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Revisiting the Elasticity of Intertemporal Substitution: Panel Data Evidence from Provincial China

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Taking into account returns on various assets, in this paper, we computed synthetic returns at the provincial level for China. To deal with the problem of weak instruments, we used LIML and CUE-GMM for estimation, and obtained a significantly positive elasticity of intertemporal substitution.

Keywords: Elasticity of Intertemporal substitution, Weak Instruments, Synthetic Returns

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I. Introduction

The elasticity of intertemporal substitution (EIS) is an important determinant of households' intertemporal consumption choices. Researchers typically estimate the following equation, derived from an Euler equation framework:

$$\Delta \log C_{t+1} = \alpha + \beta \log(1 + r_t) + u_t, \qquad (1)$$

where C is per capita consumption, r is the real return on assets,[1] and its coefficient (β) is the EIS.

In most studies based on aggregate data, the interest rate is used to proxy r. However, central banks rarely change interest rates. For instance, China's interest rates remained relatively stable before its financial crisis (see Figure 1). Consequently, estimates of the EIS are often small or insignificant because of a lack of variation in the explanatory variable (Mankiw 1981, Hall 1988 and Yogo 2004).

In this paper, we use province-level panel data to estimate China's EIS. Although interest rates might explain time-series variation in $\Delta \log C$, it is difficult to see how they might explain its cross-section variation. There are significant differences in $\Delta \log C$ between provinces (see Figure 2).[2] An initial interpretation might be that households' asset portfolios vary across provinces. Second, there may be interprovincial disparities in asset returns, particularly on real estate. These ideas come from Jorgensen (2002), Dacy and Hasanov (2011) and Gomes and Paz (2013). First, we use the China Household Finance Survey (CHFS) to estimate household asset portfolios by province. Asset portfolios are classified into three main categories: 1. real estate; 2. stocks and fund products; 3. deposits and banks' wealth investment

Figure 1. Chinese Yuan One-year Deposit Rates (Year-end values)

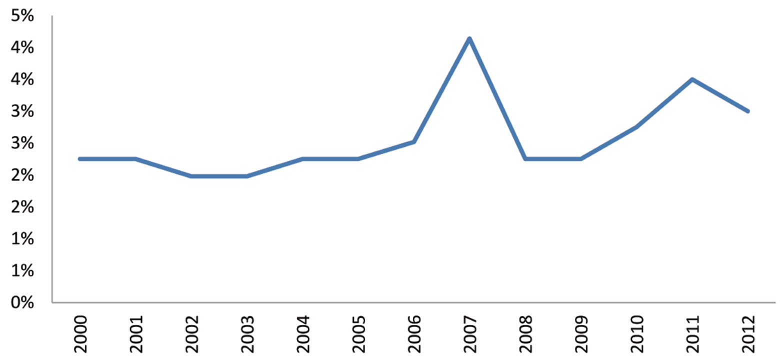
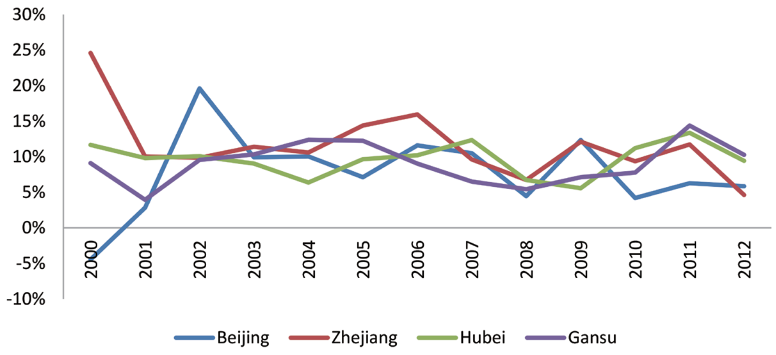


Figure 2. Δlog C in Selected Provinces



products.[3] Second, we calculate returns by category. Third, we compute synthetic returns at the provincial level.

To combat the problem of weak instruments, researchers typically use lags of the explanatory variables as instruments. Given strong state dependence or persistence in interest rates, the instruments (lagged interest rates) will be highly correlated with the endogenous explanatory variable (the interest rate) and, hence, strong instruments. However, when synthetic returns are used, the instruments are only mildly correlated with the endogenous explanatory variable, and this causes two-stage least squares (TSLS) estimation to be biased.[4] In this context, there is evidence that limited-information maximum likelihood (LIML) and the continuously updated generalized method of moments estimator (CUE-GMM) perform better than TSLS in the presence of weak instruments (Stock et al. 2002 and Hansen et al. 2002).

Despite a large literature on the EIS in developed countries, there is a paucity of literature on developing countries.[5] Using our methodology to estimate equation (1), we obtain significantly positive estimates of China's EIS, which turns out be larger than that of developed countries. This implies that asset returns strongly influence consumption in China.

The remainder of the paper is organized as follows. In Section 2, we describe the data and our methodology. In Section 3, we present and discuss the empirical results. Section 4 concludes the paper.

Ⅱ. Data and Methodology

Our main task is to compute synthetic returns at the provincial level. Synthetic returns are a weighted average of returns on the following three assets: 1. real estate; 2. stocks and fund products; 3. deposits and banks' wealth investment products.

A survey-based house price index for 70 large and medium-sized cities, published from 2000, covers all the provincial capitals and municipalities. To measure returns at the provincial level, we use annual returns on provincial capitals' real estate. To compute the annual return on stocks and fund products, we use the growth rate of the Shanghai Composite Index. For the return on deposits and banks' wealth investment products, we use Chinese yuan one-year deposit rates.[6] The latter two annual returns are consistent with their cross-section counterparts.

Using the CHFS data, we estimated the weight of each asset for each province. The CHFS was first carried out in 2011 and directed by the Survey and Research Center for China Household Finance at the Southwestern University of Finance and Economics. The CHFS contains plenty of household financial information. The data reveal that real estate as a proportion of total assets is at least 50% in most provinces. Because there is only one cross section, the weights have to be assumed constant through time.

Our final sample covers the 2000–2012 period and 22 provinces. The synthetic returns

Figure 3. Log(1+r) in Selected Provinces

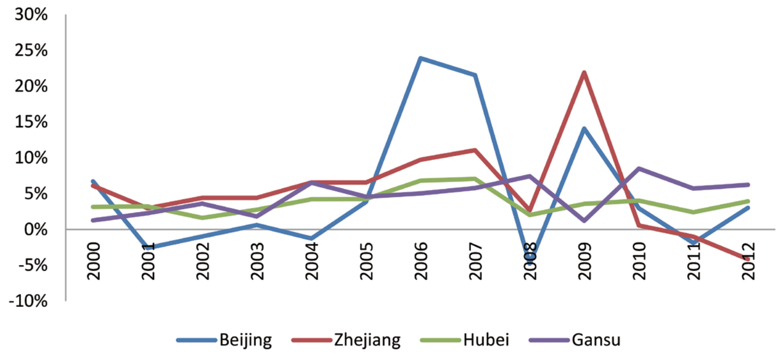


exhibit a high degree of heterogeneity at the provincial level. Returns vary significantly more in developed regions than in undeveloped regions (see Figure 3). For this reason, the real-estate returns vary dramatically in developed regions.

We use first-, second- and third-order lags of the explanatory variables as instruments. Before estimation, we perform two tests of the validity of the instruments. One is the Kleibergen–Paap (KP) test, which is an extreme test of weak instruments. The null hypothesis is that the model is under-identified; that is, that the instruments are not related to the endogenous explanatory variable. However, a rejection of the null hypothesis does not rule out the case of weak instruments. We also use the test of Stock and Yogo (2005), which is based on the F-statistic from the first stage of TSLS. Stock and Yogo (2005) also provide critical values specific to their four null hypotheses. An F-statistic below the relevant critical value implies weak instruments. If our instruments are weak, we propose to use LIML for the homoscedastic case (Stock et al. 2002) and CUE-GMM for the heteroscedastic case (Hansen et al. 2002).

Ⅲ. Results

Table 1 reports our estimated EIS from TSLS, LIML and CUE-GMM. The KP-statistic of 11.6 rejects the null hypothesis of under-identification at the 1% significance level. The first-stage F-statistic of 2.46 is well below the specific critical value provided by Stock and Yogo (2005). This constitutes evidence of weak instruments. Hence, the EIS estimates from LIML and CUE-GMM are valid, and slightly larger than the TSLS estimate. Moreover, for the heteroscedastic case, the estimated EIS is significantly different from zero at the 5% level. Hence, we are confident of a positive estimated EIS. In addition, the J-statistics do not reject the null hypothesis that the instruments are uncorrelated with the error term.

Ⅳ. Conclusion

Taking into account returns on various assets, in this paper, we computed synthetic returns at the provincial level for China. To deal with the problem of weak instruments, we used LIML and CUE-GMM for estimation, and obtained a significantly positive EIS. China's EIS exceeds those of developed countries. This implies that asset returns have a relatively strong effect on consumption in China. Furthermore, a significant and positive estimated EIS can be used for macro calibration and simulation.

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Notes

1) Considering the diversity in consumption habits, it could be argued that households should be divided into urban and rural households. However, logging and first differencing the data should eliminate much of this diversity.
2) To save space, we select representative provinces

Table 1. Estimates of the EIS

	Homoscedastic case		Heteroscedastic case
	TSLS	LIML	CUE-GMM
EIS	0.43*	0.50*	0.65**
	(0.26)	(0.30)	(0.27)
95% Confidence Interval	[−0.07, 0.93]	[−0.09, 1.1]	[0.11, 1.2]
J-statistic p-value	0.186	0.196	0.215

Notes: (1) All constant terms are statistically significant and positive, but not shown. (2) Standard errors, clustered on province, are in parentheses. (3) ** and * denote statistical significance at the 5% and 10% levels, respectively.

such as Beijing (municipality), Zhejiang (Eastern China), Hubei (Central China) and Gansu (Western China).

3) In the CHFS, respondents in rural areas also reported the market value of their self-built housing.

4) See Table 2 of Gomes and Paz (2013). They also found that Treasury-Bill returns can be predicted based on the instruments, whereas synthetic-mutual-fund returns are not easily predicted.

5) The latest reference, Yagihashi and Du (2015), investigated the relationship between risk aversion and EIS in China. They still used a gross nominal interest rate as an explanatory variable.

6) Returns on banks' wealth investment products vary with the deposit rate.

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