

The logo of the Asian Development Bank (ADB), consisting of the letters 'ADB' in white serif font on a dark blue square background.

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Demographic Transitions, Productivity, and the Role of Technology in Asia and the Pacific

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Changes and Macroeconomic Challenges

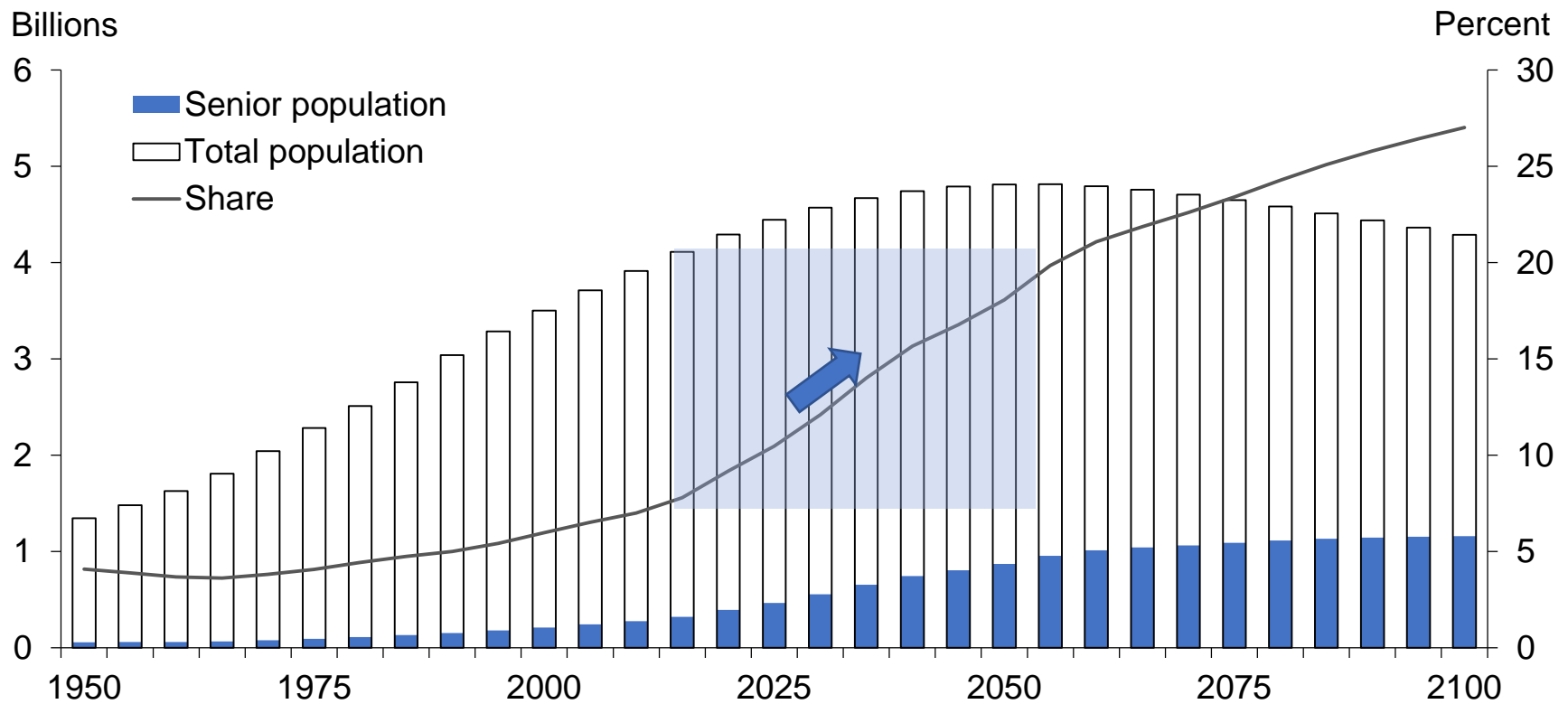


Outline

- Aging, Productivity, and the Role of Technology in Asia and the Pacific
- Harvesting Demographic Dividends as a Region

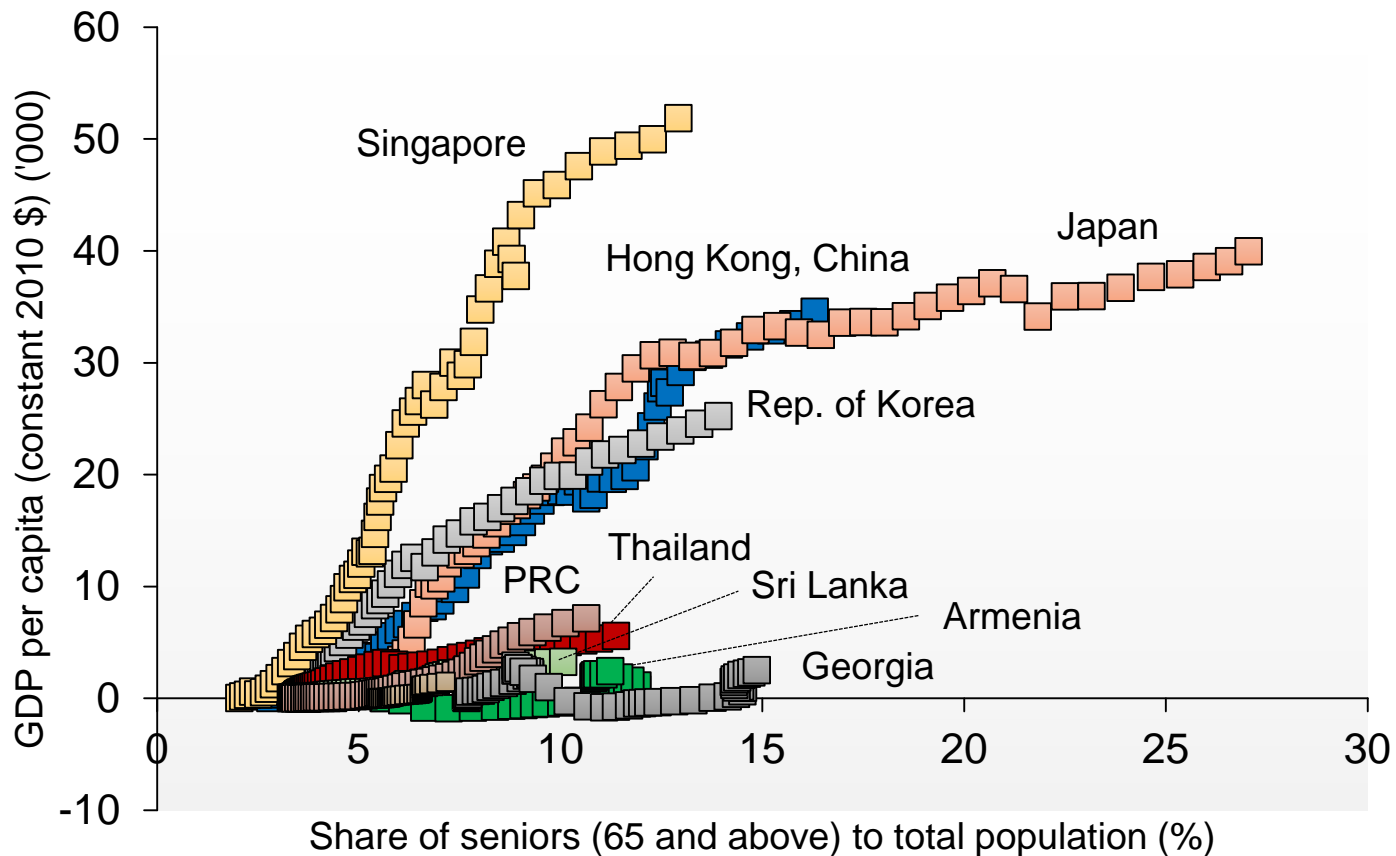
Aging, Productivity, and the Role of Technology in Asia and the Pacific

Asia is aging at an accelerating rate...



Source: ADB calculations using data from United Nations, Department of Economic and Social Affairs, Population Division.

Some economies in Asia are aging too quickly before getting rich?



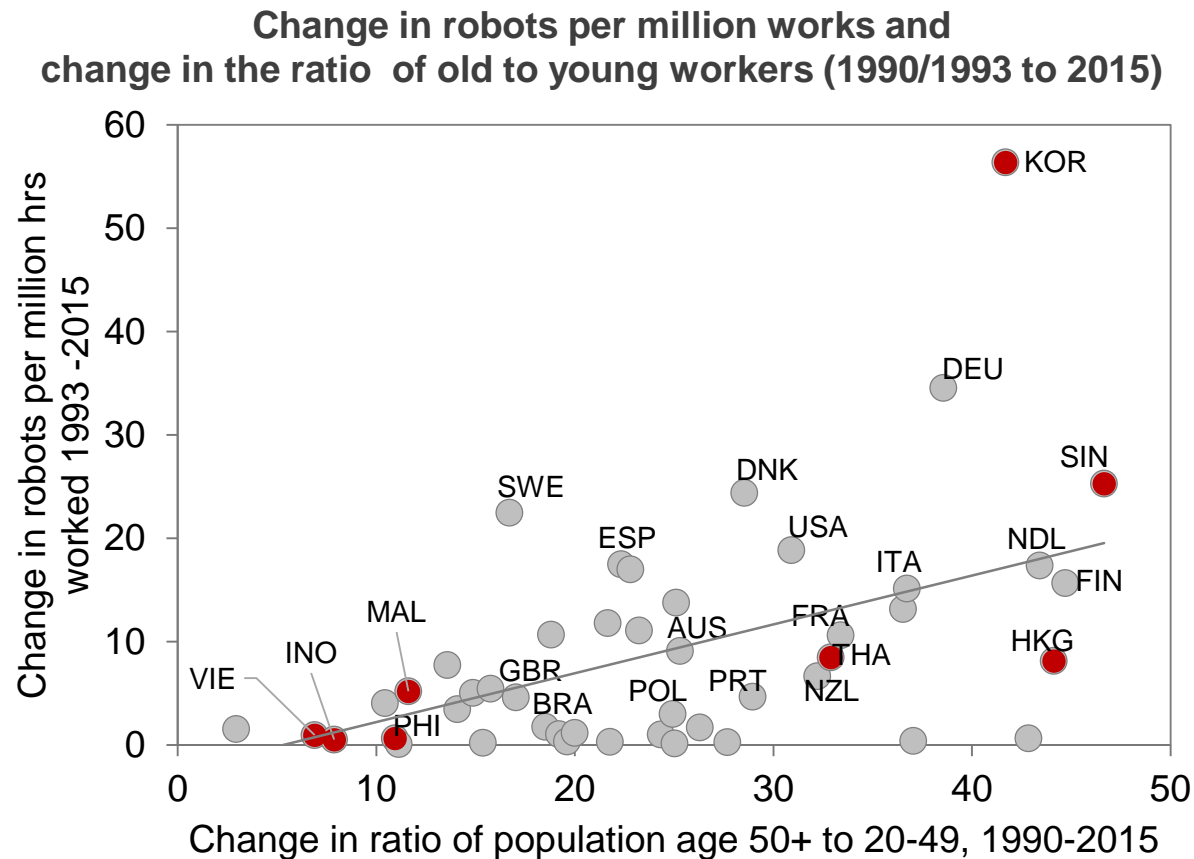
Note: GDP per capita is normalized to zero during the earliest period of availability (1961)

Source: ADB calculations using data from United Nations Population Division and World Bank.

Mixed evidence on aggregate productivity by age

Study	Coverage	Result	
Lindh and Malmberg (1999)	OECD, 1950-1990	50-64 age group affects labor productivity positively	+
Feyrer (2007 and 2008)	87 countries, 1960-1990	40-49 age group affects TFP positively	+
Park and Shin (2011)	12 Asian DMCs	Old age dependency ratio affect GDP per capita growth negatively	-
Liu and Westlius (2016)	Japanese prefectures, 1990-2007	40-49 age group affects TFP positively	+
Maestas et al. (2016)	US states, 1980-2010	60+ age group affects labor productivity negatively	-
Ayiar, et al. (2016)	EU28 countries, 1950-2014	Aging workforce (change in share of 55-64 age group) negatively affects labor productivity growth	-
Ozimek, et al (2017)	US states-industries, 2000-2015 Teams in HR company, 2013-2016	Share of 65+ affects productivity of state-industries negatively Share of 65+ affects wage of team negatively	-
Acemoglu and Restrepo (2017)	169 countries, 1990-2015	Aging (ratio of 50+/20-49) affects GDP per capita growth positively	+
Liang, et al. (2018)	57 countries (31 non-OECD), 2001-2010	Increase of median age decreases business formation and entrepreneurship	-

Aging induce labor-saving innovation and technology adoption



Source: Acemoglu, Daron, and Pascual Restrepo. 2017b. Secular Stagnation? The Effect of Aging on Economic Growth in the Age of Automation. NBER Working Paper Series 23077.

Overall impact of the aging and technology nexus on growth (Park, Shin, and Takenaka, 2018)

- In **macro growth regression**, how can we identify age specific effects?
- Following Fair and Dominguez (1991) AER, we impose flexible **non-linear age structure** by including higher polynomial effects for the age-specific population share, p_j , i.e., $\alpha_j \equiv \gamma_0 + \gamma_1 j + \gamma_2 j^2 + \gamma_3 j^3 + \dots$:

$$g = X\beta + \alpha_1 p_1 + \alpha_2 p_2 + \dots + \alpha_j p_j + u$$

- We can easily show that:

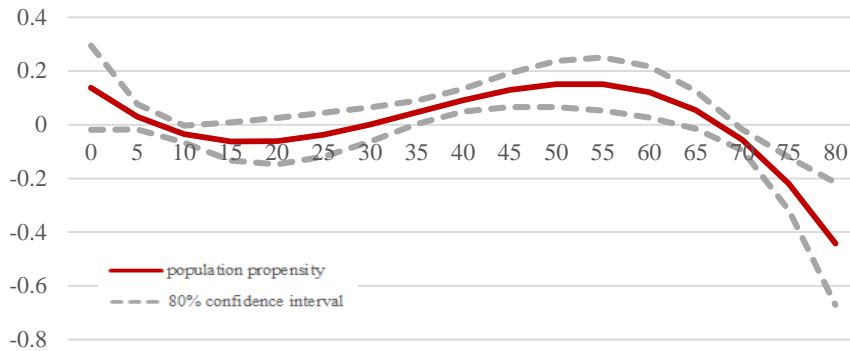
$$g = X\beta + \gamma_1 D_1 + \gamma_2 D_2 + \gamma_3 D_3 + \dots + u, D_i \equiv \left(\sum_{j=1}^J j^i p_j - \frac{1}{J} \sum_{j=1}^J j^i \right)$$

- Canonical **macro data**:

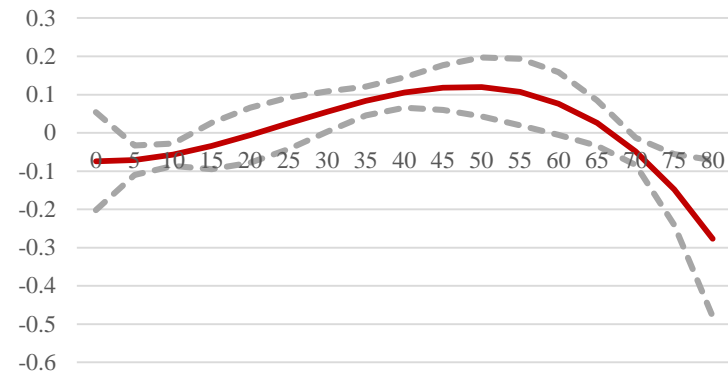
- (1) PWT 9.0
- (2) UN World Population Prospects 2017
- (3) The International Federation of Robotics data

Population distribution and per capita growth (cross country, 1993-2015, cubic function)

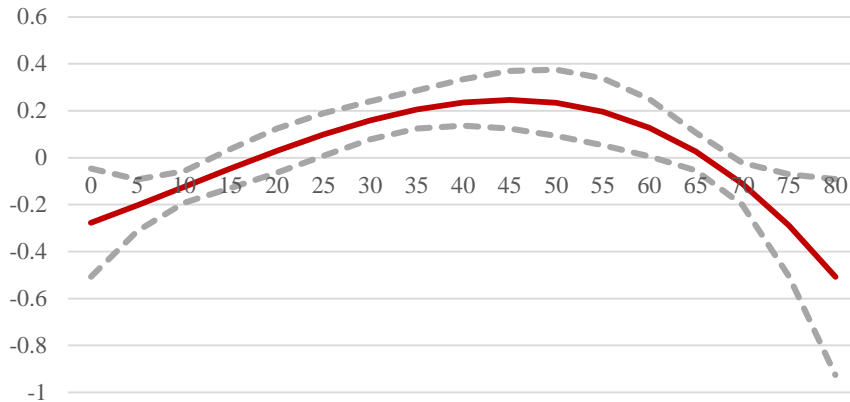
Pooled



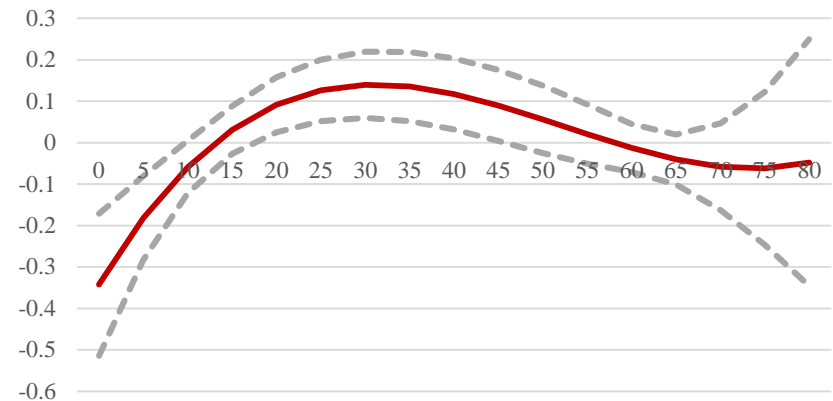
Initial GDP per Capita Controlled



Fixed Effect Regression

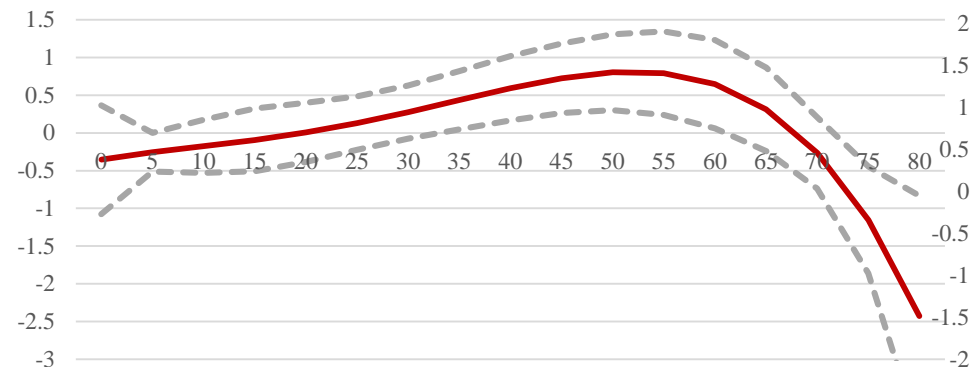


Fixed Effect, OECD Countries

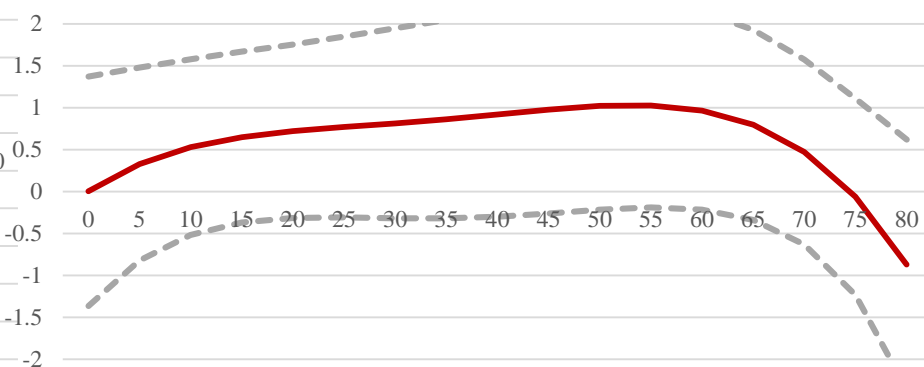


Heterogenous growth effects of robot adoption (cross country, 1993-2015, quadratic function)

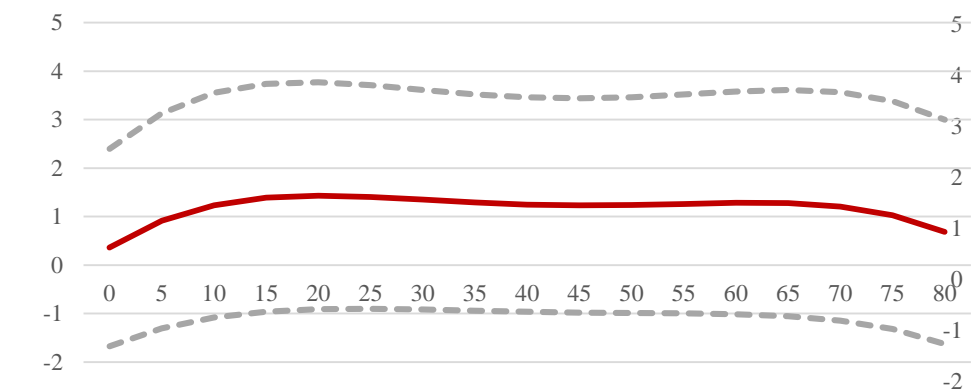
Fixed Effect, Log Robot Stock = 0



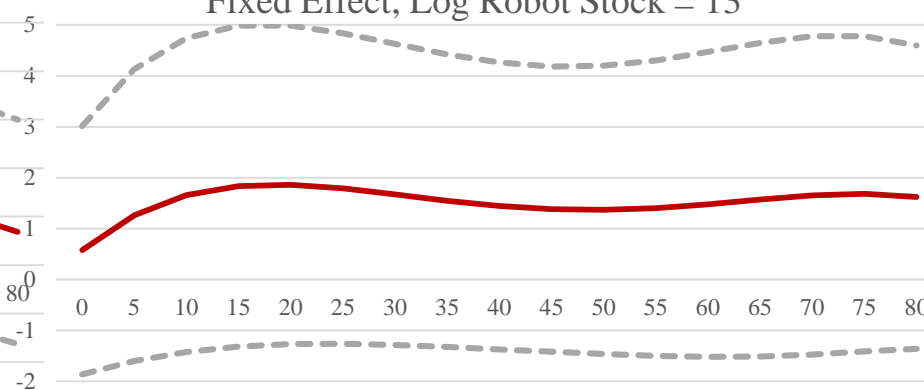
Fixed Effect, Log Robot Stock = 5



Fixed Effect, Log Robot Stock = 10



Fixed Effect, Log Robot Stock = 13



Roles of technologies

Role of Technology	Examples
1. Technology for health and longevity	Biotechnology, automated diagnosis, surgery and therapies, IOT (medical equipment and wearable sensory devices), and health-related big data analysis
2. Technology for transforming work and workplace	Industrial robots, automation, artificial intelligence, machine learning, and human function aiding devices at workplace (adaptive technologies), remote work
3. Technology for workers and supportive labor market infrastructure	Technology-based education/lifelong training, human resource and age diversity management, cloud-based job matching service

Harvesting Demographic Dividends as a Region

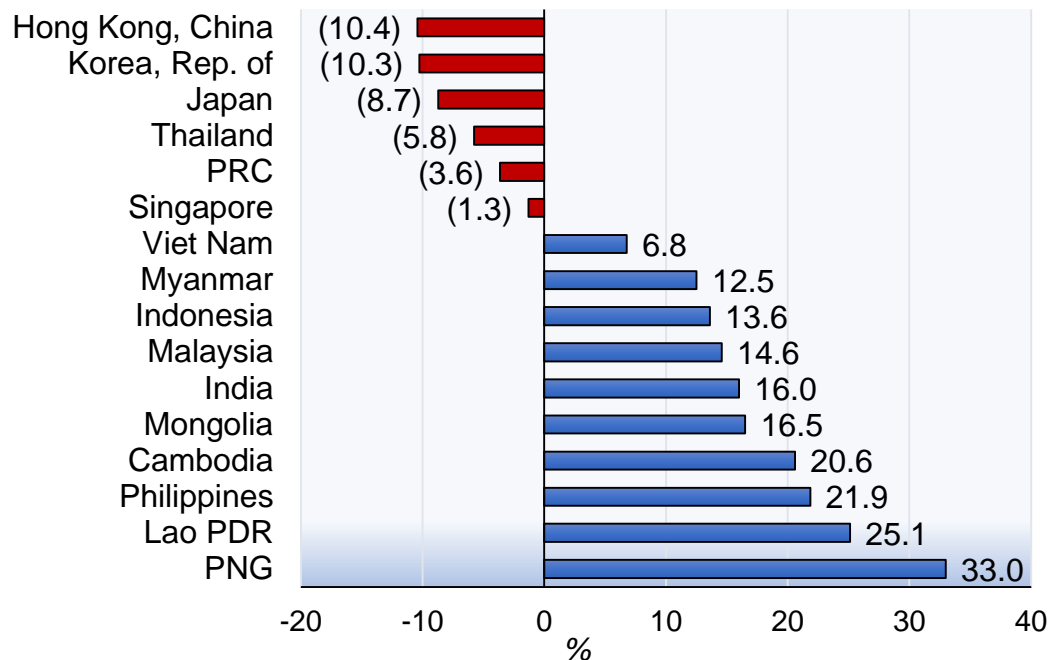
Demographic change and the implication on growth

Sequential gains from demographic dividends

1. **Expansion** of workforce.
2. Investing accumulated saving in **human capital**, leading to higher productivity.
3. The gains from investing in **longevity** and longer working life.

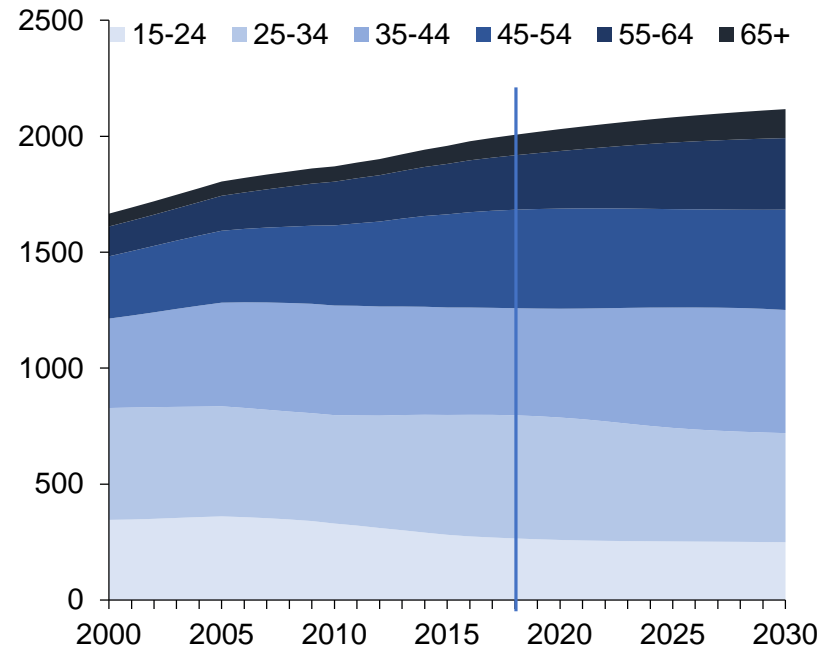
Diversified demographic dividends in Asia and the Pacific but overall gain

Percentage change in population ages 15-64 between 2017 and 2030



Source: ADB calculations using data from United Nations Population Division.

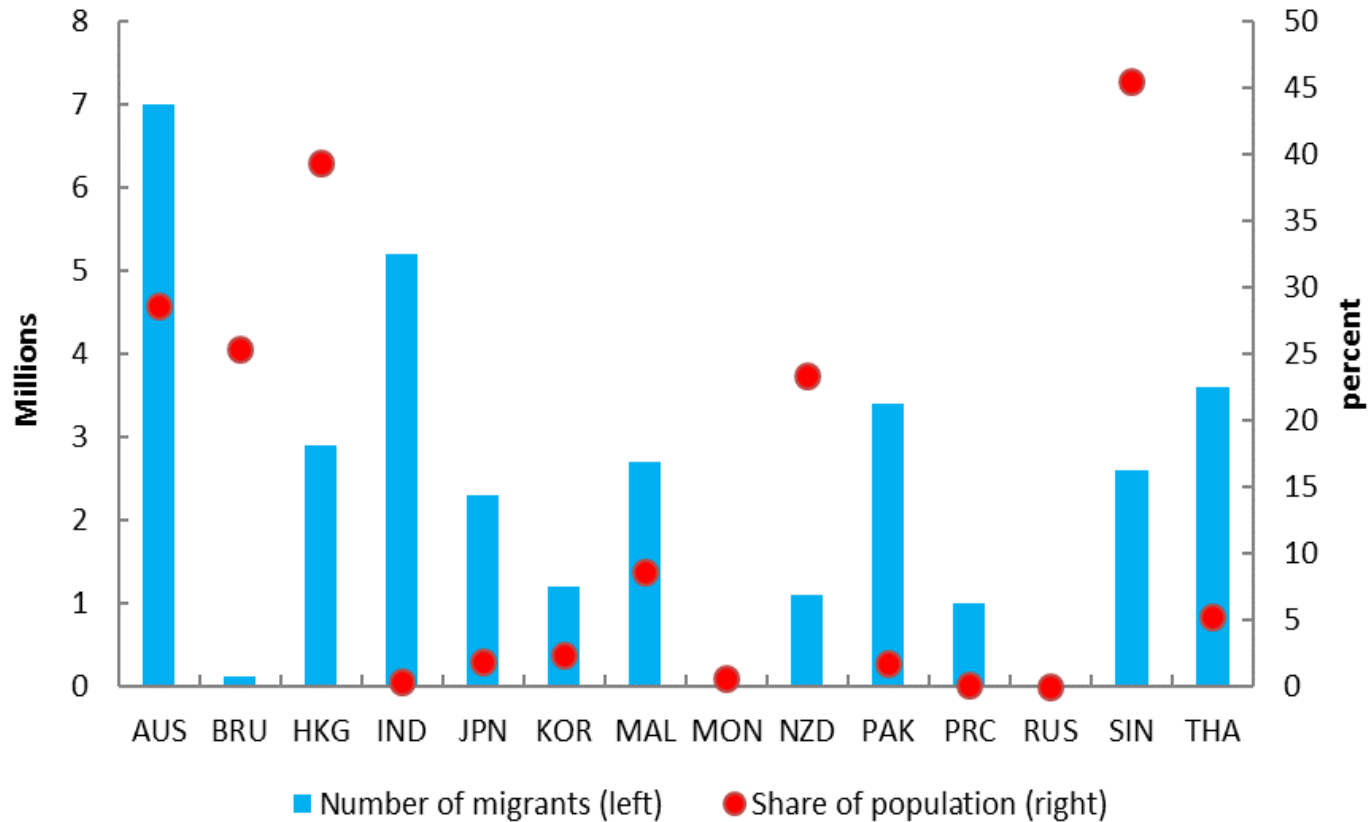
Labor force in Asia (by age group; in millions)



Source: ILO

Varying openness to migration

International migrant stock and the population share, 2017



Source: ADB calculations using data from International Migrant Stock: The 2017 Revision.
<http://www.un.org/en/development/desa/population/migration/data/estimates2/estimates17.shtml>
(accessed Aug 2018).

Job creations and human resource development through regional economic integration

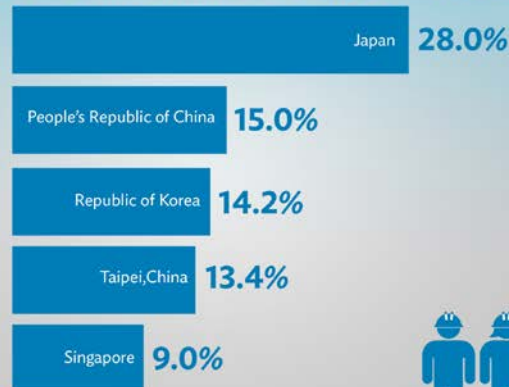
Greenfield FDI creates jobs in Asia

667,039
Number of jobs created in 2017
by greenfield FDI in Asia



46.2%
Greenfield jobs created
by intraregional FDI

Jobs created by Intra-Asia FDI, by Source, 2017



Jobs created per FDI project in Asia, 2017



302

by Asian FDI



178

by non-Asian FDI

Policy Implications

Preparing for Population Aging with Technology

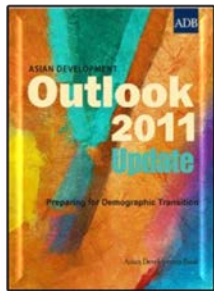
- Active promotion of technological **innovation and adoption (& adaption)**
- Creating **enabling environment for workers of all ages**

Harvesting Demographic Dividend through Regional Cooperation

- Facilitating **regional economic integration**, especially the cross-border movement of workforce, capital and services.

THANK YOU VERY MUCH

ADB Publications on Aging /Technologies



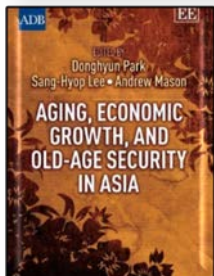
ADO 2011

Preparing for Demographic Transition



ADO 2018

How Technology Affects Jobs?



Aging, Economic Growth, and Old-age Security in Asia

Park, Lee and Mason (2012)



Tapping Technology to Maximize the Longevity Dividend in Asia

ADB (2018)