

*On-line Appendix for:*  
Global demographic trends: consumption, saving and  
international capital flows

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**Abstract**

This Appendix provides additional information on the macro data used in the chapter and presents further details on the calibration of the model and simulation methods.

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# A Data description

In this section we present a summary of calibrated parameter values in Table A.1 and time averages of indicators used as calibration targets in Table A.2. Table A.3 describes details of the database that we used for the calibration.

Table A.1: Summary of calibration parameters

Parameter	Symbol	Region			
		H-I	M-I	L-I	CHN
<i>Preferences</i>					
Discount factor (annual)	$\beta$		1.039		
Intertemporal elasticity of substitution	$1/\theta$		0.5		
Children weight in parents utility function	$\omega$		0.216		
<i>Technology</i>					
Capital share in production	$\alpha$		0.3		
Depreciation rate	$\delta$		0.05		
TFP level (initial, normalized)	$Z_0^r$	1.00	0.41	0.34	0.10
TFP growth rate (%)	$\lambda_t^r$	1.64	1.58	1.66	4.51
<i>Labour supply</i>					
Female participation rate (initial, no children)*	$\beta_0^r$	0.42	0.44	0.42	–
Speed of converge towards long-run rate $\bar{P}$	$\beta_1^r$	0.17	0.05	0.08	–
Effect on female participation of children	$\alpha_{0-4}$		-0.416		
	$\alpha_{5-9}$		-0.096		
	$\alpha_{10-14}$		-0.046		
<i>Government policies</i>					
Pension replacement rate (%)	$\kappa_t^r$	58.0		10.0	
Capital income tax rate (%)	$\tau_a^r$	35.7	15.5	13.5	25.7
Consumption tax rate (%)	$\tau_c^r$	9.7	16.0	6.3	7.7

Notes: High Income (H-I): Europe, North America, Japan, Australia, New Zealand; Middle Income (M-I): Latin America and Caribbeans, India, Taiwan, Thailand, South Korea, South Africa, Russia, Turkey; Low Income (L-I): Africa (excl. South Africa), other Asia, other Oceania (Melanesia, Micronesia, Polynesia); China (CHN).

\* For female labor force participation rates in China, we estimate the participation function without the time trend and assume a constant participation rate of 87.5% for women without children until 2000. Participation rates of women with children are adjusted using common adjustment factors  $\alpha_j$  indicated in the table. After 2000, we assume that the participation rate of women without children converges by 2150 to the long-run common value in the final steady state.

Table A.2: Time averages of indicators used as targets for calibration by region

Indicator	Period	Region			
		H-I	M-I	L-I	CHN
GDP per-capita, PPP (current international \$)	2010	35,095	7,861	4,190	7,553
GDP per-capita growth (%)	1960-2010	2.4	2.6	2.4	6.7
General government total expenditure (% GDP)	1970-2010	36.1	23.0	30.3	22.2
General government net debt (% GDP)	1990-2010	48.0	37.0	51.0	10.0

Notes: High Income (H-I): Europe, North America, Japan, Australia, New Zealand; Middle Income (M-I): Latin America and Caribbeans, India, Taiwan, Thailand, South Korea, South Africa, Russia, Turkey; Low Income (L-I): Africa (excl. South Africa), other Asia, other Oceania (Melanesia, Micronesia, Polynesia); China (CHN).

Table A.3: Dataset description

Indicator	Period	Description	Sources
GDP (constant 2000 US\$)	1960-2010	Gross domestic product at purchaser's prices expressed in constant 2000 US\$.	World Bank World Development Indicators (2013)
GDP per-capita, PPP (current international \$)	2010	Gross domestic product divided by midyear population and converted to international dollars using purchasing power parity rates. GDP at current PPP is used for within-region weighting.	World Bank World Development Indicators (2013)
GDP per-capita growth (%)	1960-2010	The annual growth rate of GDP per capita, based on constant local currency. GDP at constant 2000 US\$ is used for within-region weighting.	World Bank World Development Indicators (2013)
Capital-Output ratio	2010	It is computed using estimates of physical capital stock and real GDP (output side) expressed at current PPPs. GDP at current international \$ is used for within-region weighting.	Penn World Table (rel. 8.0)
General government total expenditure (% GDP)	1970-2010	Total spending of general government to GDP includes expenditures of central government, local government and social security funds. GDP at constant 2000 US\$ is used for within-region weighting.	IMF World Economic Outlook (2013), IMF Government Finance Statistics (2014), NBSC China Statistical Yearbook (various issues)
General government net debt (% GDP)	1990-2010	Net debt of general government to GDP is given by gross debt minus financial assets corresponding to debt instruments (monetary gold and SDRs, currency and deposits, etc.). GDP at constant 2000 US\$ is used for within-region weighting.	IMF World Economic Outlook (2013)
Capital income tax rate (%)	2000-2010	Average effective tax rate computed following the method of Mendoza, Tesar, and Razin (1994). Tax revenue data and national account aggregates available from various sources. GDP at constant 2000 US\$ is used for within-region weighting.	OECD Revenue Statistics (2014), IMF Government Finance Statistics (2014), OECD National Accounts Statistics (2014), UN National Accounts Statistics (2014)
Consumption tax rate (%)	2000-2010	Average effective tax rate computed following the method of Mendoza, Tesar, and Razin (1994). Tax revenue data and national account aggregates available from various sources. GDP at constant 2000 US\$ is used for within-region weighting.	OECD Revenue Statistics (2014), IMF Government Finance Statistics (2014), OECD National Accounts Statistics (2014), UN National Accounts Statistics (2014)
Net replacement rate (%)	2010	It is given by net pension entitlements divided by net pre-retirement lifetime earnings, accounting for individual income tax and social contributions (for a mean male earner). Computed for High Income region only, using GDP at constant 2000 US\$ for weighting.	OECD Pensions at a Glance (2011)
Female labour force participation rate	1970-2010	It is the ratio of economically active to total female population aged 15-64. Total population is used for within region weighting.	ILO LABORSTA (2013)
Total population by age groups	1950-2100	Historical data and projections (medium variant). Total population is used for within region weighting.	UN World Population Prospects (Rev. 2012)
Age-specific fertility rate	1950-2100	The age-specific fertility rate is the number of births to women in a particular age group divided by the number of women in that group. Historical data and projections (medium variant). Total population is used for within region weighting.	UN World Population Prospects (Rev. 2012)
Life expectancy at birth	1950-2100	It is the number of years a newborn would live if the prevailing patterns of mortality at the time of its birth were constant throughout its life. Historical data and projections (medium variant). Total population is used for within region weighting.	UN World Population Prospects (Rev. 2012)

## B Computation method

In this section we describe the steps to compute our model's equilibrium and transition dynamics. For the closed economy, we first compute initial and final steady states of each region. Then we compute the transition dynamics between the two steady states, feeding in the demographic transitions as exogenous factors. For the open economy, we compute initial and final steady states of four regions, in which a common interest rate clears the world capital market. We then compute the transition between the open-economy steady states by solving for the common path of open-economy interest rate and region-specific paths of tax rates.

In what follows, we describe in steps how we compute the closed-economy transition dynamics of a given region. As explained in the paper, we assume that one policy variable, a tax rate on labor income, adjusts and clears the government budget each year. We set  $T$ , the total duration of the transition, to a very large number so that extending or truncating the transition in a larger or smaller number of periods does not affect the results.

**Step 1.** We make a guess of two  $T$ -dimensional vectors for aggregate capital and labor income tax rate. The first and the last entries of these vectors are the values in the initial and final steady states that we have derived before we compute the transition dynamics. Given the level of capital in each period, we can compute the path of factor prices (interest rates and wages) that each household take as given in solving life-cycle problems in step 2.

**Step 2.** Given the path of tax rates and factor prices from step 1, we solve households problem for each cohort.

**Step 3.** Once we derive asset holding of each household in step 2, we can compute aggregate capital stock in each period, as well as the total tax revenues and expenditures of the government. We compare the values of capital to the initial guesses that we started with in step 1 and update the guesses for the next iteration. We adjust the tax rates as well to narrow the fiscal imbalance. Return to step 1 and continue until all values of aggregate capital converge and fiscal balance is achieved in each period.