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Abstract

This paper empirically analyzes the relationship between regional deposits and demographic changes. Using different types of deposit data from Japan which has experienced a sharp increase in the number of retirees, we provide clear evidence that an increase in the dependency ratio is negatively correlated with overall deposits but positively with the most liquid deposits.

JEL classification: E1, F4

Keywords: Regional deposits, Demographic changes, Panel cointegration, Panel DOLS

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1. Introduction

Japan's population has been aging rapidly, and the proportion of the elderly (especially those aged 65 and over) reached 23.1% in 2010, the highest rate among advanced economies. With the potential significant effect of demographic changes on the economy, some studies have been conducted. For example, Horioka (2010) reported evidence of the dis-saving behaviors of retirees using Japanese survey data (the Family Income and Expenditure Survey) which allow one to identify the amount of retirees' savings. In this paper, we look into a similar issue but from a different angle; particularly, the relationship between the dependency ratio and the different types of aggregate savings (rather than retirees' savings alone) using a different data set and advanced statistical methods for nonstationary panel data.

2. The Statistical Model

Since deposits are part of 'money' by definition, our general specification is analogous to that used to analyze the demand for regional money (Mulligan and Sala-i-Martin 1992), but is constructed for nonstationary variables.[1]

$$\begin{aligned} m_{it} &= \alpha_i + \lambda_i t + \phi_t + \beta X_{it} + u_{it} \qquad (1) \\ \Delta X_{it} &= v_{it} \end{aligned}$$

where subscripts i ($i = 1, \ldots, 47$) and t ($t = 1975, \ldots, 2007$) represent prefecture and time. The m is a vector of real regional deposits and X is a vector of explanatory variables. Following the standard money demand theory, X includes real income (y) and the interest rate (i), and m is expected to be a positive (negative) function of y (i). The relationship between m and y should also reflect the recent discussion of weak (negative) economic growth contributing to the dis-saving practices. In addition, the dependency ratio ($demog$) is included in X and is expected to be negatively associated with deposits when there is a strong tendency of dis-saving behaviors. Finally, this equation is very comprehensive and includes fixed effects (α_i), a time dummy (ϕ_t) and a time trend (t), and the vector of errors w_{it} ($w_{it} = (u_{it}, v'_{it})$ and $E[w_{it}, w_{jt-k}] = 0$ where $i \neq j$) is assumed to follow the functional central limit theorem.

[1] While not reported here, our data are found to be nonstationary using the panel ADF unit root test.

3. Data

Our data set comprises regional deposits, regional income, interest rates and a dependency ratio for 47 prefectures from 1975 to 2007. Unlike previous studies, our data on deposits and income are region-specific, and deposits in the Japanese private banks have several categories; Demand, Time & Savings, and Total Deposits.[2] In addition, we use deposits in the *Yucho Bank* (Japan Post Bank Company) which was privatized in 2007 and has been the largest financial institution in terms of deposit amounts. These deposits are referred to as Post Office Deposits, and the sum of Total and Post Office Deposits as All Deposits here.

The data have been collected from several sources. Deposits in private banks are obtained from the Bank of Japan, and those of the *Yucho Bank* from the Kinyu Koho Chuo Committee (Central Council for Financial Services Information). Regional income data are obtained from the Japan Cabinet Office. Both deposit and income data are expressed in terms of per capita and real terms using the population and the Consumer Price Index by region respectively, both of which are from the Ministry of Internal Affairs and Communications (MIAC).

In addition, we use two types of interest rates; the money market rate and government yield (10 year maturity), collected from the International Financial Statistics of the International Monetary Fund. A different type of interest rate is used to check the robustness of our findings since the nominal short-term rate has stayed around zero percent since 1995.

Finally, the dependency ratio is calculated using population and labor force. Our definition of the labor force is the number of the employed aged 14 years old or older, and thus that of the dependent population is obtained by subtracting the number of the employed from the population. The labor force data are from the MIAC. Due to the absence of regional specific data, the interest rates and the dependency ratio are at the country level, and thus are expected to capture part of the common trends across prefectures.

4. Results

Prior to analyzing the impact of demographic changes on deposits, we study whether a long-run relationship exists in our model using a panel cointegration method. For this purpose, we employ a panel approach based on Johansen's multivariate cointegration test (1991) applied to deposit (money) equations for individual

[2] Total Deposits consist of Demand, Time & Savings, Public, and Financial Institutions' Deposits.

prefectures. A panel test statistic combined from individual Johansen tests can be constructed as per Fisher (1932):

$$-2\sum_{i=1}^{N}\ln(p_i) \sim \chi^2(2N)$$

where N is the number of prefectures. The p is the p-value obtained from the Johansen test applied to each region, and is calculated on the basis of MacKinnon, Haug and Michelis (1999). This statistic is shown to be distributed as Chi squared.

Our results in Table 1 often show the absence of cointegration in the standard deposit specification with income and the interest rate. A cointegrated relationship generally exists when the dependency ratio is included.

Furthermore, the deposit function is estimated using the panel Dynamic OLS (DOLS) approach (Nelson and Sul, 2003). This approach is flexible to accommodate different types of heterogeneity among regions (as shown in equation (1)), and their Monte Carlo experiments show that cointegration vector estimators from the panel data are more precise than those from the single equation DOLS.

We focus on the deposit function, which is cointegrated and consists of income, the interest rate, and the dependency ratio. Table 2 shows that income and the dependency ratio are often significant. As expected, income elasticity is positive and ranges from zero to 0.5 (Table 2), and this result remains unchanged even when different deposits are employed. The dependency ratio is negatively associated with many types of deposits, especially with less liquid ones such as Time & Savings Deposits. Post Office Deposits which are not classified in terms of liquidity are also negatively associated with the dependency ratio with a similar magnitude to that of Total Deposits. This implies that an increase in the proportion of retirees was associated with a reduction in savings in general since the birth rate has stayed low (at less than 2.0 since 1975) from 1975 onwards (1.3 in 2008). However, interestingly the dependency ratio is positively associated with Demand Deposits–the most liquid of this kind–although this positive effect is offset by a negative effect in other types of deposits. This implies that people have shifted part of their money from Time & Savings Accounts to Demand Deposits.

5. Conclusion

This paper examines whether demographic factors affect consumers' holding liquid and safe assets. We showed that an increased dependency ratio tends to decrease total deposits. This finding has international implications since persistent Japanese current account surpluses have often been argued as resulting from domestic surpluses (i.e., high savings). If this aging trend continues, Japanese current account surpluses will likely decline. Furthermore because the aging phenomenon is shared by a number of countries including China, Singapore and South Korea, changes in current account behaviors in Japan may well herald a similar phenomenon in many other countries.

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Table 1. Fisher Panel Cointegration Test Based on the Johansen Method

Variables	Test type	None	At most 1	At most 2	At most 3
DemandD, Income, Call	Trace	95.32	66.89	71.08	--
	Max-eigen	64.42	46.64	71.08	--
DemandD, Income, Govt	Trace	69.36	55.78	66.43	--
	Max-eigen	44.69	37.65	66.43	--
DemandD, Income, Call, Demog	Trace	213.4**	125.0*	129.5**	74.4
	Max-eigen	124.5*	43.27	115.2	74.4
DemandD, Income, Govt, Demog	Trace	122.6*	80.65	81.25	88.78
	Max-eigen	69.05	35.63	50.49	88.78
TimeSavingD, Income, Call	Trace	287.0**	117.6	35.36	--
	Max-eigen	238.2**	142.0**	35.36	--
TimeSavingD, Income, Govt	Trace	219.3**	44.72	38.09	--
	Max-eigen	271.5**	43.85	38.09	--
TimeSavingD, Income, Call, Demog	Trace	805.3**	489.5**	304.7**	31.3
	Max-eigen	369.5**	254.5**	384.4**	31.3
TimeSavingD, Income, Govt, Demog	Trace	513.1**	333.6**	167.3**	17.99
	Max-eigen	224.8**	230.6**	234.8**	17.99
TotalD, Income, Call	Trace	89.43	89.35	36.57	--
	Max-eigen	38.3	103.6	36.57	--
TotalD, Income, Govt	Trace	45.12	58.96	28.04	--
	Max-eigen	16.9	72.16	28.04	--
TotalD, Income, Call, Demog	Trace	176.0**	65.59	32.16	30.23
	Max-eigen	166.8**	68.74	33.53	30.23
TotalD, Income, Govt, Demog	Trace	91.06	42.43	20.27	16.93
	Max-eigen	82.48	52.12	27.14	16.93
Post OfficeD, Income, Call	Trace	369.0**	133.0**	98.81	--
	Max-eigen	317.6**	98.41	98.81	--
Post OfficeD, Income, Govt	Trace	404.9**	125.4*	114.2	--
	Max-eigen	373.2**	78.77	114.2	--
Post OfficeD, Income, Demog	Trace	330.05**	128.4*	67.67	--
	Max-eigen	276.7**	120.3*	67.67	--
Post OfficeD, Income, Govt, Demog	Trace	666.0**	267.2**	99.73	51.01
	Max-eigen	485.6**	238.7**	101.6	51.01
AllD, Income, Call	Trace	118.5*	75.51	20.61	--
	Max-eigen	83.14	104.7	20.61	--
AllD, Income, Govt	Trace	106.2	84.59	29.99	--
	Max-eigen	59.54	104.9	29.99	--
AllD, Income, Call, Demog	Trace	590.7**	468.7**	257.0**	80.5
	Max-eigen	172.6**	281.9**	258.9**	80.5
AllD, Income, Govt, Demog	Trace	501.0**	239.7**	124.2*	40.46
	Max-eigen	323.5**	171.9**	144.3**	40.46

Notes: Full sample. "D" stands for deposits, e.g., DemandD means demand deposits. AllD is the sum of TotalID and Post OfficdD. P-values to evaluate the hypothesis for the Johansen test are based on MacKinnon, Haug and Michelis (1999), and those values are used to construct Fisher type statistics which follow the Chi-square distribution. The constant and time trend are included in the cointegrating vector for the Johansen test. Asterisks ** and * indicate statistics significant at the one and five percent significance levels respectively. The maximum lag length is two. The deposit equation for Post OfficeD with Demog does not include the call rate since no evidence of cointegration is reported.

Table 2. Cointegration Vector Estimation by Panel DOLS for Regional Money

	[A]	[B]
Demand Deposits		
Income	0.049 [0.146]	0.144 [0.142]
Call	-0.025 [0.013]+	--
Govt	--	0.014 [0.014]
Demog	0.054 [0.012]**	0.053 [0.011]**
Time & Savings Deposits		
Income	0.462 [0.133]**	0.421 [0.136]**
Call	0.002 [0.013]	--
Govt	--	-0.024 [0.013]
Demog	-0.157 [0.010]**	-0.149 [0.010]**
Total Deposits		
Income	0.392 [0.120]**	0.432 [0.116]**
Call	-0.001 [0.015]	--
Govt	--	0.004 [0.018]
Demog	-0.098 [0.009]**	-0.096 [0.009]**
Post Office		
Income	0.416 [0.089]**	0.369 [0.088]**
Call	--	--
Govt	--	-0.039 [0.009]**
Demog	-0.084 [0.008]**	-0.083 [0.008]**
All Deposits		
Income	0.369 [0.080]**	0.364 [0.080]**
Call	0.004 [0.009]	--
Govt	--	-0.018 [0.010]
Demog	-0.097 [0.006]**	-0.090 [0.006]**
Heterogeneous time trend	Yes	Yes
Common time effect	Yes	Yes

Notes: Full sample. The regional money equation is estimated by the Nelson and Sul method (2003). Asterisks ** and + indicate statistic significance at the one and ten percent significance levels respectively. The panel DOLS utilizes the first order lead and lag variables.