. It is apparent that χ_i depends on the assumed interest rate r and the estimated values of a_i and b_i which conveys the degree of persistence of ε_{it}. Thus, given a forecasting equation for income, one can calculate the value of χ_i and compare it the amount of the adjustment in consumption due to the same income innovation ε_{it}.

Following DeJuan et al. (2004, 2010), we estimate the following two-equation system for each province i:

$$\begin{aligned} A_i(L)\Delta Y_{it} &= B_i(L)\varepsilon_{it} \\ \Delta C_{it} &= \alpha_i + \beta_i\varepsilon_{it} + \xi_{it} \end{aligned} \tag{11}$$

where β_i represents the amount of the adjustment in consumption resulting from an income innovation ε_{it}, and ξ_{it} denotes random disturbance term. The PIH predicts that the estimate of β_i should be equal to χ_i, where χ_i is calculated based on (10). We formally test this prediction by estimating the following cross-province regression:

$$\beta_i = \mu_0 + \mu_1\chi_i + \nu_i \tag{12}$$

where μ_0 is the intercept, μ_1 is the slope coefficient, and ν_i is the random disturbance term.

Test #1 (Strong form of PIH): $\beta_i = \chi_i$ for each province i.

To determine whether $\beta_i = \chi_i$, one can test the hypothesis that $\mu_0 = 0$ and $\mu_1 = 1$. If this hypothesis is not rejected by the data at a given significance level, then the adjustment of consumption and permanent income to income innovation is as predicted by the PIH.

West (1988), Quah (1990), DeJuan et al (2004, 2010) among others, point out that testing for the strict equality of β_i and χ_i is too restrictive in many cases, if not stylized. For example, they note that the prediction equation for income specified in (9) presupposes that households use only the previous values of their income to forecast the future. Households however may utilize other pertinent information in forecasting their future income. This implies that the estimate of ε in (9) is based on a limited information set and hence, will not fully reflect the true income innovation which in turn biases the estimate of β_i. Although the strict equality of β_i and χ_i may not hold, β_i and χ_i are still expected to be systematically positively related across provinces if the PIH is true. Consequently, a less demanding test is warranted to determine whether there exist a positive relationship between β_i and χ_i across provinces.

Test #2 (Weak form of PIH): $d\beta_i/d\chi_i > 0$ across provinces.

To conduct Test #2, we can test the hypothesis that $\mu_1 = 1$ in (12). If this hypothesis is not rejected at a given significance level, then the adjustments of consumption and permanent income are consistent with the weak restriction of the PIH. Otherwise, household consumption behaves according to the traditional Keynesian current income model.

3. DATA AND EMPIRICAL RESULTS

Annual data on real per capita household expenditure and real per capita disposable income at the provincial level are collected from Comprehensive Statistical Data and Materials on 50 Years of New China and from various issues of the China Statistical Yearbook published by the National Bureau of Statistics (NBS) of China. Comprehensive household surveys are conducted annually by the NBS. In order to have a representative sample from the population, households are chosen based on a two-tiered stratified random sampling scheme. Households in the survey are also required to keep a record of their income and expenditures in a diary for a full year.[3] Disposal income is defined as household total income less taxes. Household consumption expenditure is the sum of spending on food, housing and utilities, apparel, transportation, health care, communication, entertainment and recreation, education, and miscellaneous goods and services. The sample covers 29 provinces of China (excluding Tibet and Chongqing) over the period 1980-2008, for which consistent data on disposal income and consumption expenditure are available. Real per capita values of disposable income and household expenditure are used as measures of Y and C, respectively. All variables are expressed in natural logarithms, following the convention used in empirical research in this literature.

We present summary statistics of the annual growth rate of Y and C in Table 1. The average growth rate of income and consumption over the period 1980-2008 are 6.77 percent and 6.18 percent, respectively. Column 2 shows that the average growth rates are higher for urban households than for rural households. In terms of saving as a percent of income, column 3 shows that the average household saving rate is 19 percent. Moreover, rural households tend to save at a much higher rate than urban households. This difference may reflect the larger precautionary saving among Chinese rural households whose incomes are more volatile, determined in large part by weather and market conditions. Urban and rural households in China are known to experience different institutional and social environments. Kraay (2000), for example, notes that urban households have access to subsidized housing, education, and health care, and most of them are covered by generous pension schemes provided by their employers. Rural households, on the other hand, do not have access to these benefits. Instead, most of

[3] For details on the data series, see Xu (2008, 2009).

them have to rely on their own saving for housing and their children for support in old age.

TABLE 1.

Summary statistics

	Avg $\%\Delta Y$	Avg $\%\Delta C$	Avg S Rate	Std Dev $\%\Delta Y$	Std Dev $\%\Delta C$	Std Dev S Rate	Correlation $\%\Delta Y$ & $\%\Delta C$
Province	6.770	6.180	18.500	6.580	5.280	7.430	0.503
Urban	6.610	5.730	16.220	5.610	5.470	7.660	0.593
Rural	5.750	5.390	20.430	8.320	7.220	10.560	0.444

Avg $\%\Delta Y$, Avg $\%\Delta C$, and Avg %S Rate are respectively the sample average growth rate of income, and the average growth rate of consumption, and the average saving rate as a percentage of income. Std Dev $\%\Delta Y$, Std Dev $\%\Delta C$, and Std Dev %S ate are respectively the sample standard deviation of growth rate of income, the standard deviation of growth rate of consumption, and the standard deviation of saving rate as a percentage of income. Correlation $\%\Delta Y$ & $\%\Delta C$ is the sample correlation between the average growth rate of income and the average growth rate of consumption.

The standard deviation of the growth rate of income and consumption over the period under study are 6.58 percent and 5.28 percent, respectively. These findings support the well-known stylized facts that aggregate income is more volatile than aggregate consumption. It is also worth noting that the dispersion of both income and consumption growth is much higher for rural households than for urban households. Finally, average consumption growth is procyclical with respect to income growth across provinces, with an average correlation of 0.50 for all households and correlation of 0.59 and 0.44 for urban and rural households, respectively.

Next we evaluate the univariate time series properties of Y and C using the Augmented Dickey-Fuller (ADF) test for the null hypothesis of a unit root. The t-values of the ADF tests are reported in Table 2, where critical values for our exact sample size are calculated using MacKinnon's (1991) response surface method. The results indicate that the null hypothesis of a unit root cannot be rejected for any ΔY and ΔC series at the 5 percent significance level. For completeness, we have included in Table 2 the results of the ADF test for the first differenced series, ΔY and ΔC series. This time the ADF test for ΔY and ΔC rejects the unit root hypothesis at conventional significance level for majority of the provinces in China. On the whole, these results suggest that the Y and C series can be characterized as integrated processes of order one; hence, first-differenced data will be utilize to conduct the empirical tests.

We estimate the two-equation system (11) using nonlinear least squares method. In our empirical strategy, ΔY is restricted as a simple first order autoregressive process but the results do not appreciably change when longer autoregressive lags are used in the estimation process. Estimate of

χ is based on the assumed value of interest rate r. Here, r is set at three percent, but the results are qualitatively similar using alternative rates of one percent or six percent.

The estimation results of (11) are given in Table 3. Column 2 shows that the estimates of β are positive and statistically significant at conventional level for majority of the provinces in our sample. They range from a low of 0.10 in Ningxia to a high of 0.95 in Yunnan, with an average value of 0.54. These results suggest that the adjustments of consumption to income innovation are not only statistically significant but also economically significant; specifically, a 1 percent increase in income innovation results, on average, in a 0.54 percent increase in consumption. Turning now to the estimates of χ, column 4 shows that they are significantly positive, ranging from 0.68 in Ningxia to 1.31 in Fujian, with an average value of 0.98. These results can be interpret as an indication that innovations to current income contain information about future income that makes households adjust the estimates of their permanent income. In particular, a 1 percent increase in income innovation results, on average, in a 0.98 percent increase in permanent income.

Is β_i positively related to χ_i across provinces in China as the PIH predicts? We answer this question by first presenting the data on β_i and χ_i for $i = 1, \ldots, 29$ in the form of a scatter plot. Visual inspection of Figure 1 reveals a pronounced positive relation between the variables. Notice also that many of the observations lie below the 45 degree line, suggesting that the adjustment of consumption is much smaller than that of permanent income.

FIG. 1. All Households

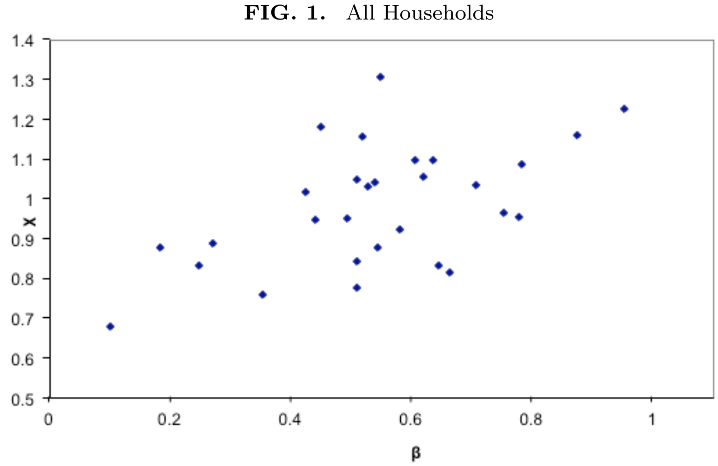


TABLE 2.
Augmented Dickey Fuller test for a unit root: real per capita household expenditure (C) and real per capita disposable income (Y)

	Augmented Dickey-Fuller t-statistics			
Chinese Province	C	Y	ΔC	ΔY
Anhui	−0.987 (3)	−2.156 (2)	−3.013 (2)	-3.266^{**} (4)
Beijing	−2.017 (0)	−1.926 (1)	-3.925^{*} (0)	-3.668^{*} (1)
Fujian	−2.728 (2)	−2.377 (1)	-4.857^{*} (5)	-3.644^{*} (1)
Gansu	−1.235 (0)	−0.989 (0)	-4.066^{*} (5)	-3.467^{**} (2)
Guangdong	-3.628^{**} (6)	-3.429^{**} (5)	-4.756^{*} (5)	-4.486^{*} (0)
Guangxi	−2.914 (0)	−2.703 (0)	-5.232^{*} (1)	-6.977^{*} (0)
Guizhou	−2.131 (0)	−1.892 (0)	-4.059^{*} (0)	-5.437^{*} (0)
Hainan	−1.067 (6)	−1.394 (5)	−2.527 (3)	-4.002^{*} (3)
Hebei	−1.747 (0)	−2.918 (2)	-4.208^{*} (0)	-3.925^{*} (0)
Heilongjiang	0.958 (6)	−1.491 (0)	-3.882^{*} (5)	-6.137^{*} (0)
Henan	−1.747 (0)	−2.853 (3)	-4.199^{*} (0)	-4.198^{*} (4)
Hubei	−1.804 (0)	−1.712 (0)	-3.491^{**} (0)	-4.301^{*} (0)
Hunan	−2.456 (1)	−1.111 (0)	-3.415^{**} (4)	-4.501^{*} (0)
Inner Mongolia	0.022 (0)	−0.231 (1)	-5.007^{*} (0)	-5.710^{*} (0)
Jiangsu	−2.426 (1)	−3.054 (2)	−3.218 (0)	-4.429^{*} (5)
Jiangxi	−1.054 (0)	−0.889 (0)	-4.768^{*} (0)	-4.908^{*} (0)
Jilin	−0.892 (0)	−1.261 (0)	-4.546^{*} (0)	-5.961^{*} (0)
Liaoning	−0.366 (0)	0.091 (1)	-4.972^{*} (0)	-6.060^{*} (0)
Ningxia	−0.845 (0)	−1.468 (1)	-4.819^{*} (0)	-5.459^{*} (1)
Qinghai	−3.131 (2)	−2.870 (2)	-4.767^{*} (4)	-4.397^{*} (4)
Shaanxi	−0.372 (1)	−0.119 (2)	-5.705^{*} (0)	-3.690^{*} (1)
Shandong	−1.637 (1)	−1.441 (0)	-3.957^{*} (0)	-4.925^{*} (0)
Shanghai	−1.119 (0)	−1.407 (0)	-3.564^{**} (3)	-3.487^{**} (2)
Shanxi	−0.790 (0)	−1.057 (0)	-3.296^{**} (1)	-5.857^{*} (3)
Sichuan	−1.565 (0)	−0.702 (0)	-4.048^{*} (0)	-5.033^{*} (0)
Tianjin	−1.662 (0)	−1.784 (0)	-4.514^{*} (5)	-5.444^{*} (0)
Xinjiang	−1.535 (0)	−1.032 (2)	-4.886^{*} (0)	-3.611^{*} (1)
Yunnan	−2.022 (4)	−2.272 (0)	−2.881 (3)	−3.085 (0)
Zhejiang	−1.998 (1)	−3.049 (0)	-4.674^{*} (0)	-3.622^{*} (4)

ADF(lag) is the Augmented Dickey and Fuller t-statistics, using the AIC lag length selection procedure to ensure a parsimonious lag length for serially uncorrelated residuals in the test regression. The finite-sample critical values for the unit-root test developed by MacKinnon (1991) are used to determine statistical significance of the test. * and ** denote statistical significance at 5 and 10 percent levels, respectively.

We formalize the relationship shown in Figure 1 by estimating equation (12). There are two econometrics issues associated with estimating

TABLE 3.

Summary statistics for the two-equation system (11): all households

Chinese Province	β	SE(β)	χ	SE(χ)
(1)	(2)	(3)	(4)	(5)
Anhui	0.509*	0.148	1.052*	0.160
Beijing	0.782*	0.150	1.088*	0.149
Fujian	0.548*	0.225	1.310*	0.245
Gansu	0.580*	0.224	0.925*	0.149
Guangdong	0.706*	0.106	1.038*	0.123
Guangxi	0.508*	0.157	0.778*	0.091
Guizhou	0.777*	0.141	0.956*	0.096
Hainan	0.605*	0.262	1.100*	0.198
Hebei	0.634*	0.151	1.099*	0.175
Heilongjiang	0.247**	0.130	0.834*	0.122
Henan	0.544*	0.144	0.879*	0.103
Hubei	0.538*	0.111	1.044*	0.142
Hunan	0.424*	0.163	1.021*	0.177
Inner Mongolia	0.271**	0.140	0.892*	0.141
Jiangsu	0.620*	0.149	1.057*	0.163
Jiangxi	0.528*	0.140	1.034*	0.156
Jilin	0.182	0.148	0.881*	0.142
Liaoning	0.448*	0.163	1.181*	0.236
Ningxia	0.101**	0.058	0.681*	0.074
Qinghai	0.873*	0.103	1.163*	0.122
Shaanxi	0.492*	0.168	0.952*	0.148
Shandong	0.441*	0.119	0.951*	0.135
Shanghai	0.664*	0.138	0.817*	0.093
Shanxi	0.517*	0.180	1.159*	0.215
Sichuan	0.753*	0.148	0.965*	0.124
Tianjin	0.509*	0.134	0.845*	0.106
Xinjiang	0.353*	0.144	0.760*	0.093
Yunnan	0.952*	0.140	1.228*	0.155
Zhejiang	0.644*	0.147	0.835*	0.092

* and ** denote statistical significance at 5 and 10 percent levels, respectively. SE(β) is the estimated standard error of the β and SE(χ) is the estimated the standard error of the χ.

equation (12). First, the dependent variable in (12), $\hat{\beta}_i$, is an estimated quantity. This can induce heteroskedasticity in the regression's error terms if sampling variability in $\hat{\beta}_i$ is not constant across observations. We also have an estimated quantity in the form of $\hat{\chi}_i$ as our explanatory variable in (12). This can induce generated-regressor biases in the estimated standard errors of the parameter estimates (Pagan, 1984). For the former, White's (1980) heteroscedasticity-consistent standard errors should yield reasonable results, unless the share of the regression residuals due to sampling error in $\hat{\beta}_i$ is extremely high. To correct for the generated-regressor biases, we should in principle compute the standard errors of the parameter estimates using an asymptotic covariance matrix estimator proposed by Murphy and Topel (1985). Unfortunately, we have a relatively small sample size (with $N = 29$) at our disposal. This rules out an effective adjustment of the standard errors for the generated-regressor problem as Murphy and Topel's asymptotic covariance matrix estimate is known to perform very poorly in small samples.

With the above caveats, we report the estimation result for equation (12):

$$\hat{\beta}_i = \underset{(0.246)}{-0.133} + \underset{(0.248)}{0.688}\hat{\chi}_i$$

where White's (1980) heteroskedasticity-consistent standard errors of the parameter estimates are in parentheses.

From Table 4, the cross-province regression shows a relatively high degree of explanatory power in terms R-squared value of 0.28. The estimate of μ_0 is -0.133, which is not significantly different from zero. The estimate of μ_1, on the other hand, is 0.688 which is significantly different from zero and not significantly different from one.[4] Based on the estimate of μ_1, the data support the weak form of PIH that there exists a positive relation between β_i and χ_i.

Having found $\mu_0 = 0$ and $\mu_1 = 1$ individually, we further examine the joint hypothesis of $\mu_0 = 0$ and $\mu_1 = 1$. The value of the F-statistics for this joint hypothesis test is 100.32, with a recorded p-value of 0.001. Thus, the data decisively rejects the strict equality $\beta_i = \chi_i$ which could partly be explained by the restrictiveness of this particular formulation alluded to earlier.

Previous research has found different consumption behavior for urban and rural households. For example, Kraay (2000) reports that despite the limited access to and availability of formal consumer credits mechanisms in rural areas of China, rural households were able to find ways to smooth their consumption in the face of income shocks. Moreover, he finds that rural household consumption behaves in a manner consistent with the standard intertemporal models of consumption while urban households do not. We have time series data from both groups of households, so it is worthwhile to

[4] We also calculate the Spearman rank correlation which is robust to outlying observations as well as the functional relation between β and χ. The rank correlation coefficient is 0.48 with a recorded p-value of 0.01 (see Table 4).

TABLE 4.

Regression and Spearman Rank correlation results

Sample	μ_0	μ_1	R^2	Spearman
All	−0.133	0.688*	0.283	0.480
	(0.246)	(0.248)		[0.008]
Urban	0.661	−0.074	0.002	−0.006
	(0.389)	(0.406)		[0.974]
Rural	−0.282	0.748*	0.255	0.467
	(0.286)	(0.286)		[0.011]

Numbers under the parameter estimates (in parentheses) are Whites (1980) heteroskedasticity corrected standard errors, under the Spearman rank correlations [in brackets] are the p-values. * and ** denote statistical significance at 5 and 10 percent levels, respectively.

further investigate the possibility that consumption behavior are different between urban and rural households in China.

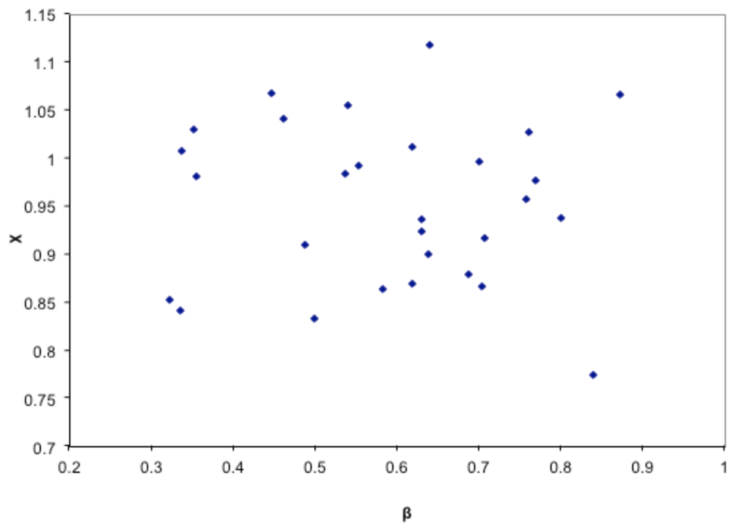
Tables 5 and 6 summarize the estimation results of the two-equation system (11). Estimates of β_i and χ_i are significantly different from zero, both statistically and quantitatively, in many provinces. In addition Figures 2 and 3 show the scatter plots of β_i and χ_i. It is apparent that there is a positive relation between β_i and χ_i for rural households but not for urban households. The cross-province regression results for these two subsamples are:

$$\begin{array}{lcccc} \text{Urban Household:} & \hat{\beta}_i = & \underset{(0.389)}{0.661} & - & \underset{(0.746)}{0.074\hat{\chi}_i} \\ \text{Rural Household:} & \hat{\beta}_i = & \underset{(0.286)}{0.282} & + & \underset{(0.286)}{0.748\hat{\chi}_i} \end{array}$$

where, as before, White's (1980) heteroskedasticity-consistent standard errors of the parameter estimates are in parentheses. For urban households, the estimate of μ_1 is negative in sign and not statistically significantly different from zero. In contrast, for rural households, the estimate of μ_1 is of the hypothesized sign, statistically significantly different from zero, and not statistically significantly different from one. These results suggest that there are evidence of systematic differences in the observed consumption behavior of urban and rural households in China, providing support to the findings reported by Kraay (2000).

The applicability of PIH to rural households in China is not at all surprising given that rural households tend to have a high saving rate and consequently, can use their saving to adjust their consumption as a result of income innovation (Meng 2003). Moreover, Wang (1995) observes that these households often obtain support from networks of families and from various government-funded welfare programs such as the 'Five Guarantee' wubao system in rural areas of China. On a related note, there exists a large literature documenting the consumption smoothing abilities of households in rural areas in other developing countries (see, for example, Paxson (1993), Murdoch (1995), Case (1995), and other papers in the summer 1995 issue of the Journal of Economic Perspective).

FIG. 2. Urban Households



On the whole, our principal finding gives some support for the PIH model. We find that across 29 Chinese provinces, innovations to income lead to an adjustment in consumption that is positively related to the adjustment in permanent income. We also document that there are marked differences in the consumption behavior of urban and rural households in China.

4. CONCLUDING REMARKS

Household consumption behavior may hold the key to China's future economic growth and for resolving the persistent global trade imbalance. To have a better understanding of Chinese consumption behavior, in this paper, we employ the empirical methodology proposed by DeJuan et al (2004, 2010) to test the permanent income hypothesis which asserts that new information about future income should give rise to a proportional adjustment in both consumption and permanent income. Using a relatively underutilized data from 29 Chinese provinces, our empirical findings

TABLE 5.

Summary statistics for the two-equation system (11): urban households

Chinese Province	β	SE(β)	χ	SE(χ)
(1)	(2)	(3)	(4)	(5)
Anhui	0.636*	0.108	0.902*	0.096
Beijing	0.870*	0.135	1.068*	0.123
Fujian	0.581*	0.129	0.865*	0.097
Gansu	0.628*	0.178	0.937*	0.141
Guangdong	0.552*	0.131	0.993*	0.143
Guangxi	0.497*	0.147	0.834*	0.100
Guizhou	0.700*	0.183	0.997*	0.133
Hainan	0.703*	0.154	0.867*	0.103
Hebei	0.617*	0.273	0.870*	0.118
Heilongjiang	0.445*	0.162	1.069*	0.187
Henan	0.333*	0.149	0.842*	0.122
Hubei	0.354**	0.182	0.983*	0.172
Hunan	0.768*	0.185	0.977*	0.142
Inner Mongolia	0.539*	0.176	1.056*	0.177
Jiangsu	0.536*	0.136	0.984*	0.144
Jiangxi	0.486*	0.143	0.911*	0.130
Jilin	0.335*	0.134	1.008*	0.172
Liaoning	0.628*	0.210	0.925*	0.141
Ningxia	0.617*	0.185	1.013*	0.161
Qinghai	0.638*	0.130	1.118*	0.168
Shaanxi	0.351*	0.187	1.031*	0.189
Shandong	0.460*	0.159	1.042*	0.179
Shanghai	0.756*	0.140	0.958*	0.117
Shanxi	0.322*	0.148	0.853*	0.126
Sichuan	0.759*	0.179	1.028*	0.154
Tianjin	0.686*	0.117	0.880*	0.092
Xinjiang	0.706*	0.218	0.918*	0.135
Yunnan	0.838*	0.200	0.776*	0.092
Zhejiang	0.799*	0.135	0.939*	0.111

* and ** denote statistical significance at 5 and 10 percent levels, respectively. SE(β) is the estimated standard error of the β and SE(χ) is the estimated the standard error of the χ.

reveal that household consumption in China, in particular, rural households, respond significantly to news about income, and that the amount of the adjustment in consumption is systematically positively related to the amount of the adjustment in permanent income across provinces. These

TABLE 6.

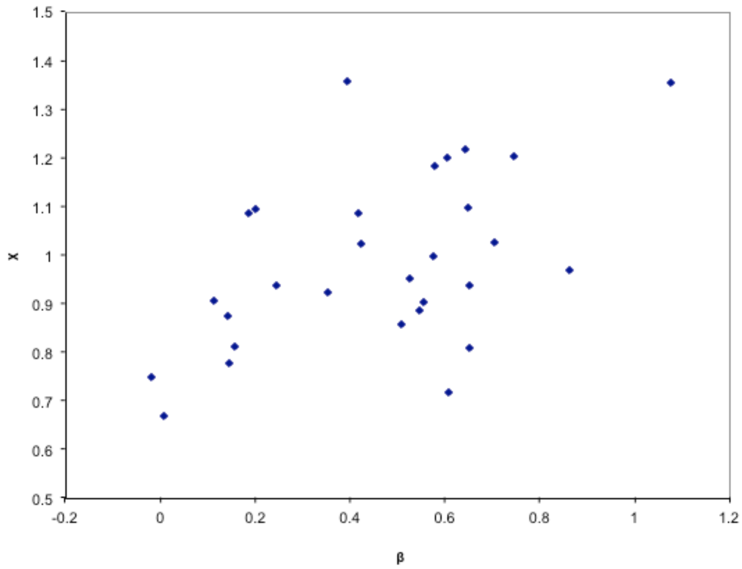
Summary statistics for the two-equation system (11): rural households

Chinese Province	β	SE(β)	χ	SE(χ)
(1)	(2)	(3)	(4)	(5)
Anhui	0.423*	0.159	1.023*	0.160
Beijing	0.393**	0.199	1.357*	0.286
Fujian	0.186	0.171	1.087*	0.171
Gansu	0.245	0.267	0.939*	0.166
Guangdong	0.417*	0.157	1.088*	0.195
Guangxi	0.545*	0.161	0.886*	0.117
Guizhou	0.653*	0.138	0.939*	0.105
Hainan	0.862*	0.289	0.969*	0.144
Hebei	0.579*	0.176	1.184*	0.215
Heilongjiang	−0.020	0.119	0.749*	0.100
Henan	0.554*	0.142	0.905*	0.106
Hubei	0.648*	0.118	1.097*	0.144
Hunan	0.199	0.166	1.095*	0.221
Inner Mongolia	0.157	0.131	0.813*	0.114
Jiangsu	0.745*	0.184	1.204*	0.200
Jiangxi	0.642*	0.149	1.218*	0.192
Jilin	0.141	0.161	0.875*	0.140
Liaoning	0.113	0.140	0.908*	0.155
Ningxia	0.006	0.024	0.669*	0.074
Qinghai	0.651*	0.122	0.810*	0.080
Shaanxi	0.575*	0.175	0.999*	0.151
Shandong	0.354*	0.122	0.924*	0.138
Shanghai	0.607*	0.180	0.719*	0.079
Shanxi	0.606*	0.172	1.200*	0.215
Sichuan	0.704*	0.139	1.027*	0.138
Tianjin	0.525*	0.192	0.952*	0.152
Xinjiang	0.143	0.124	0.778*	0.107
Yunnan	1.078*	0.155	1.355*	0.174
Zhejiang	0.509*	0.146	0.859*	0.102

* and ** denote statistical significance at 5 and 10 percent levels, respectively. SE(β) is the estimated standard error of the β and SE(χ) is the estimated the standard error of the χ.

results based Chinese province-level data give some support to the permanent income model and thus, confirm and complement the findings of several previous studies that used national level and household survey data.

FIG. 3. Rural Households



There are several important implications for our empirical findings. First, policy formulation to rebalance the Chinese economy, for example, through changes in tax policy, should consider how households will respond to the proposed changes. In particular, if Chinese households to a large extent respond to changes in permanent income, then temporary tax policy may not prove to be effective. On the other hand, policy measures such as further reform and opening up, which enhance productivity and thus the earning potential of Chinese households, may have the desired effect. Redistribution policy through changes in income tax, which may lead to more equal income distribution, will have differential effects on the consumption expenditure of different income groups in China. Second, our finding of systematic differences between the observed consumption behavior of urban and rural households deserve more attention. The fact that Chinese rural households respond more positively to changes in permanent income than urban households may indicate the existence of distinct risk-sharing mechanisms. Further work along the line of risk sharing mechanisms is a promising avenue for future research and has important welfare consequences for Chinese households. Finally, policy dialogue among major countries in resolving persistent global trade imbalance should take into account micro behaviors of households in relevant countries to achieve the desired outcome.

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