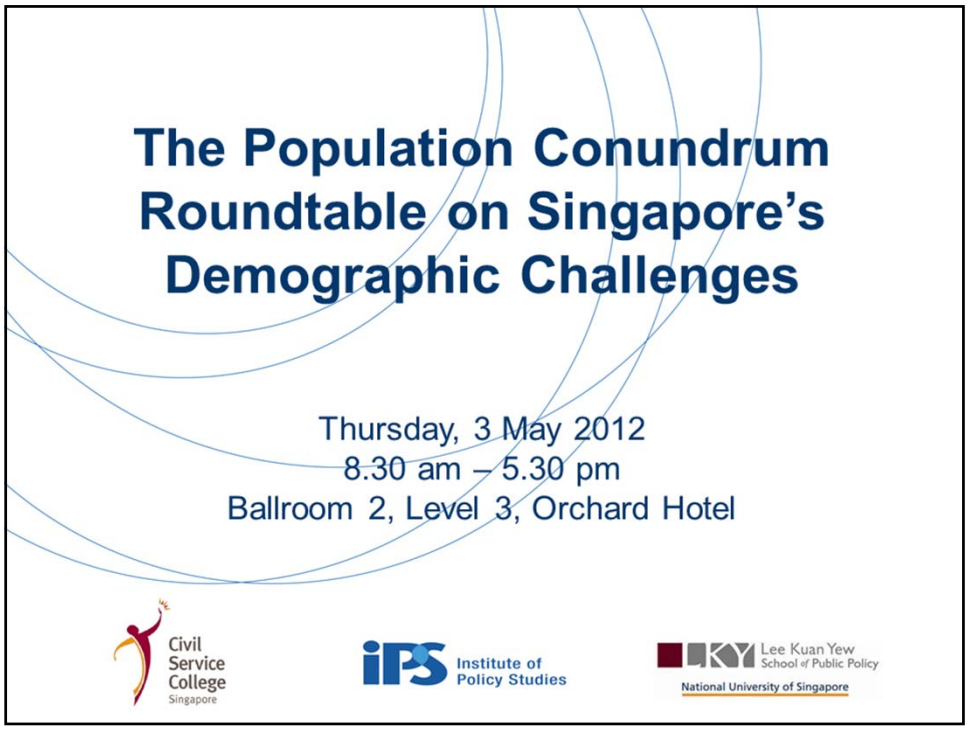
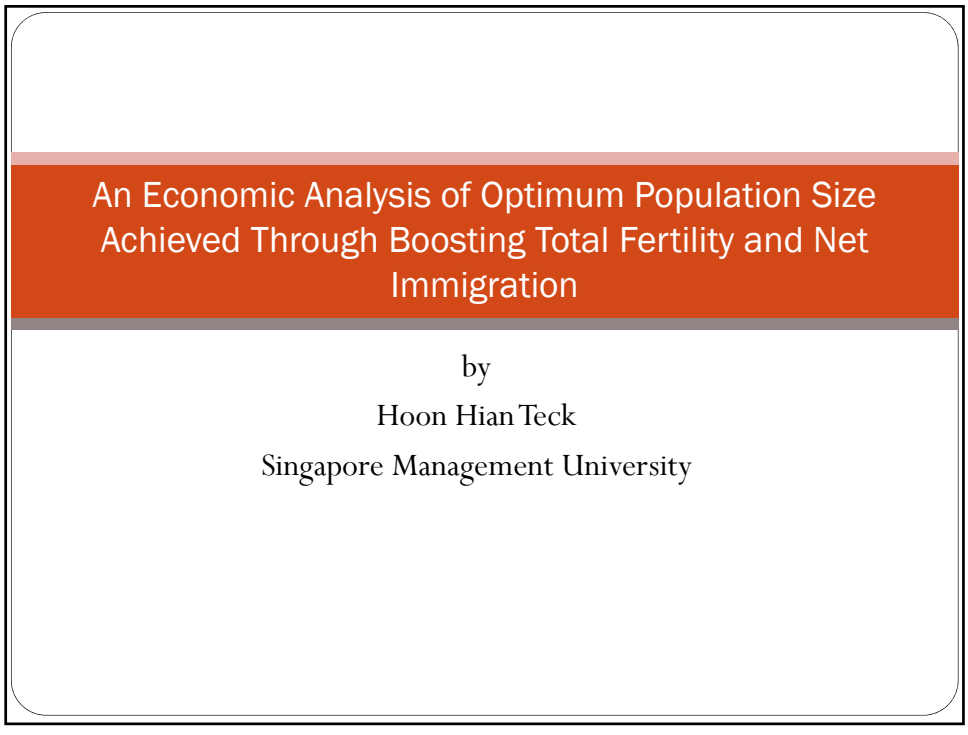




Outline

- One useful picture
- Arriving at the optimum population size
- Optimal mix to achieve population size increase
- Summing up

Racing to catch-up

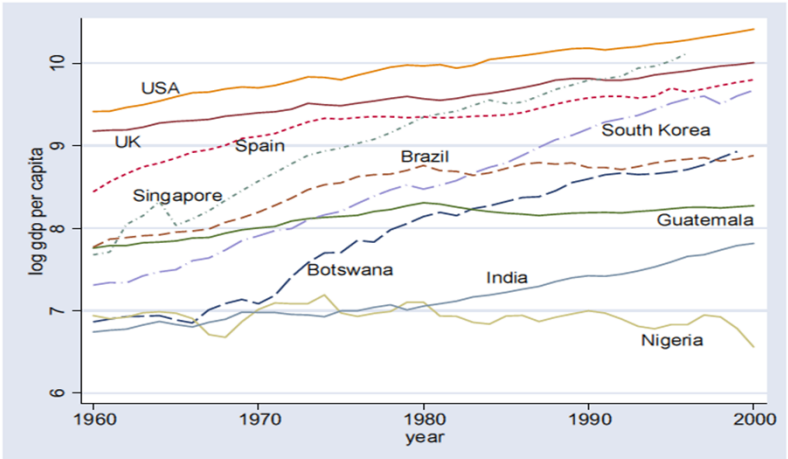
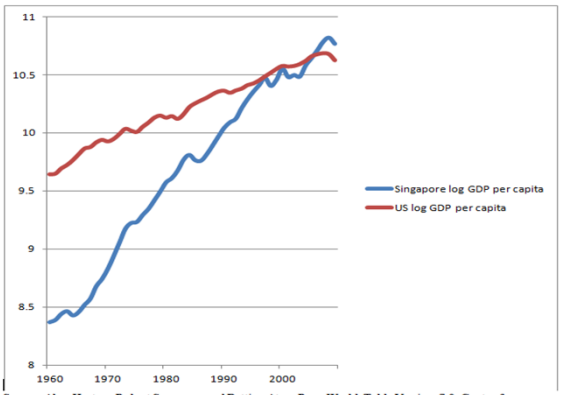


FIGURE 1.8. The evolution of income per capita in the United States, United Kingdom, Spain, Singapore, Brazil, Guatemala, South Korea, Botswana, Nigeria and India, 1960-2000

Source: Acemoglu (2009)

End of catch-up to being a mature economy

Figure 1: Real GDP per capita Series for Singapore and the U.S., 1960-2009



Source: Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 7.0, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, May 2011.
Note: PPP-adjusted GDP per capita at constant 2005 prices.

Hoon (2012)

Arriving at optimum population size

- Thought experiment: If citizen population size shrinks to the size in 1970, would our standard of living return to the level attained in 1970?

Arriving at optimum population size

$$y = (L/P)F(k,h,A)$$

where y = real GDP per capita

L/P = labor force participation rate

k = physical capital per worker

h = human capital per worker

A = index of technology

Arriving at optimum population size

Takeaway Number 3:

- As the technology gap has narrowed, and huge investments in education have raised the average level of human capital of workers, the standard of living in a future where citizen population size is down, say, to the level it was in 1970, is likely to remain higher than it was in 1970.

Arriving at optimum population size

Arguments for a smaller population size:

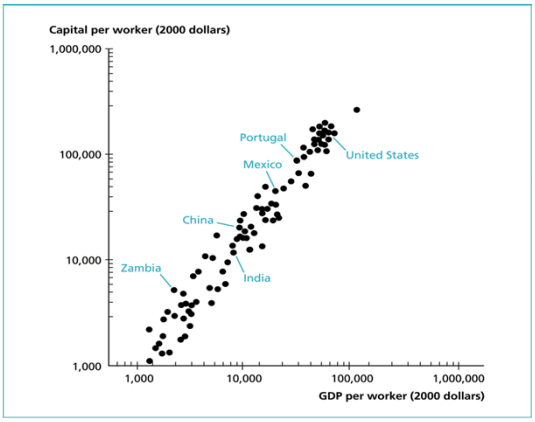
- Capital dilution effect
- Limited land and congestion effect

Arriving at optimum population size

Arguments for a bigger population size:

- Mozart effect
- Human capital externalities effect
- Tax base effect
- Okun's Law effect

Capital dilution effect



Sources: Calculations based on Heston et al. (2006) and World Bank (2007a).

Weil (2005)

Limited land and congestion effect

1.8 POPULATION AND LAND AREA

Year	Mid-Year Population [1]		Land Area [2]	Population Density	Median Age [3]	Dependency Ratio [4]	Sex Ratio [3]
	Total	Resident					
	Thousand		Square Kilometres	Per Square Kilometre	Years	Per Hundred	Males Per 1,000 Females
2000	4,027.9	3,273.4	682.7	5,900	34.0	41.1	998
2005	4,265.8	3,467.8	697.9	6,112	35.8	39.1	985
2006	4,401.4	3,525.9	699.5	6,292	36.1	38.5	983
2007	4,588.6	3,583.1	705.1	6,508	36.4	37.9	982
2008	4,839.4	3,642.7	710.2	6,814	36.7	37.2	980
2009	4,987.6	3,733.9	710.3	7,022	36.9	36.5	976
2010	5,076.7	3,771.7	712.4	7,126	37.4	35.7	974

1 Total population comprises Singapore residents and non-residents.
The resident population comprises Singapore citizens and permanent residents.
2 The land area of Singapore comprises the mainland and other islands.
Prior to 2002, data are based on approved land lots. From 2002 onwards, data are based on land owned parcels.
3 Refers to Singapore residents (citizens and permanent residents).
4 Residents aged under 15 years and those aged 65 years and over divided by residents aged 15 - 64 years.

Yearbook of Statistics 2011, Singapore

Arriving at optimum population size

- Mozart Effect:
- "If I could re-do the history of the world, halving population size each year from the beginning of time on some random basis, I would not do it for fear of losing Mozart in the process." – Edmund S. Phelps

Mozart effect

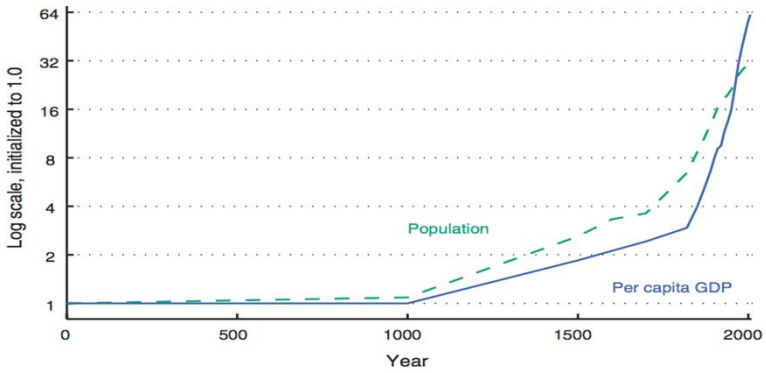


FIGURE 2. POPULATION AND PER CAPITA GDP OVER THE VERY LONG RUN

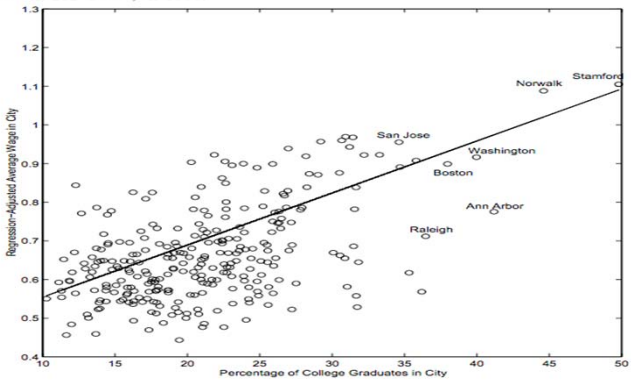
Notes: Population and GDP per capita for "the West," defined as the sum of the United States and 12 western European countries. Both series are normalized to take the value 1.0 in the initial year, 1 AD.

Source: Maddison (2008).

Jones and Romer (2010)

Human capital externalities effect

Figure 5: Correlation Between Regression-Adjusted Average Wage and Percentage of College Graduates in 282 Cities, in 1990.



NOTES: Regression–adjusted average wage is obtained by conditioning on individual education, gender, race, Hispanic origin, U.S. citizenship and work experience. Weighted OLS fit superimposed.

Moretti (2004)

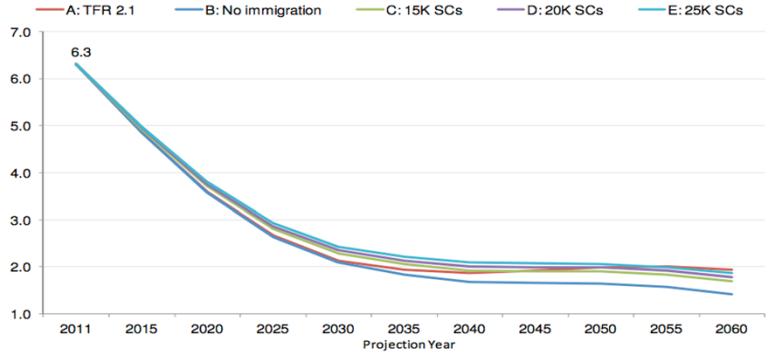
Arriving at optimum population size

Tax Base Effect:

- A decline in the population size reduces the "tax base" supporting each old and retired person, making it desirable to increase population growth.

Tax base effect

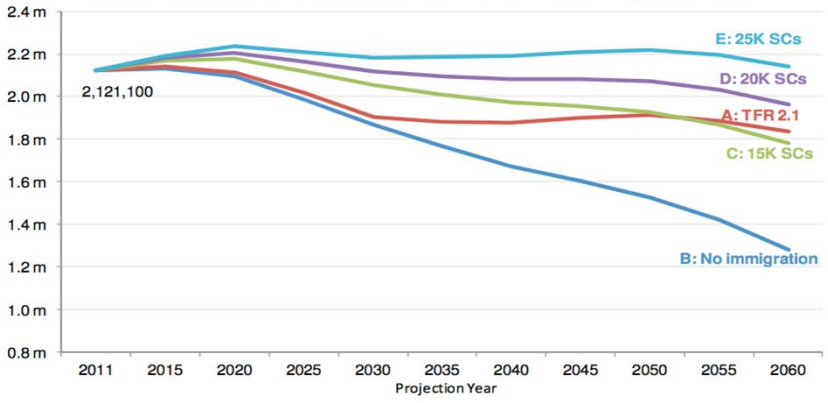
Chart 8: Citizen old-age support ratio[6]
(persons aged 20-64 years per elderly citizen)



NPTD (2012)

Tax base effect

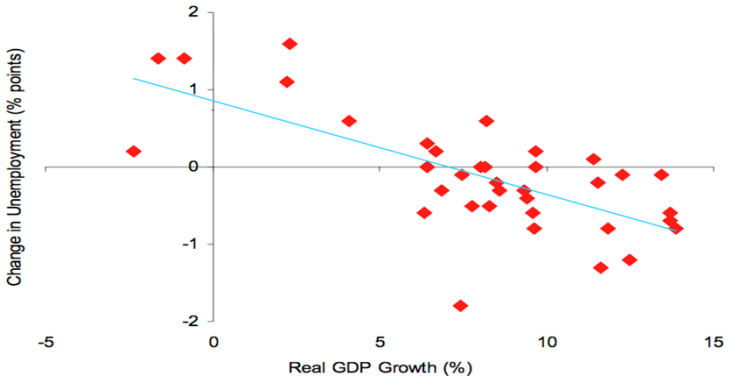
Chart 6: Number of working-age citizens (20-64 years) ('millions)



NPTD (2012)

Okun's Law effect

Figure 9
Scatter Plot of Change in Unemployment Rate vs Real GDP Growth Rate



Source: Ministry of Manpower

Hoon (2006)

Optimal mix to achieve population size increase

- Measures to boost total fertility
- Net immigration

Optimal mix to achieve population size increase

Takeaway Number 7:

- As individuals become richer, earning a higher market wage per unit of time spent working, the opportunity cost of the time devoted to raising a child correspondingly increases, which leads couples to choose to have fewer children and to make bigger human capital investments in each child. (This can be called a "level" effect.)

Income level and total fertility rate

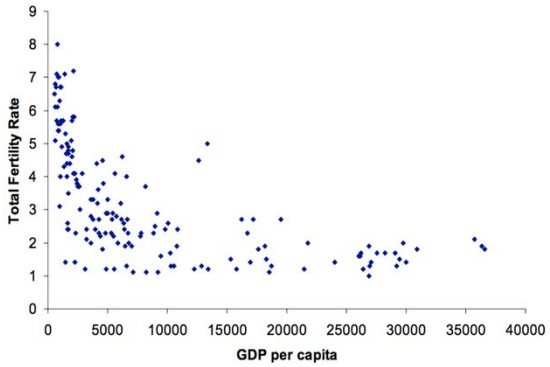


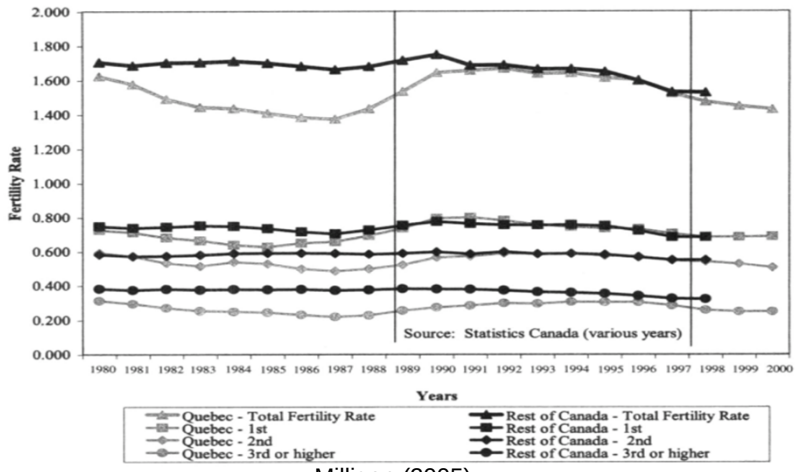
Figure 1: Income and Fertility, 2000

Manuelli and Seshadri (2009)

Do financial incentives matter for fertility? Natural experiment in Quebec, Canada

SUBSIDIZING THE STORK

FIGURE 1.—FERTILITY RATES: QUEBEC AND REST OF CANADA



Milligan (2005)

Optimal mix to achieve population size increase

Takeaway Number 8:

- In an era of high growth rates, the potential to gain from parental investment in a child's education might be higher as higher skills are more valued in a rapidly growing economy. If this is true, then the implied growth slowdown as the Singapore economy matures could mean that total fertility rate would increase on this account. (This can be called a "growth" effect.)

Optimal mix to achieve population size increase

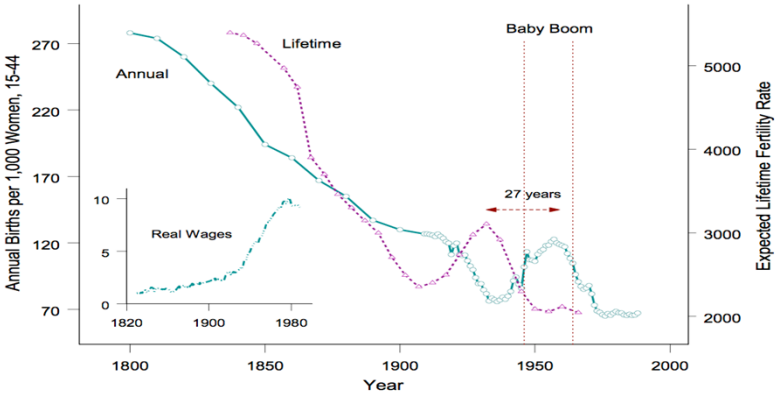
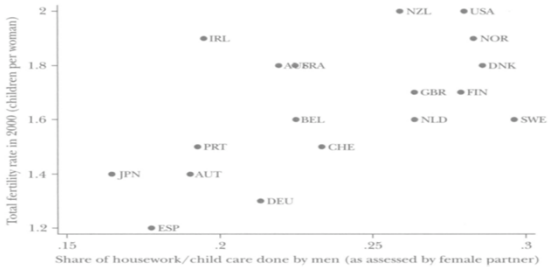


Figure 1: FERTILITY IN THE U.S., 1800-1990

Greenwood, Seshadri and Vendenbroucke (2005)

Optimal mix to achieve population size increase

Figure 5
Total Fertility Rate versus Share of Housework/Child Care Done by Men in 2000



Sources: Total fertility rates are from United Nations data. Data on men's work are from the 2002 wave of the International Social Survey Program.
Notes: Details on variable construction: We start with 4 survey questions in which each household adult is asked who usually performs the following activities: 1) laundry, 2) caring for sick family members, 3) cleaning, 4) preparing meals. The possible responses in the raw data are 1) always me, 2) usually me, 3) about equal between me and my spouse, 4) usually my spouse, 5) always my spouse. We limit the sample to households with children under five and with both a man and woman present. We use the woman's responses and convert the raw data to the percentage done by the man, as assessed by the woman. We use the following recoding of the data: "always the woman" = 0 percent done by the man; "usually the woman" = 25 percent done by the man; "about equal" = 50 percent done by the man; "usually the man" = 75 percent done by the man; and "always the man" equals 100 percent done by the man. We then average the percent done by the man across the four categories of housework. Points on graph are labeled using standard World Bank/UN country abbreviations available at ⟨http://unstats.un.org/unsd/methods/m49/m49alpha.htm⟩.

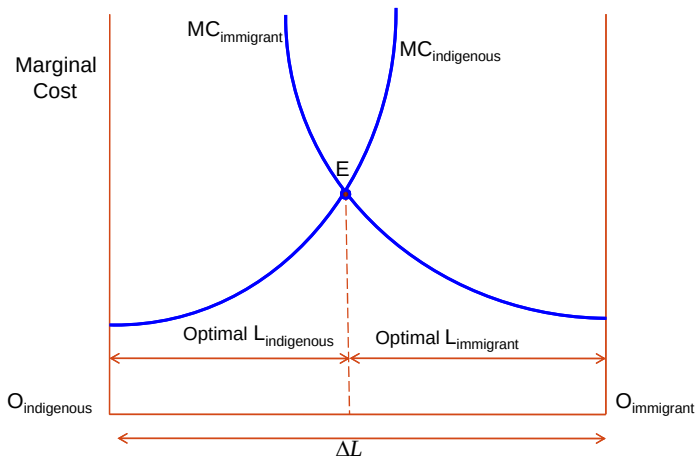
Feyrer, Sacerdote, and Stern (2008)

Optimal mix to achieve population size increase

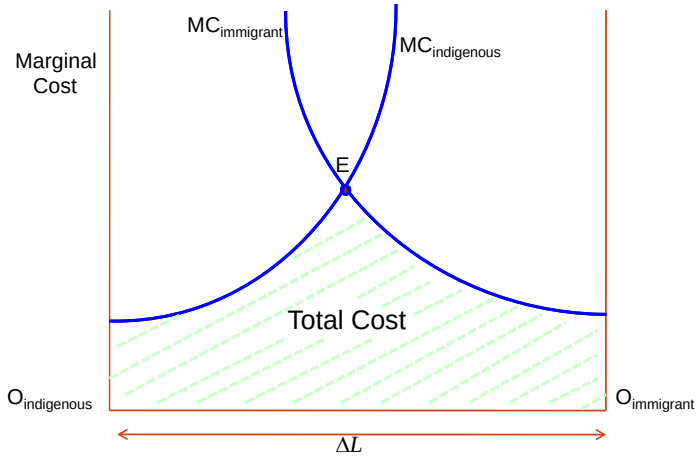
Takeaway Number 9a:

- While the cost of policy measures to boost the total fertility rate can be explicitly accounted for in the national budget, the cost to society of achieving a given increase in population size via net immigration appears to be more indirect and works through its effect on social capital.

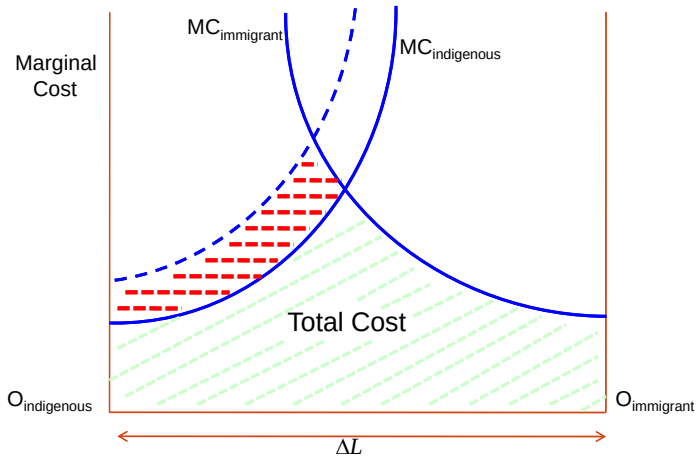
Optimal mix to achieve population size increase: Diagram 1



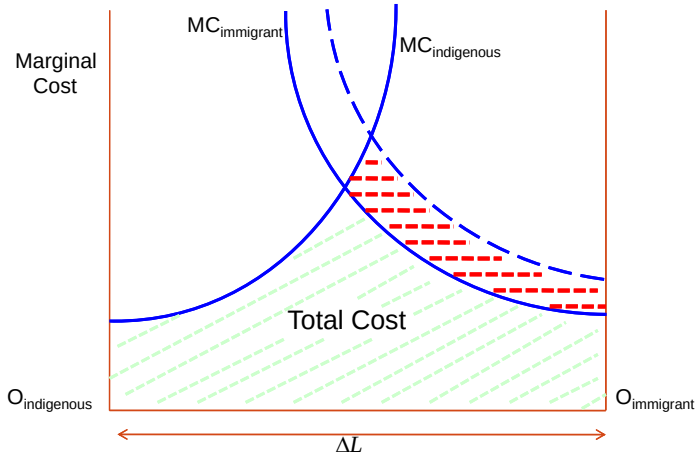
Optimal mix to achieve population size increase: Diagram 2



Optimal mix to achieve population size increase: Diagram 3



Optimal mix to achieve population size increase: Diagram 4

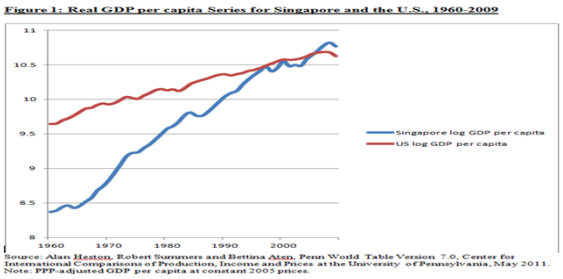


Optimal mix to achieve population size increase

Takeaway Number 10:

- An investment to forge a national identity that recognizes the economic contributions of both indigenous citizens and immigrants can lower the marginal cost curve from achieving population increase via net immigration and thus reduce the total cost of achieving a given population size increase.

Summing up: Living life in a mature economy



Hoon (2012)

1. Slower growth
2. Service sector becomes more important, where annual productivity gains are smaller
3. Innovation becomes more important
4. Achieving an increase in population size likely requires *both* measures to boost total fertility and net immigration

Summing up: One scenario

Scenario E: 25 thousand new immigrants each year to maintain **citizen labor force** at roughly ***2 million*** by 2060. This implies a **citizen population size** of about ***4 million*** and **citizen old-age support ratio** of about *2*.

Number of permanent residents currently over 0.5 million. If non-resident workforce is 1 million (one-third of workforce), population density increases from 7,126 persons per square km to 7,720 persons per square km (8-percent increase). In New York City, with land area of 786 square km and over 8 million people, population density is 10,4000 persons per square km.

References

- Acemoglu, Daron, 2009, *Introduction to Modern Economic Growth*, Princeton: Princeton University Press.
- Feyrer, James, Bruce Sacerdote, and Ariel Dora Stern, 2008, "Will the Stork Return to Europe and Japan? Understanding Fertility within Developed Nations," *Journal of Economic Perspectives*, 22 (Summer): 3-22.
- Greenwood, Jeremy, Ananth Seshadri and Guillaume Vandenbroucke, 2005, "The Baby Boom and Baby Bust: Some Macroeconomics for Population Economics," *American Economic Review*, 95 (March): 183-207.
- Hoon, Hian Teck, 2006, "Future Job Prospects in Singapore," in W.T.H. Koh and R. Mariano (eds.), *The Economic Prospects of Singapore*, Singapore: Pearson, Addison-Wesley.
- Hoon, Hian Teck, 2012, *The Singapore Economy in Transition: From Catch-up Growth to Life in a Mature Economy*, manuscript in preparation, Singapore Management University.
- Jones, Charles I. and Paul Romer, 2010, "The New Kaldor facts: Ideas, Institutions, Population, and Human Capital," *American Economic Journal: Macroeconomics*, 2 (January): 224-245.
- Manuelli, Rodolfo and Ananth Seshadri, 2009, "Explaining International Fertility Differences," *Quarterly Journal of Economics*, 124(2): 77-807.
- Milligan, Kevin, 2005, "Subsidizing the Stork: New Evidence on Tax Incentives and Fertility," *Review of Economics and Statistics*, 87 (August): 539-555.
- Moretti, Enrico, 2004, "Human Capital Externalities in Cities," in *Handbook of Regional and Urban Economics*, North-Holland: Elsevier.
- National Population and Talent Division, 2012, "Citizen Population Scenarios," Occasional Paper, April, Prime Minister's Office.
- Weil, David, *Economic Growth*, New York: Pearson, Addison-Wesley.

Supplementary slide: Labor force growth

1.11 EMPLOYMENT

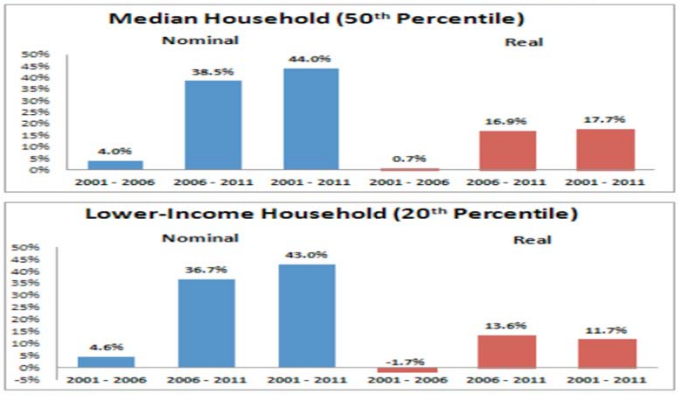
Year	Labour Force [1,3]	Unemployment Rate [2,3]	Resident Labour Force Participation Rate [1,3]			CPF Contributors in Labour Force	Union Members Among Employed
			Total	Males	Females		
	Thousand	Per Cent					
2000	2,192.3	3.5	63.2	76.6	50.2	58.1	13.6
2005	2,367.3	3.3	63.0	74.4	52.0	58.3	19.9
2006	2,594.1	2.7	65.0	76.2	54.3	56.4	18.5
2007	2,710.3	2.3	65.0	76.3	54.2	57.0	18.8
2008	2,939.9	2.2	65.6	76.1	55.6	54.8	18.1
2009	3,030.0	3.2	65.4	76.3	55.2	54.3	18.1
2010	3,135.9	2.2	66.2	76.5	56.5	na	-

Note: Data for 2007 have been adjusted following the revision of population estimates.
1 Refers to persons aged 15 years and over in June of the respective years.
2 Refers to seasonally adjusted unemployment rates in June.
3 Data are sourced from Labour Force Survey, Ministry of Manpower except for 2005, which are from General Household Survey.

Yearbook of Statistics 2011, Singapore

Supplementary slide: Income growth

Chart 1: Growth of Singaporean Household Incomes Per Member



Source: DOS

Notes
Based on Singaporean-headed households with at least one employed person.
Household income growth is based on household income (including employer CPF contributions) per member.
Income of the median household is deflated by overall CPI at 2009 prices. Income of the household at the 20th percentile is deflated by CPI for lowest 20% at 2009 prices.

Budget Speech 2012, MOF, Singapore

Supplementary slide: Investment growth

5.6 GROSS FIXED CAPITAL FORMATION

Million Dollars

	2000	2005	2006	2007	2008	2009	2010
	At Current Market Prices						
Total	49,233.5	44,116.2	50,651.8	63,070.6	75,780.9	76,367.9	75,903.7
Construction & Works	24,915.0	19,719.3	21,777.5	30,480.1	39,019.5	44,282.0	43,376.5
Residential Buildings	11,024.8	7,793.9	8,482.9	12,115.0	15,247.0	16,731.2	20,537.5
Non-residential Buildings	9,798.3	8,360.1	9,787.0	14,730.6	17,997.2	20,641.8	16,090.7
Other Construction & Works	4,091.9	3,565.3	3,507.6	3,634.5	5,775.3	6,909.0	6,748.3
Transport Equipment	3,818.2	5,532.4	7,613.3	9,827.7	14,629.1	11,795.5	7,737.7
Machinery, Equipment & Software	20,500.3	18,864.5	21,261.0	22,762.8	22,132.3	20,290.4	24,789.5
	At 2005 Market Prices						
Total	48,199.4	44,116.2	50,560.7	60,485.2	68,652.8	66,655.4	70,038.4
Construction & Works	26,157.7	19,719.3	21,232.2	26,449.0	29,605.5	33,555.0	35,008.2
Residential Buildings	11,430.3	7,793.9	8,216.5	10,192.8	11,299.8	12,611.3	15,760.7
Non-residential Buildings	10,304.7	8,360.1	9,562.3	12,929.3	13,814.6	15,725.6	13,463.8
Other Construction & Works	4,399.6	3,565.3	3,453.4	3,326.9	4,491.1	5,218.1	5,783.7
Transport Equipment	3,841.4	5,532.4	7,795.1	10,109.2	15,376.6	11,490.4	7,709.6
Machinery, Equipment & Software	18,609.5	18,864.5	21,533.4	23,927.0	23,670.7	21,610.0	27,320.6

Note: As the constant price series are chain-linked at the base year, they are not additive prior to the base year. Thus, prior to 2005, the aggregate at 2005 prices may not be equal to the sum of their components.

Yearbook of Statistics 2011, Singapore

Supplementary slide: Ten takeaways

- 1. Neoclassical growth theory, with physical capital accumulation being a major driving force behind the rise in standard of living, predicts that, with diminishing marginal product of capital, a decline in population growth rate, holding labor force participation rate constant, leads to a rise in the standard of living due to a "capital dilution" effect.
- 2. The rate of population growth that can be sustained without placing severe limits on the growth in the standard of living due to limited supply of usable land depends positively on the rate of technological progress and negatively on the share of land as a factor of production. However, even if technological progress could mitigate the diminishing marginal returns to labor due to limited supply of land, too high a population density is likely to lead to strong "congestion" effects that make it desirable to have a smaller population size.

Supplementary slide: Ten takeaways

- 3. As the technology gap has narrowed, and huge investments in education have raised the average level of human capital of workers, the standard of living in a future where citizen population size is down, say, to the level it was in 1970, is likely to remain higher than it was in 1970.
- 4. As Singapore's technology gap has narrowed due to past decades of catch-up, facilitated by free international trade and inflows of multinational corporations, its future (more modest) growth in standard of living must be fueled by indigenous innovations. If creativity is important for innovation, and the probability of being a creative and talented person is independently distributed, then a greater number of creative and talented people is present in a larger population. This "Mozart effect" channel and a "human capital externalities" channel make it desirable to have a larger population size.

Supplementary slide: Ten takeaways

- 5. At any point in time, there co-exist different generations of people within a given population. There are a certain number of young people who work and who have the capacity to pay taxes that fund items such as health subsidies that are predominantly received by a certain number of old and retired people. A decline in the population size reduces the "tax base" supporting each old and retired person, making it desirable to increase population growth.
- 6. The reputation that Singapore has built as a good investment destination allows it to grow its labor supply (by boosting population size) without a corresponding decline in labor productivity because capital grows to support the additional headcounts. The higher GDP growth, in turn, lowers the unemployment rate based on "Okun's Law."

Supplementary slide: Ten takeaways

- 7. As individuals become richer, earning a higher market wage per unit of time spent working, the opportunity cost of the time devoted to raising a child correspondingly increases, which leads couples to choose to have fewer children and to make bigger human capital investments in each child. (This can be called a "level" effect.) Policy measures such as parental leave, childcare subsidy and the Baby Bonus effectively lower the opportunity cost of having an additional child and produce substitution and income effects.
- 8. In an era of high growth rates, the potential to gain from parental investment in a child's education might be higher as higher skills are more valued in a rapidly growing economy. If this is true, then the implied growth slowdown as the Singapore economy matures could mean that total fertility rate would increase on this account. Whether this "growth" effect will offset the "level" effect, thus reversing the trend toward lower total fertility rate, is an empirical question.

Supplementary slide: Ten takeaways

- 9. While the cost of policy measures to boost the total fertility rate can be explicitly accounted for in the national budget, the cost to society of achieving a given increase in population size via net immigration appears to be more indirect and works through its effect on social capital. An optimal mix of the measures to boost total fertility, on the one hand, and net immigration, on the other hand, to achieve a given increase in citizen population size equates the marginal cost of both approaches.
- 10. An investment to forge a national identity that recognizes the economic contributions of both indigenous citizens and immigrants can lower the marginal cost curve from achieving population increase via net immigration and thus reduce the total cost of achieving a given population size increase. An environment that enhances work-life balance can simultaneously lower the marginal cost curve of achieving population increase via measures to boost total fertility.