Time-Series Evidence on the Impact of the Age Structure of the Population on the Household Saving Rate in Korea and India

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I. INTRODUCTION

Introduction (1)

High saving rates, relative stagnant domestic investment in emerging Asia

↓

Large capital outflows (current account surpluses) in emerging Asia

Introduction (2)

Rapid population aging in emerging Asia

↓

Sharp decline in saving rates in emerging Asia?

Not necessarily. Large differences among the economies of emerging Asia in demographic trends

↓

Saving rates will not necessarily decline any time soon in emerging Asia as a whole

The Purpose of This Presentation

(1) To present long-term times series data on household saving rates in Korea and India

(2) To analyze the determinants of household saving rates in Korea and India with emphasis on the impact of the age structure of the population

(3) To project future trends in household saving rates in Korea and India based on our estimation results

Reasons for Focusing on Korea and India

Because these economies are very different in terms of:

(1) Their stage of economic development

(2) The timing of population aging

(3) Trends in their household saving rates

Contributions of This Paper

(1) Utilizes long-term time series data for individual economies rather than cross-country panel data

(2) Focuses on the household saving rate rate, which is the dominant component of national saving in most economies and which one would expect to be the component of national saving that is the most sensitive to the age structure of the population

(3) Focuses on economies in emerging Asia

II. PREVIOUS LITERATURE

Analysis of the Determinants of Household Saving Rates in Japan using Long-term Times Series Data

Horioka, Charles Yuji (1997), "A Cointegration Analysis of the Impact of the Age Structure of the Population on the Household Saving Rate in Japan" *Review of Economics and Statistics*, vol. 79, no. 3 (August 1997), pp. 511-516.

Horioka (1997)

Horioka applies cointegration techniques to time-series data on Japan for the 1955–1993 period and finds that the age structure of the population strongly affects the household saving rate. In particular, Horioka finds that there is a cointegrating relationship among the household saving rate, the ratio of minors to the working-age population, and the ratio of the aged to the working-age population and that both demographic variables have a negative and significant impact on the household saving rate.

Horioka (1997)(cont'd)

Horioka then estimates an error-correction model (ECM) to determine the short-run dynamics of the system and finds that the coefficient of the error-correction term is negative and statistically significant in the household saving rate equation, meaning not only that the ECM is valid but also that there is a significant conservative force tending to bring the model back into equilibrium whenever it strays too far.

Analysis of the Determinants of Domestic Saving Rates in Emerging Asia using Cross-country Panel Data

Horioka, Charles Yuji, and Terada-Hagiwara, Akiko (2012), "The Determinants and Long-term Projections of Saving Rates in Developing Asia," *Japan and the World Economy*, vol. 24, no. 2 (March), pp. 128-137.

Horioka and Terada-Hagiwara (2012)

HTH present data on trends over time in domestic saving rates in twelve economies in emerging Asia during the 1966-2007 period and use these data to analyze the determinants of those trends and to project trends in domestic saving rates in these same economies during the next twenty years (2011-2030 period) based on their estimation results.

Horioka and Terada-Hagiwara (2012) (cont'd)

HTH find that domestic saving rates in developing Asia have, in general, been high and rising but that there have been substantial differences from economy to economy, that the main determinants of the domestic saving rate in developing Asia during the 1960-2007 period appear to have been the age structure of the population (especially the aged dependency ratio), income levels, and the level of financial sector development, that the direction (cont'd)

Horioka and Terada-Hagiwara (2012) (cont'd)

of impact of each factor has been more or less as expected, and that the impacts of income levels and the level of financial sector development are nonlinear (convex and concave, respectively).

HTH also find that the domestic saving rate in emerging Asia as a whole will remain roughly constant during the next two decades because the negative impact of population aging thereon will be roughly offset by the positive impact of higher income levels thereon but that (cont'd)

Horioka and Terada-Hagiwara (2012) (cont'd)

there will be substantial variation from economy to economy, with the rapidly aging economies showing a sharp downturn in their domestic saving rates by 2030 because the negative impact of population aging thereon will dominate the positive impact of higher income levels thereon and the less rapidly aging economies showing rising domestic saving rates, at least until 2020, because the positive impact of higher income levels thereon(cont'd)

Horioka and Terada-Hagiwara (2012) (cont'd)

will dominate the negative impact of population aging thereon.

ATH conclude that dramatic rebalancing will not occur in emerging Asia as a whole, that the "saving glut" in emerging Asia will not be eliminated at least for the next two decades, and that policies to stimulate investment and/or to moderate saving may be warranted in developing Asia in the short to medium run.

III. ESTIMATION MODEL

Estimation Model (1)

HHSR(t) = a0 + a1*DEP(t) + a2*AGE(t) + a3*GRINC(t)
+ a4*RRATE(t) + e(t), where

HHSR = the household saving rate (defined as the ratio of net household saving to the net national disposable income of households)

DEP = the youth dependency ratio, defined as the ratio of the population aged 0 to 19 to the population aged 20-64

AGE = the aged dependency ratio, defined as the ratio of the population aged 65 and older to the population aged 20-64

Estimation Model (2)

GRINC = the growth rate of real GDP

RRATE = the real interest rate

e = error term

IV. DATA SOURCES

Data Sources (1)

- The data on both the net saving and net disposable income of Korean households and non-profit institutions serving households were taken from OECD (available at http://stats.oecd.org/).
- The data for India were taken from CEIC. The net household saving rate was calculated as the ratio of net household saving to net household disposable income.

Data Sources (2)

- The price data needed to calculate GRINC: Data on the Consumer Price Index (CPI) were taken from the *International Financial Statistics* of the International Monetary Fund for Korea, and data on the Wholesale Price Index (WPI) were taken from Haver Analytics for India.
- The data on DEP (the youth dependency ratio) and AGE (the aged dependency ratio) were calculated from the population data in the United Nations Population Statistics (available at http://esa.un.org/unpd/wpp/index.htm).

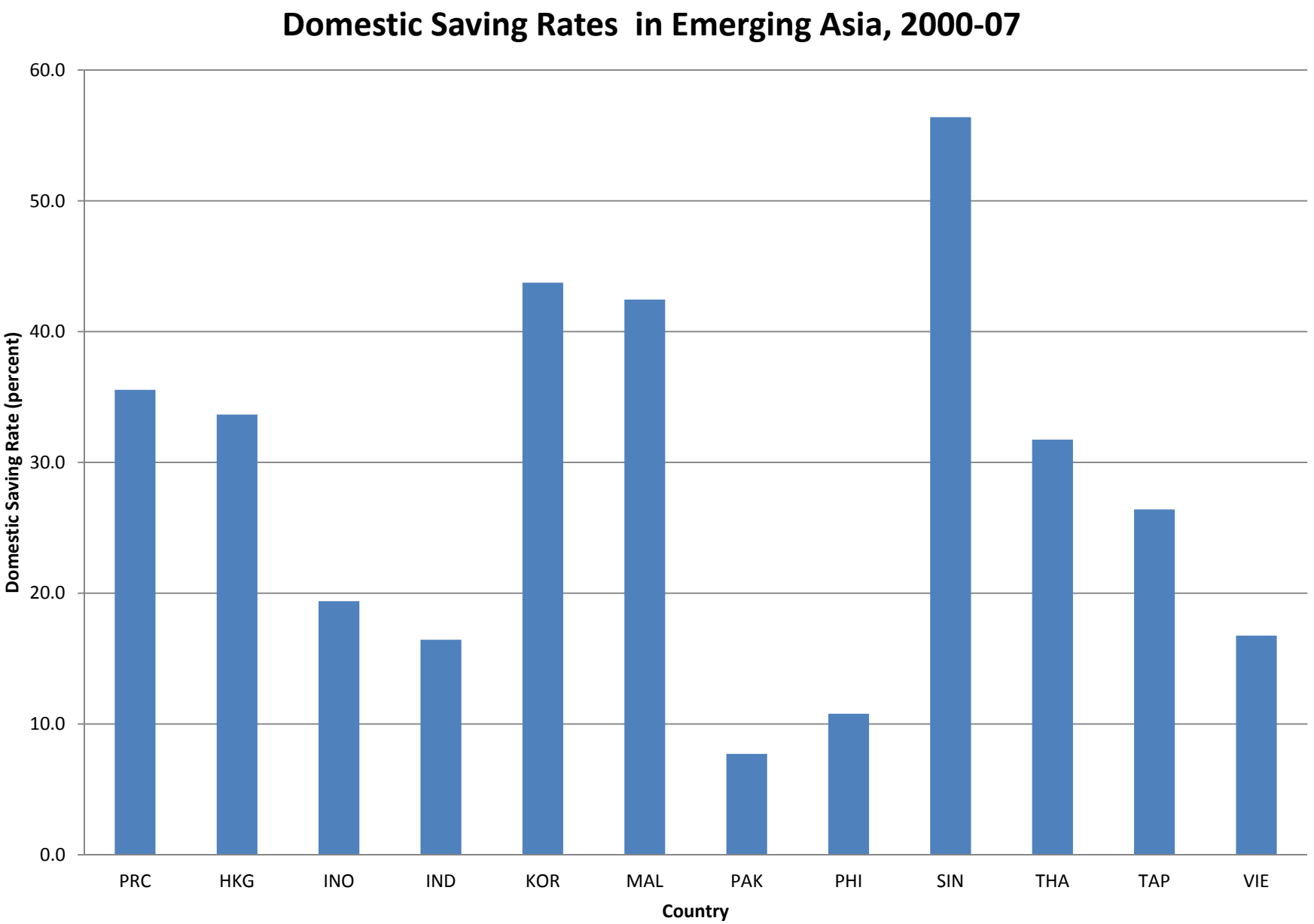
Data Sources (3)

- The data on RRATE for both Korea and India were taken from *World Development Indicators (WDI)* of the World Bank (available at http://devdata.worldbank.org/dataonline/).

Data on deposit rates were used for Korea, and data on lending rates were used for India because data on deposit rates were not available.

V. DATA ON HOUSEHOLD SAVING RATES IN KOREA AND INDIA

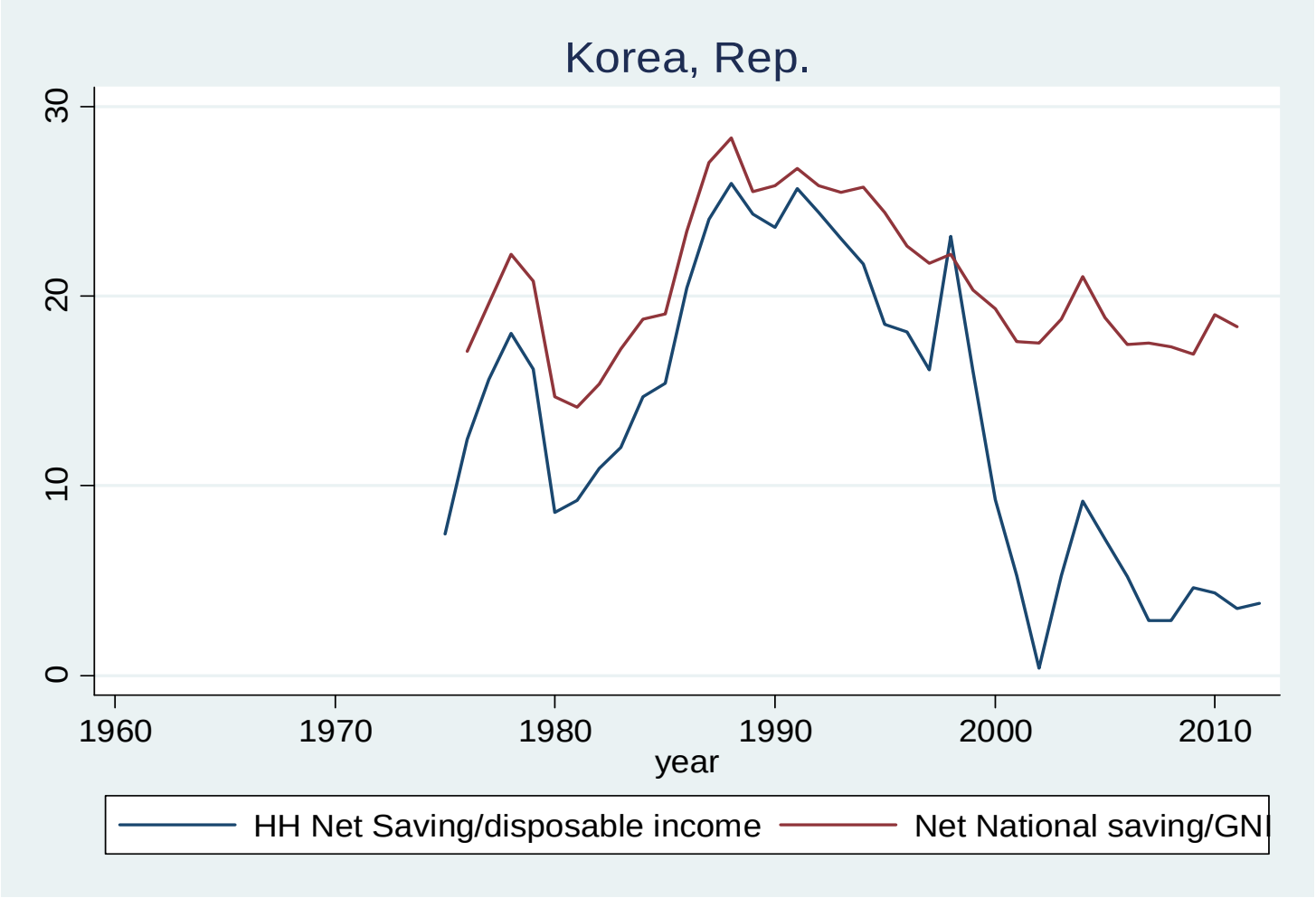

Hong Kong, China
India
Indonesia
Korea, Rep. of
Malaysia
China, People's Rep. of
Pakistan
Philippines
Singapore
Taipei,China
Thailand
Viet Nam
Average Domestic Saving Rate
0
20
40
60
70 75 80 85 90 95 00 07
Nominal measure
Real measure
Graphs by ctry


Domestic Saving Rates in Emerging Asia, 2000-07
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Domestic Saving Rate (percent)
PRC
HKG
INO
IND
KOR
MAL
PAK
PHI
SIN
THA
TAP
VIE
Country

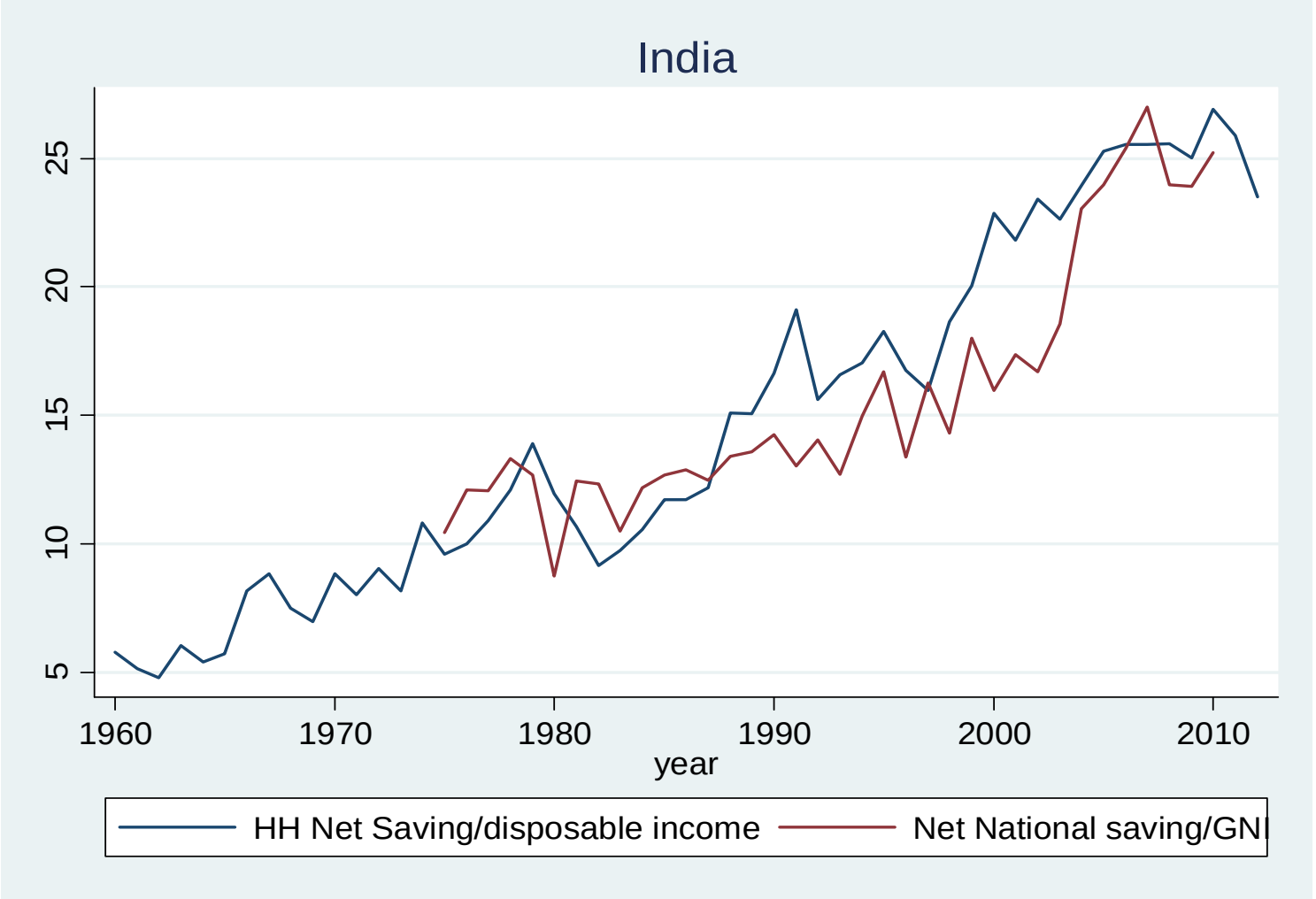
Trends in Household Saving Rates

- Korea: Volatile, peaking at 26.0% in 1988, troughing at 0.4% in 2002, and recovering somewhat thereafter.
- India: Showed a long-term upward trend over time, increasing from 5 percent in the early 1960s to almost 27 percent in 2010 before declining slightly thereafter

Trends in Household Saving Rates (Korea)



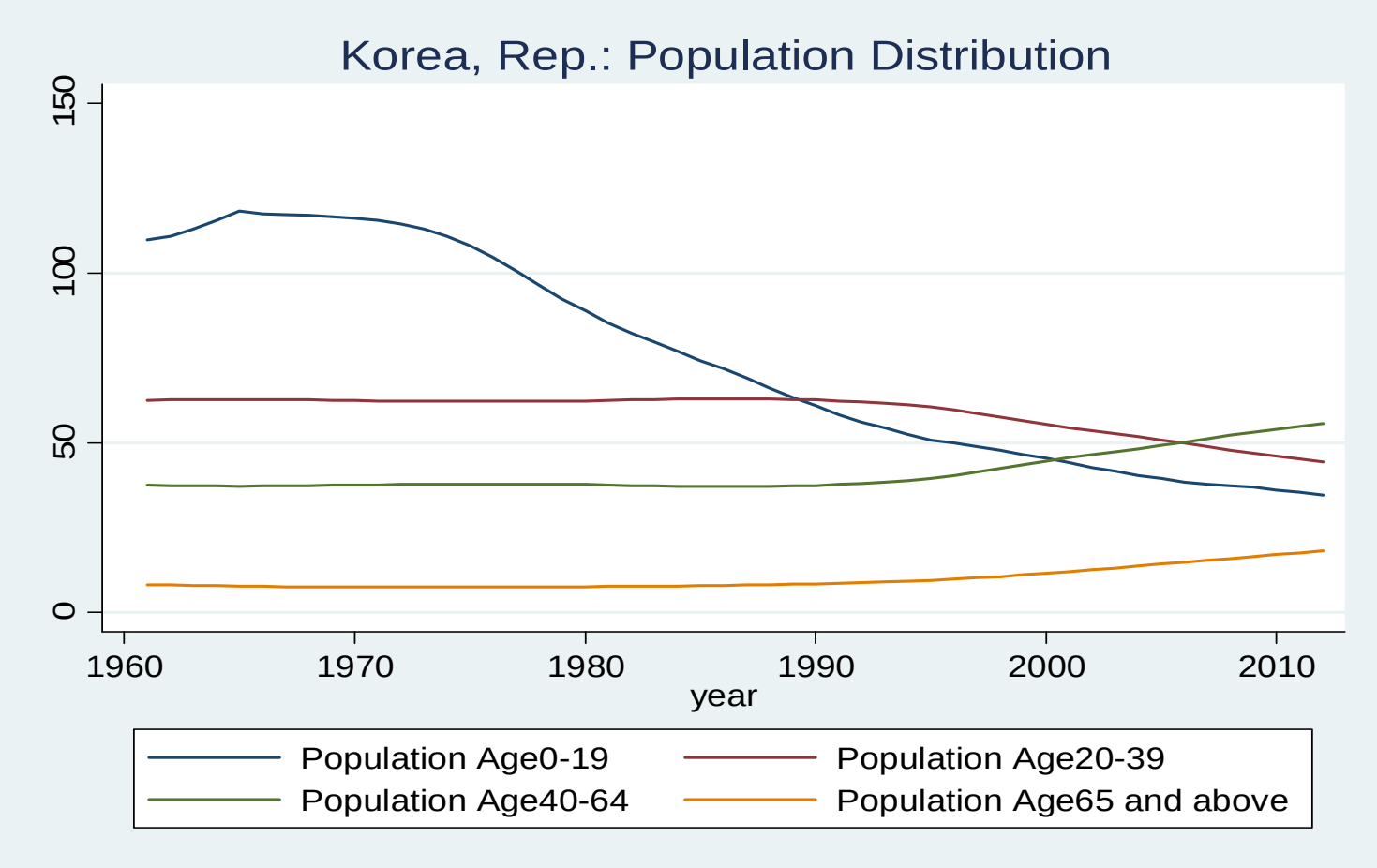
Trends in Household Saving Rates (India)



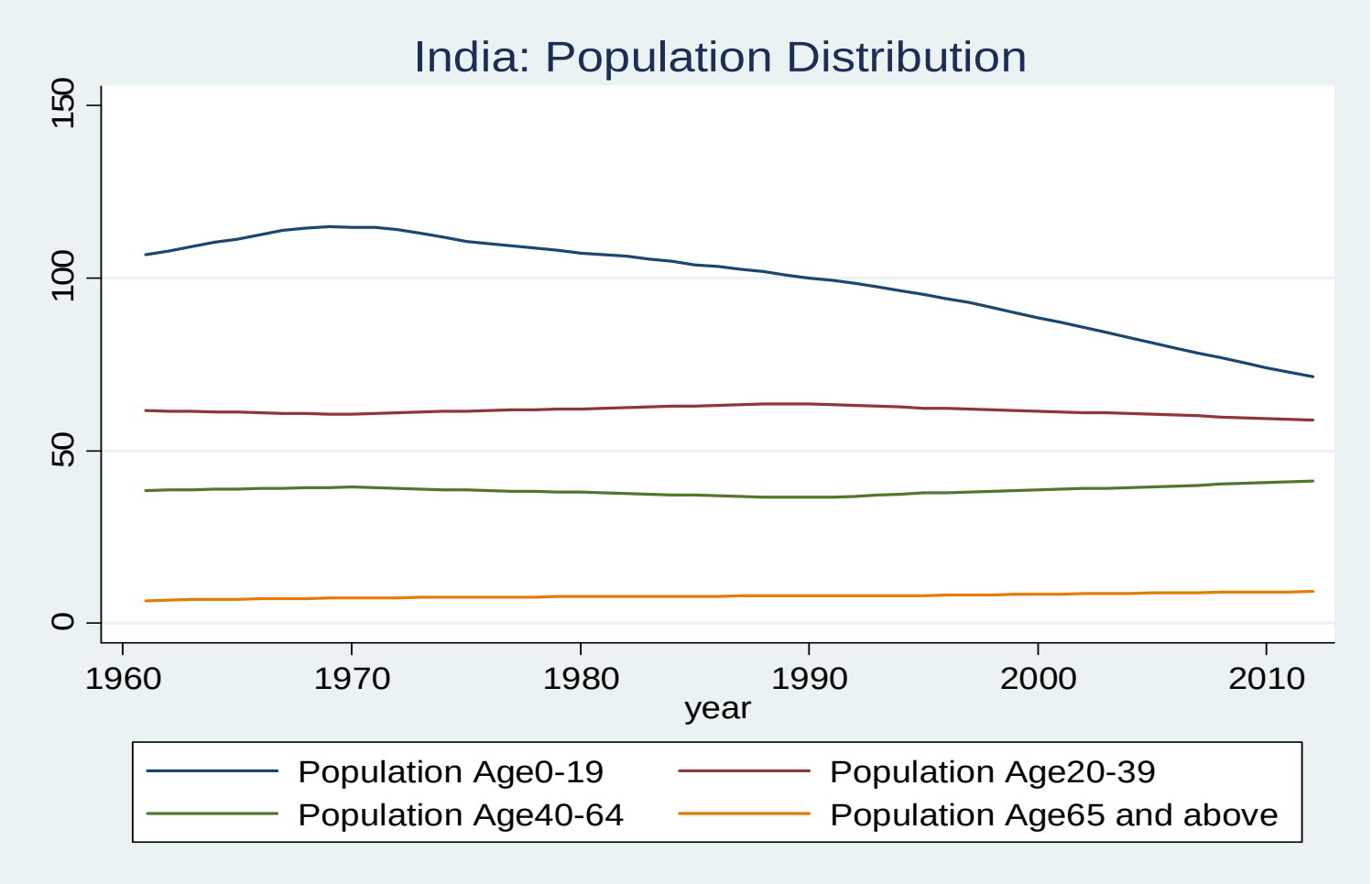
Trends in the Age Structure of the Population

- Korea: DEP declining sharply due to sharp declines in fertility; AGE increasing sharply due to sharp increases in longevity.
- India: DEP declining only moderately due to high fertility; AGE increasing only moderately due to moderate increases in longevity.
- Faster downturn in the household saving rate in Korea can be explained by the faster increase in AGE.

Trends in the Age Structure of the Population (Korea)



Trends in the Age Structure of the Population (India)



VI. ESTIMATION RESULTS CONCERNING THE DETERMINANTS OF HOUSEHOLD SAVING RATES IN KOREA AND INDIA

Time Series Properties of the Data

(Korea)

HHSR is I(1)

AGE and DEP are I(0) or I(1), or I(2)

GROWTH and RRATE are stationary

(India)

HHSR is I(1)

AGE and DEP are I(0), I(1), or I(2)

GROWTH and RRATE are stationary

Time Series Properties of the Data (Korea)

KOREA			
Results of Unit-Root Tests			
Variable	Type of Test	Without Time Trend	With Time Trend
HHSR	DF	−1.145	−2.061
	ADF(1)	−1.396	−2.013
	ADF(2)	−1.146	−1.728
D_HHSR	DF	−4.811***	−4.793***
	ADF(1)	−4.196***	−4.182**
	ADF(2)	−4.061***	−4.057**
DEP	DF	0.482	−1.956
	ADF(1)	−1.564	−2.749
	ADF(2)	−2.051	−2.132
S_DEP	DF	−1.944	−1.771
	ADF(1)	−2.555	−2.368
	ADF(2)	−3.128**	−3.155
AGE	DF	13.141***	4.043**
	ADF(1)	−0.265	−0.134
	ADF(2)	−0.446	−0.158
D_AGE	DF	−0.346	−2.607
	ADF(1)	−0.404	−2.268
	ADF(2)	−0.362	−1.633
RRATE	DF	−4.073***	−4.036**
	ADF(1)	−3.857***	−3.848**
	ADF(2)	−3.819***	−3.877**
GRINC	DF	−3.311**	−3.889**
	ADF(1)	−3.128**	−3.875**
	ADF(2)	−3.043**	−3.391*

Time Series Properties of the Data (India)

INDIA			
Results of Unit-Root Tests			
Variable	Type of Test	Without Time Trend	With Time Trend
HHSR	DF	−0.755	−3.168
	ADF(1)	−0.700	−2.719
	ADF(2)	−0.694	−2.482
D_HHSR	DF	−8.148***	−8.041***
	ADF(1)	−5.581***	−5.464***
	ADF(2)	−4.789***	−4.702***
DEP	DF	6.047***	−7.234***
	ADF(1)	−0.080	−2.810
	ADF(2)	0.278	−2.337
S_DEP	DF	−2.207	−1.872
	ADF(1)	−2.574	−2.256
	ADF(2)	−2.511	−2.278
AGE	DF	−0.606	−1.633
	ADF(1)	0.297	−1.198
	ADF(2)	0.628	−0.680
D_AGE	DF	−5.086***	−4.997***
	ADF(1)	−5.002***	−4.930***
	ADF(2)	−4.014***	−4.010**
RRATE	DF	−4.803***	−4.757***
	ADF(1)	−5.377***	−5.311***
	ADF(2)	−3.600**	−3.556**
GRINC	DF	−7.943***	−8.362***
	ADF(1)	−5.945***	−6.560***
	ADF(2)	−4.354***	−4.909***

Cointegration Tests

(Korea)

Dickey-Fuller: No cointegration

Augmented Dickey-Fuller: Cointegration

Johansen: Cointegration

(India)

Dickey-Fuller: Cointegration

Augmented Dickey-Fuller: No cointegration

Johansen: Cointegration

Cointegration Tests (Korea)

KOREA				
Results of Engel Granger Tests for Cointegration				
Dependent variable: Household net saving / Household disposable income				
Variable	Type of Test	Time Period	Number of Observations	Statistics
RRPOP019 & RRPOP65ab	ADF	1976-2012	36	-2.165
	ADF(1)	1977-2012	35	-2.888*
	ADF(2)	1978-2012	34	-2.686*
RRPOP019, RRPOP65ab, and GRINC	ADF	1976-2012	36	-2.535
	ADF(1)	1977-2012	35	-2.831*
	ADF(2)	1978-2012	34	-2.485
RRPOP019, RRPOP65ab, GRINC, and RRATE	ADF	1976-2012	36	-2.485
	ADF(1)	1977-2012	35	-2.841*
	ADF(2)	1978-2012	34	-2.776*

Cointegration Tests (India)

INDIA				
Results of Engel Granger Tests for Cointegration				
Dependent variable: Household net saving / Household disposable income				
Variable	Type of Test	Time Period	Number of Observations	Statistics
RRPOP019 & RRPOP65ab	ADF	1962-2012	50	-3.003**
	ADF(1)	1963-2012	49	-2.759*
	ADF(2)	1964-2012	48	-2.583
RRPOP019, RRPOP65ab, and GRINC	ADF	1962-2012	50	-3.027**
	ADF(1)	1963-2012	49	-2.558
	ADF(2)	1964-2012	48	-2.556
RRPOP019, RRPOP65ab, GRINC, and RRATE	ADF	1962-2012	50	-3.475**
	ADF(1)	1963-2012	49	-2.541
	ADF(2)	1964-2012	48	-2.349

Cointegrating Vector

(Korea)

- OLS, Johansen: Coefficients of DEP and AGE negative and significant, as expected; coefficient of AGE larger in absolute magnitude than coefficient of DEP

(India)

- OLS, Johansen: Coefficients of DEP and AGE negative and significant, as expected; coefficient of AGE larger in absolute magnitude than coefficient of DEP; coefficients of both DEP and AGE much larger in absolute magnitude than in the case of Korea.

Cointegrating Vector (Korea)

Table: Estimates of Cointegrating Vector (Korea)												
Model	Constant		DEP		AGE		GRINC		RRATE			No. of Obs.
Ordinary Least Squares												
1	61.028	***	−0.264	***	−2.971	***					0.654	38
	7.512		0.061		0.393						0.635	
2	56.772	***	−0.281	***	−2.708	***	0.391	**			0.709	37
	7.520		0.064		0.389		0.156				0.682	
3	55.002	***	−0.263	***	−2.644	***	0.343	*	0.131		0.710	37
	8.621		0.076		0.420		0.192		0.299		0.674	
Maximum Likelihood												
1	113.408		−1.085	***	−2.340	***						36
			0.161		0.794							
2	184.920		−1.864	***	−3.575	**	−2.846	***				35
			0.444		1.759		0.612					
3	179.091		−1.854	***	−2.808	*	−2.090	***	−0.644			35
			0.355		1.550		0.646		0.880			

Cointegrating Vector (India)

Ordinary Least Squares												
1	287.940	***	−1.231	***	−18.882	***					0.932	38
	72.763		0.248		6.045						0.928	
2	245.279	***	−1.097	***	−15.148	**	−0.023				0.942	36
	71.436		0.241		5.966		0.026				0.937	
3	242.206		−1.083	***	−14.924	**	−0.016		−0.094		0.946	36
	70.112		0.236		5.855		0.026		0.062		0.939	
Maximum Likelihood												
1	2376.603		−8.625	***	−187.231	***						36
			1.704		38.278							
2	4256.599		−15.273	***	−331.725	***	−1.576	***				34
			3.340		72.383		0.357					
3	453.239		−2.063	**	−30.985		−0.291	***	−1.797	***		31
			0.946		20.059		0.107		0.451			

Error Correction Model

(Korea)

- Coefficients of demographic variables are insignificant
- Coefficient of error correction term is negative, as expected, but insignificant

(India)

- Coefficients of demographic variables are insignificant except in the variant with the growth rate and the real interest rate
- Coefficient of error correction term is negative and marginally significant in the baseline model but positive and significant in the other two models

Error Correction Model (Korea)

KOREA			
ESTIMATION RESULTS OF THE ERROR-CORRECTION MODEL			
	Dependent Variable		
Explanatory Variable	D_SR	D_SR	D_SR
Constant	0.3146833	2.942565	1.660482
	4.81247	4.709014	4.796664
	0.07	0.62	0.35
Z(-1)	-.1379595	-0.0030455	-0.0242623
	.1123939	0.0466735	0.0515436
	-1.23	-0.07	-0.47
D_SR(-1)	.3143705*	-0.0030455	0.1615812
	.1894662	0.0466735	0.2025214
	1.66	-0.07	0.80
D_AGE(-1)	-10.49291	-5.878152	-6.420083
	7.742441	7.528772	7.83754
	-1.36	-0.78	-0.82
D_DEP(-1)	-.5164403	0.7778258	.1998179
	1.65362	1.648926	1.666918
	-0.31	0.47	0.12
D_GRINC(-1)		0.786421	.0191122
		.1249964	.1351048
		0.63	0.14
D_RRATE(-1)			.2917068
			.26444
			1.10
Error correction terms	Z=SR + 1.085006 * DEP + 2.340217*AGE-113.4076	Z=SR + 1.86446 * DEP + 3.574872*AGE+2.846357 * GRINC-184.9201	Z=SR + 1.854008 * DEP + 2.808306*AGE + 2.090094 * GRINC + 0.644261 * RRATE-179.0914
Number of obs	36	35	35
R-sq	0.1235	0.0843	0.1242
RMSE	3.36163	3.50806	3.49163
Diagnostic Tests			
LM test for autocorrelation: chi2 (2)	6.7908	23.4587	25.9086
Jarque-Bera Normality test: chi2	3.882	21.355	12.114

Error Correction Model (India)

INDIA			
ESTIMATION RESULTS OF THE ERROR-CORRECTION MODEL			
	Dependent Variable		
Explanatory Variable	D_SR	D_SR	D_SR
Constant	.0695568	.652842	-.2538532
	.591253	.4643773	.8020129
	0.12	1.41	-.44
Z(-1)	-.0470485	.0544832*	.218201**
	.0288494	.0312305	.0905532
	-1.63	1.74	2.41
D_SR(-1)	-.2221959	-.2306812	-.5205004
	.1486658	.1581127	.2285829
	-1.49	-1.46	-2.28
D_AGE(-1)	-6.575288	-.1013344	-16.98127
	6.079444	6.417223	9.22115
	-1.08	-.02	-1.84
D_DEP(-1)	-.547444	-.0630735	-2.066175
	.4272261	.266341	.8287845
	-1.28	-.24	-2.61
D_GRINC(-1)		-.0480506	-.0422498
		.0382369	.0551396
		-1.26	-.77
D_RRATE(-1)			-.0747314
			.101958
			-.73
Error correction terms	Z=SR + 2.52644 * DEP + 52.81833*AGE-690.164	Z=SR + 0.9726379 * DEP+2.934744*AGE+1.824857 * GRINC-147.9735	Z=SR + 1.15764 * DEP + 13.05947*AGE +.8632016 * GRINC +.5956766 * RRATE-245.162
Number of obs	50	50	32
R-sq	0.1558	0.1638	0.3851
RMSE	1.44553	1.45495	1.35883
Diagnostic Tests			
LM test for autocorrelation: chi2 (2)	12.8223	22.0383	17.8246
Jarque-Bera Normality test: chi2	10.307	16.872**	13.624

Summary of Estimation Results

(1) There is a long-run equilibrium relationship between the household saving rate and the age structure of the population

(2) The age structure of the population does not have a short-run impact on the household savign rate, except possibly in India

(3) There is some evidence of a tendency of the household saving rate to return in equilibrium in both economies

VII. FUTURE TRENDS IN HOUSEHOLD SAVING RATES IN KOREA AND INDIA

Future Demographic Trends

The United Nations projects that there will be enormous variations in the timing of population aging in the economies of emerging Asia, with the proportion of the aged in the total population reaching 14% in 2015-20 in Korea but not until 2050-55 in India.

Future Demographic Trends

Table 3: Population Aging in Developing Asia	
Economy	The Period during which the Population Aged 65 and Older Reaches 14 Percent the Total Population
PRC	2020-25
Hong Kong, China	2010-15
Indonesia	2040-45
India	2050-55
Korea, Rep. of	2015-20
Malaysia	2040-45
Pakistan	After 2055
Philippines	2050-55
Singapore	2015-20
Thailand	2020-25
Taipei,China	2015-20
Viet Nam	2030-35
Japan	1990-95
Data Source: The United Nations' (U.N.) projections available at http://esa.un.org/unpp, and the Statistical Yearbook for Taipei, China, available at http://www.cepd.gov.tw/encontent/m1.aspx?sNo=0000063.	

Future Trends in Household Saving Rates

Our estimation results imply that the household saving rate of Korea will decline sharply in the immediate future but that the household saving rate of India will not decline for the foreseeable future due to differences in the timing and speed of population aging.

Policy Implications

Given the divergent trends in population aging and household saving rates among the economies of emerging Asia, the household saving rate will not decline sharply in emerging Asia as a whole in the foreseeable future.

Thank you very much for your kind attention.