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System Dynamics of Hypothetical and Realistic Demographics: Implications of Foreign Labour Policy

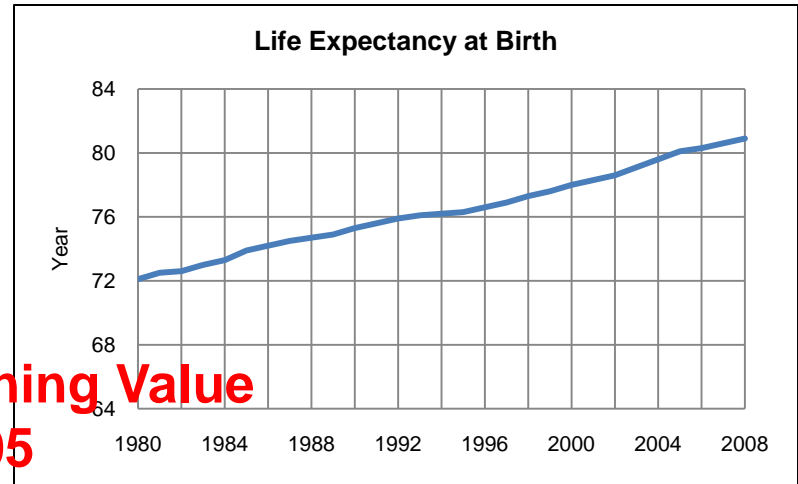
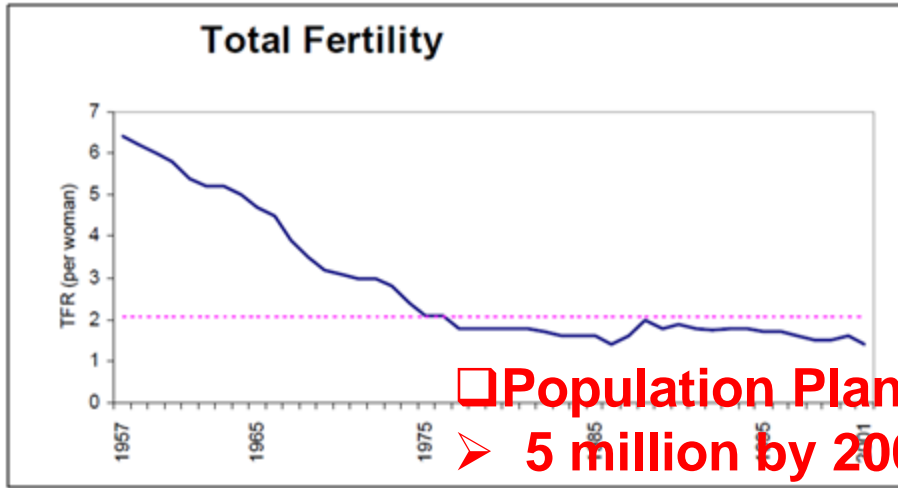
John P. Ansah, Crystal M. Riley and James P. Thompson
Health Services and System Research (HSSR)

Background

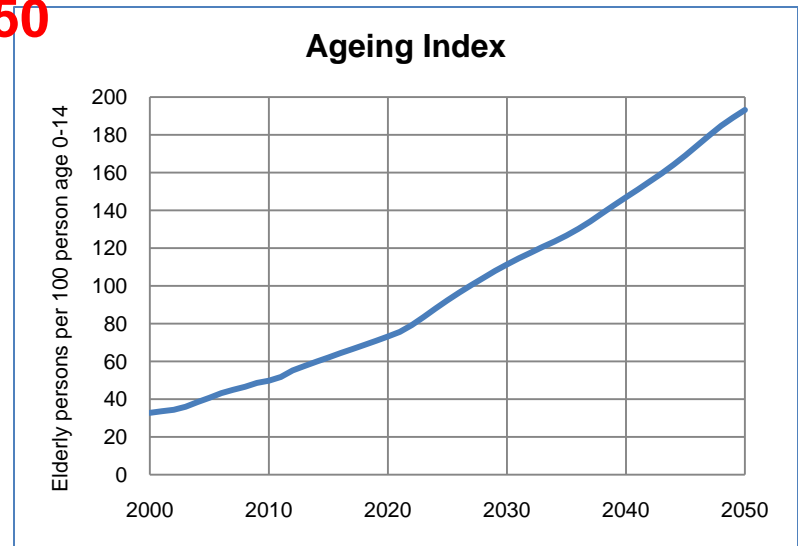
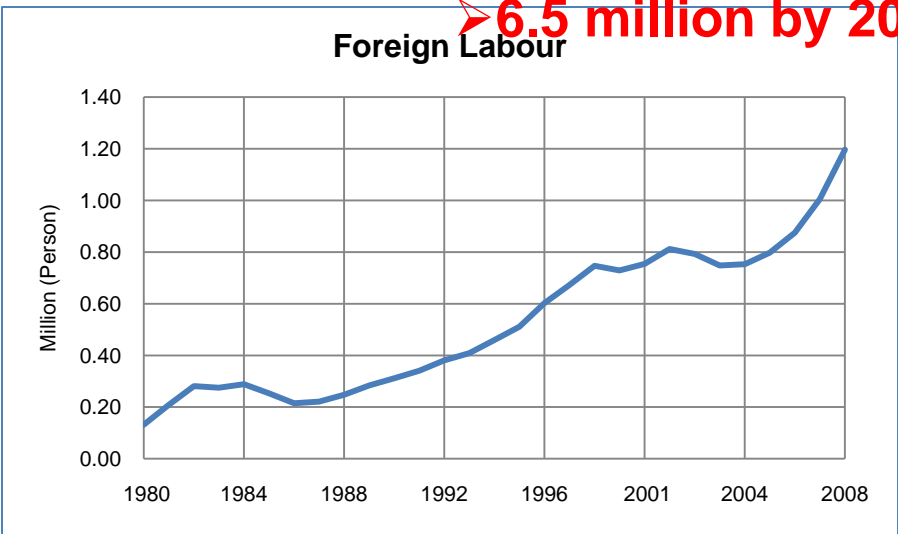
- Singapore is city-state in southeast Asia
- Land area of 682 sq. km.
- Total population of approx. 5.1 million (2010)
 - 3.8 million citizens and permanent residents
 - 1.3 million foreign labour



Demographic Dynamics



Population Planning Value
 ➤ 5 million by 2005
 ➤ 6.5 million by 2050



Dependency Ratio

- Dependency Ratio is a key indicator of the social support needs

$$\text{DependencyRatio} = \frac{\textit{juvenile} + \textit{elderly}}{\textit{fecund} + \textit{mature} + \textit{foreignlabour}}$$

- Dependency ratio provides rough approximation of the **actual dependency burden on society.**
- If interpreted with caution, it is a useful indicator of **trends in support needs and how it expected to change**

Research Question

- How will different policy scenarios affect age dependency ratio?

Given:

- High life expectancy
- Ultra low fertility
- Reliance on foreign labour
- Population planning value of 6.5 million

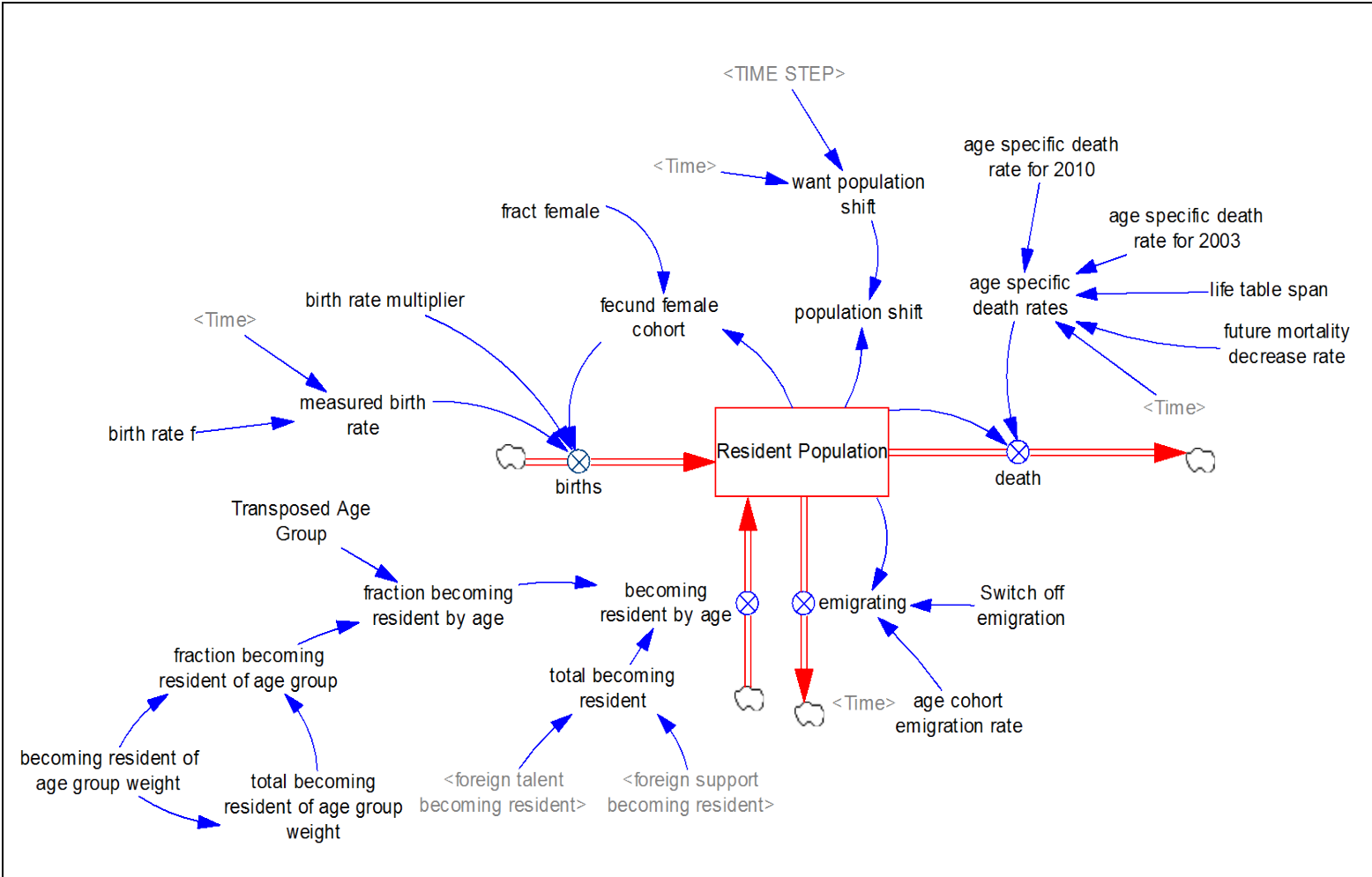
Method

- System Dynamics methodology

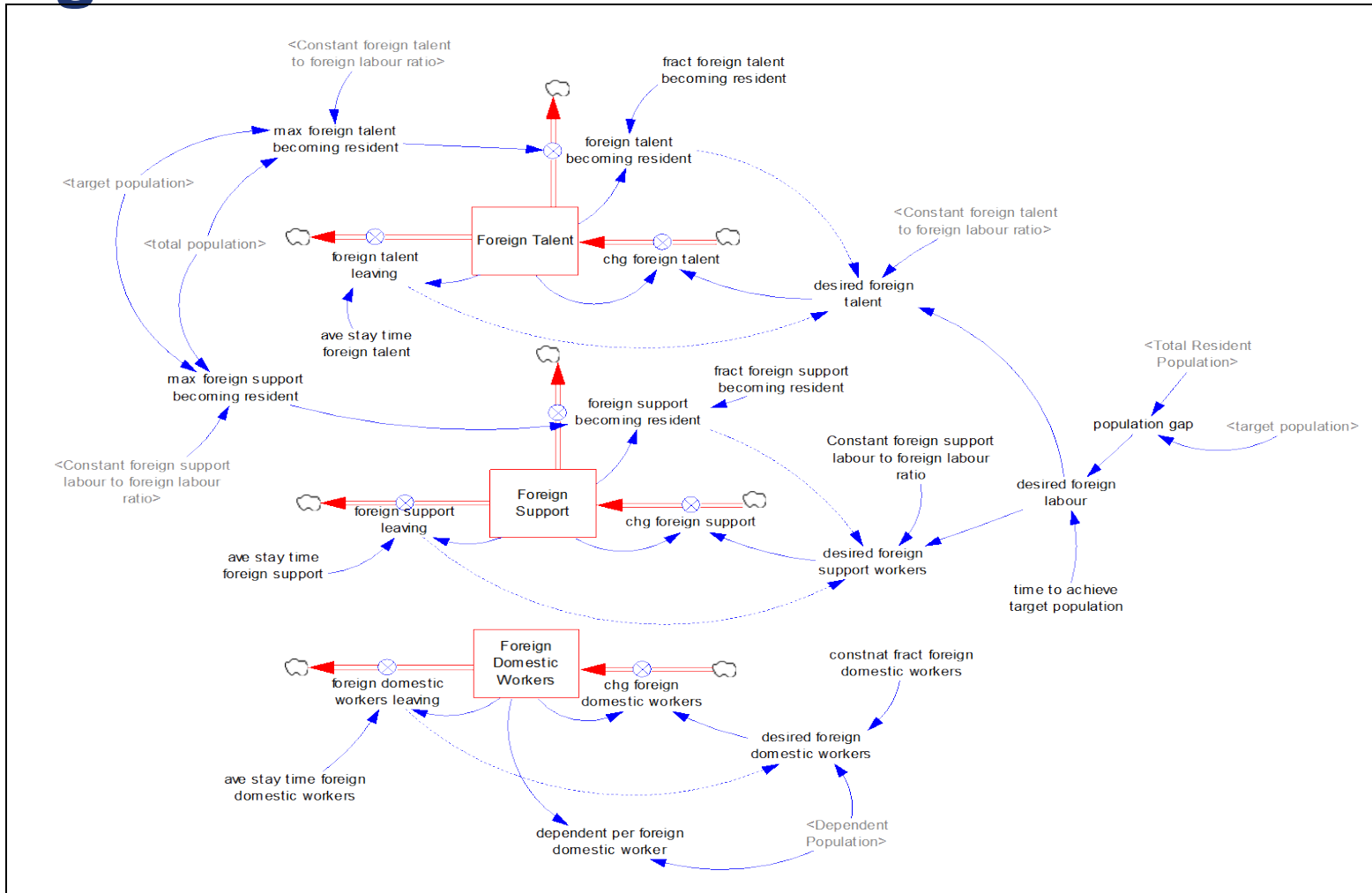
Developed SD model which has two sectors

- Population sector – time shifted population cohorts replicate discrete event
- Foreign labour sector- continuous time

Population Model



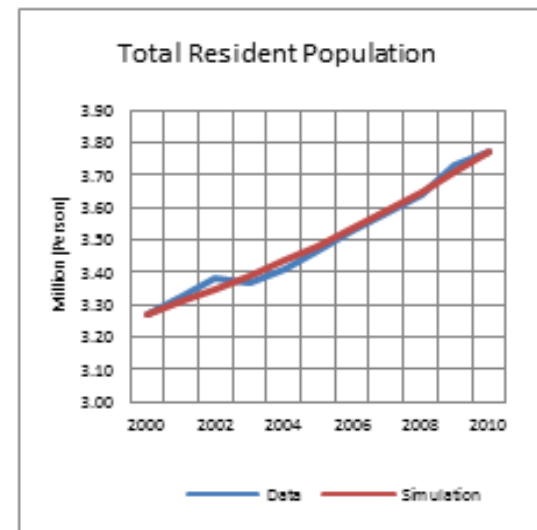
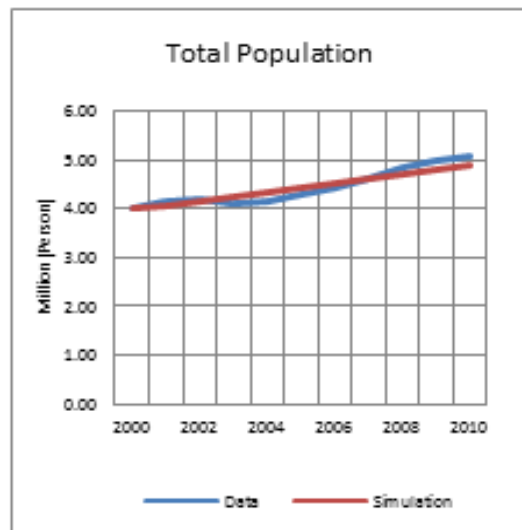
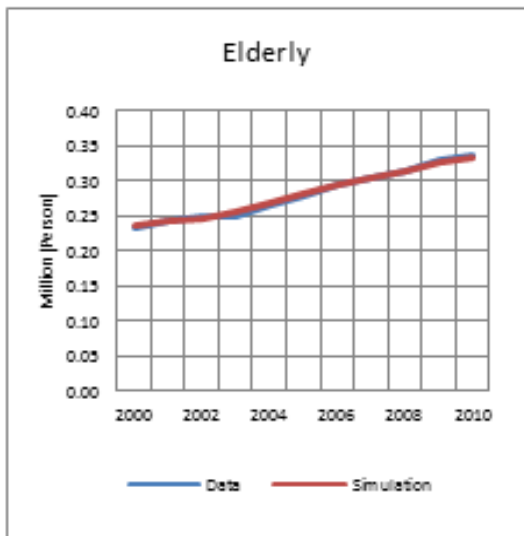
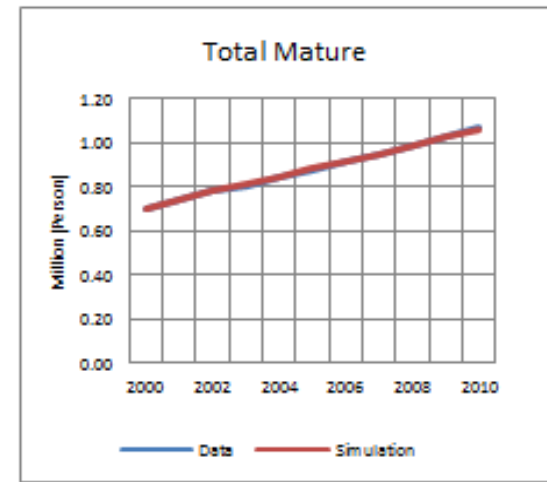
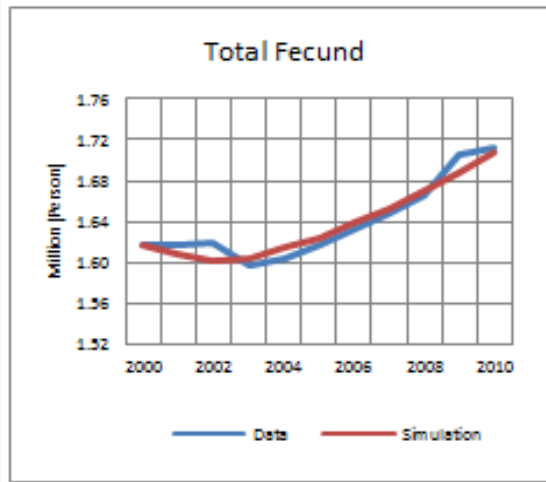
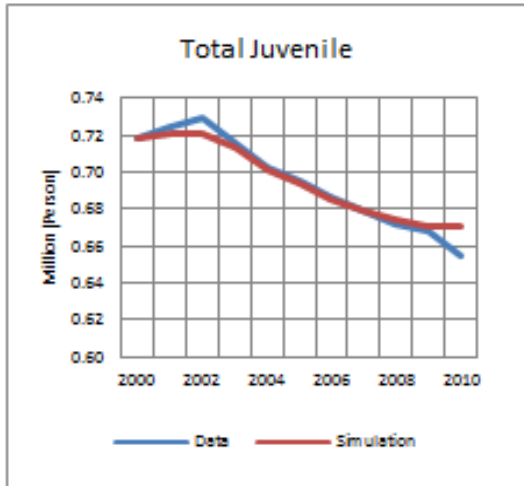
Foreign Labour Model



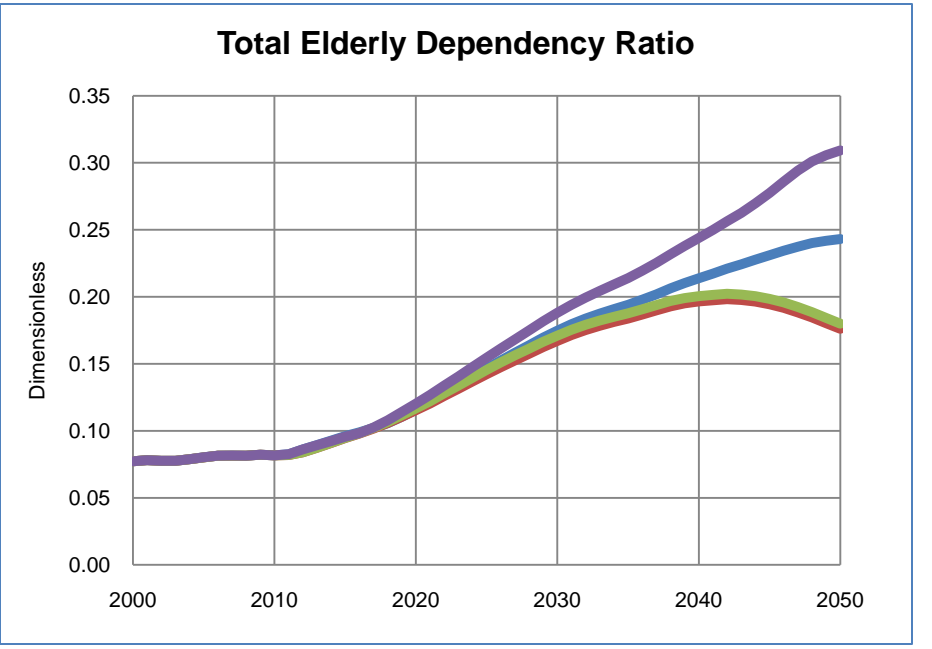
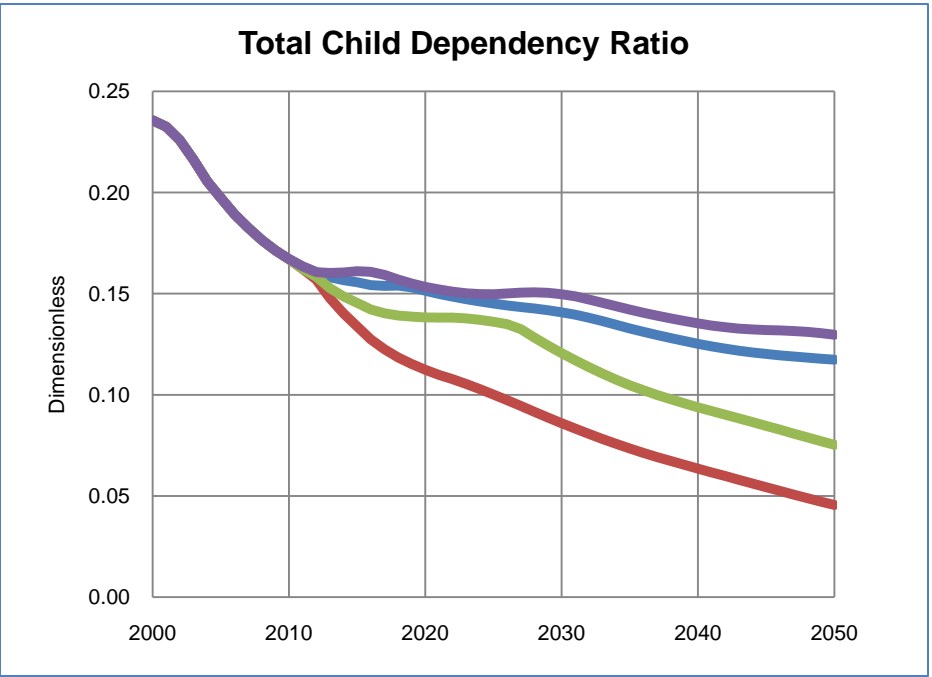
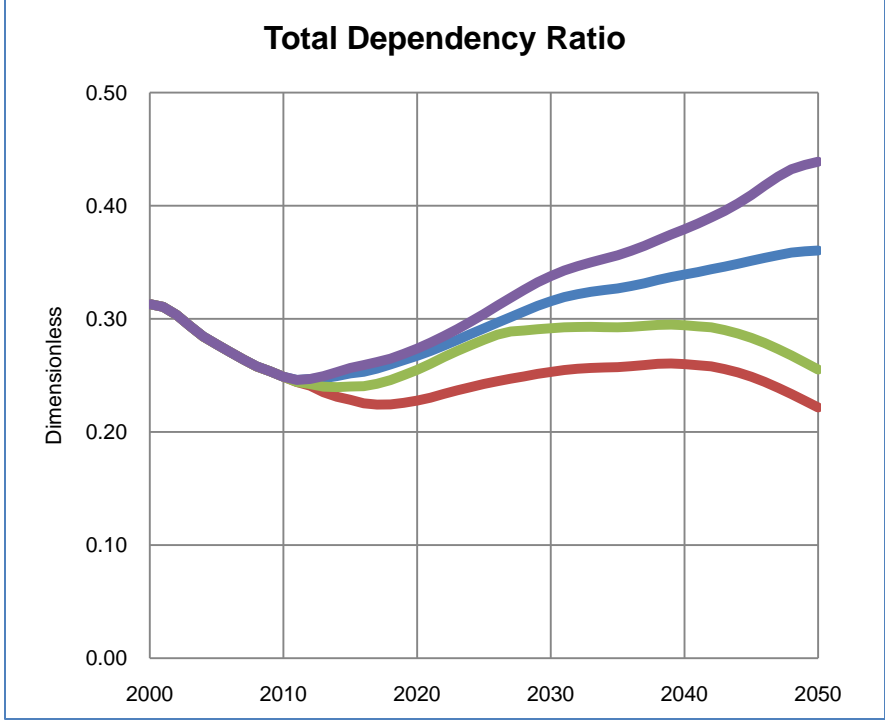
Scenarios

- **Business-as-Usual:** Current birth, becoming resident rate, and emigration rates
- **No foreign labour becoming resident:** Current birth and emigration rates but with the becoming resident rate set constant at zero
- **Replacement birth rate:** Replacement birth rate, becoming resident rate set constant at zero, and current emigration rate
- **No Emigration:** Current birth and becoming resident rates, emigration rate set constant at zero

Validation: Comparing simulation to historical data



Total Dependency

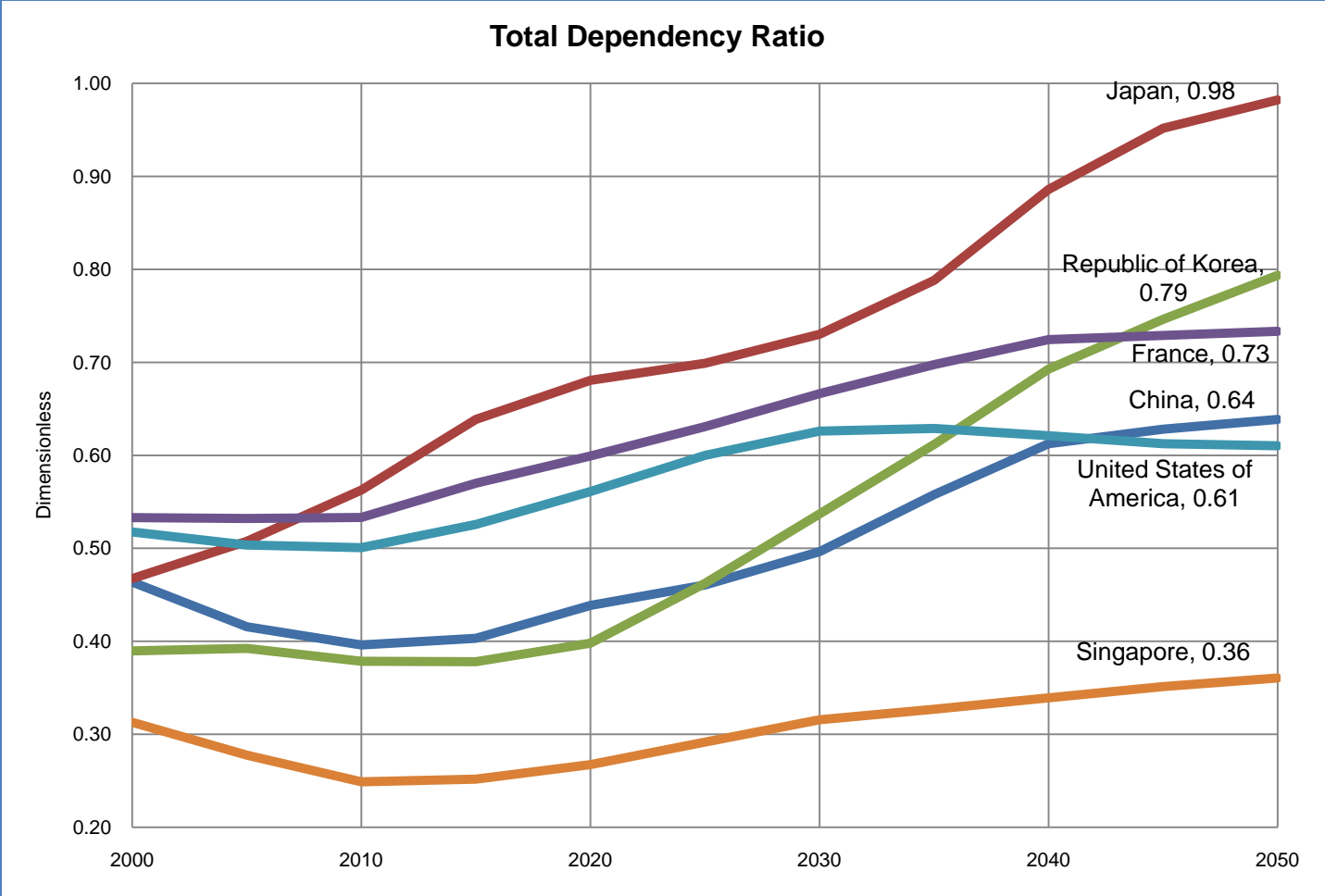


Scenarios

- Business-as-Usual
- No foreign labour becoming resident
- Replacement Birth Rate
- No-emigration



Total Dependency by Selected Countries



Findings

- Dependency ratio is likely to increase and by 2050 (BAU scenario) the model project 1 dependent to 2.3 working age persons
- Decreasing foreign labour becoming resident will decrease dependency ratio, however, resident population is expected to decrease significantly
- Increasing fertility is likely to decrease dependency ratio
- Reducing emigration is likely to increase dependency ratio

Implications

- Singapore relies on foreign population to sustain local population. A decrease in relative attractiveness would consequently affect dependency ratio
- Increasing elderly dependency means increasing care needs for the elderly
- Foreign labour policy is likely to be sustainable for the short and long term horizon provided Singapore remains relatively attractive

Thank You

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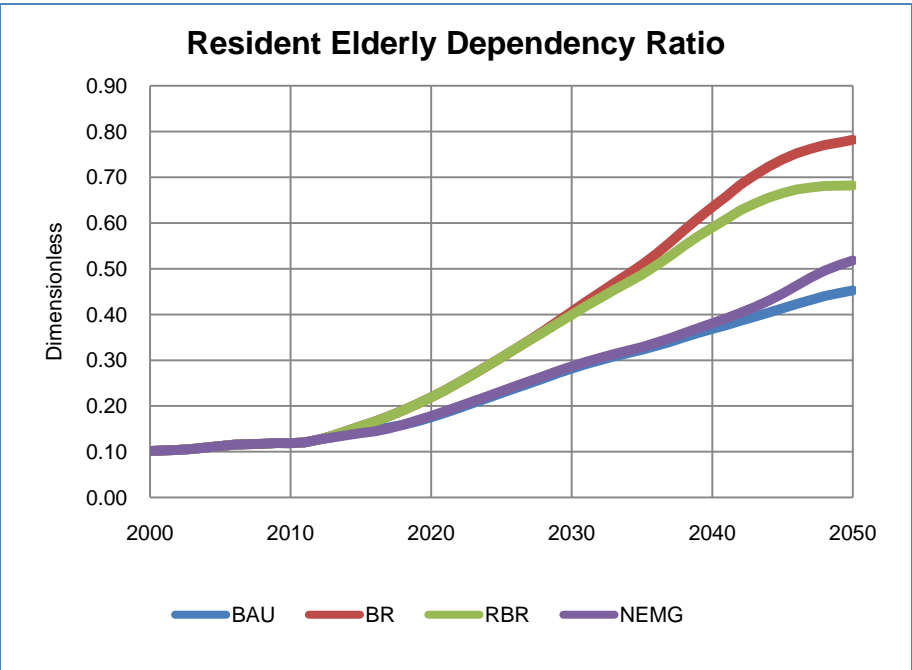
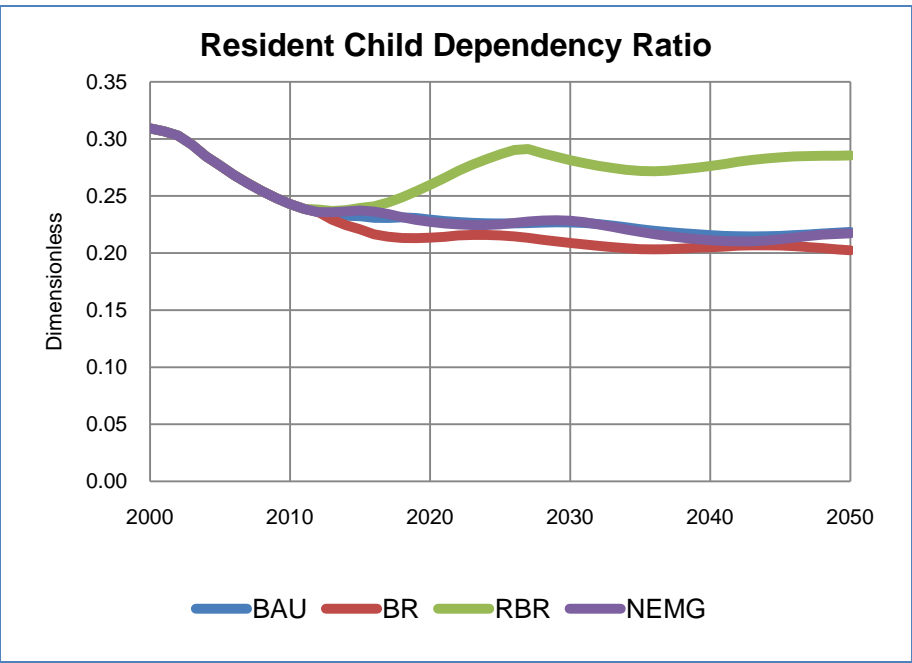
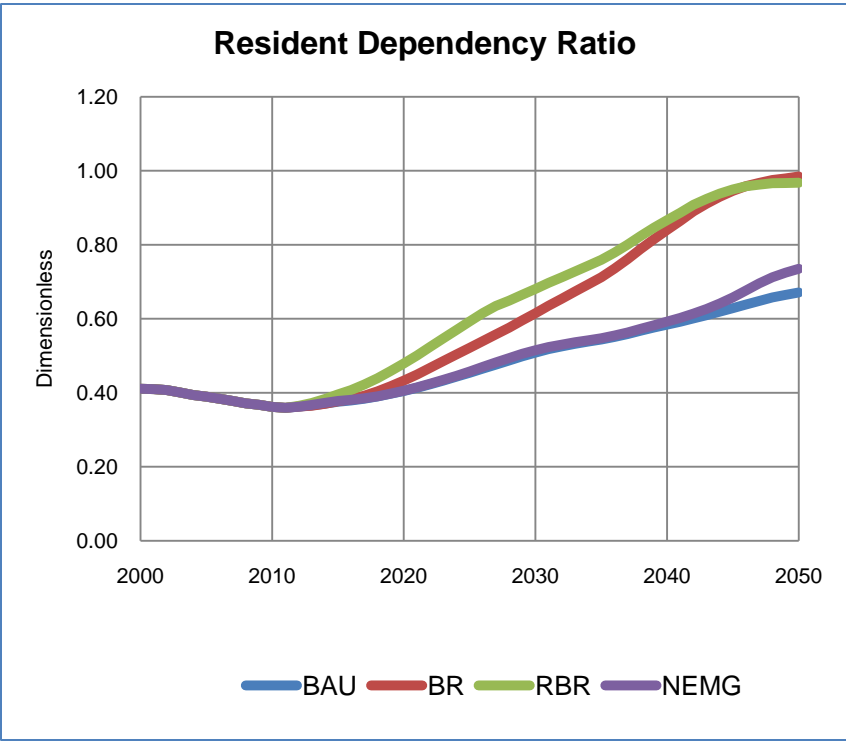


Appendix

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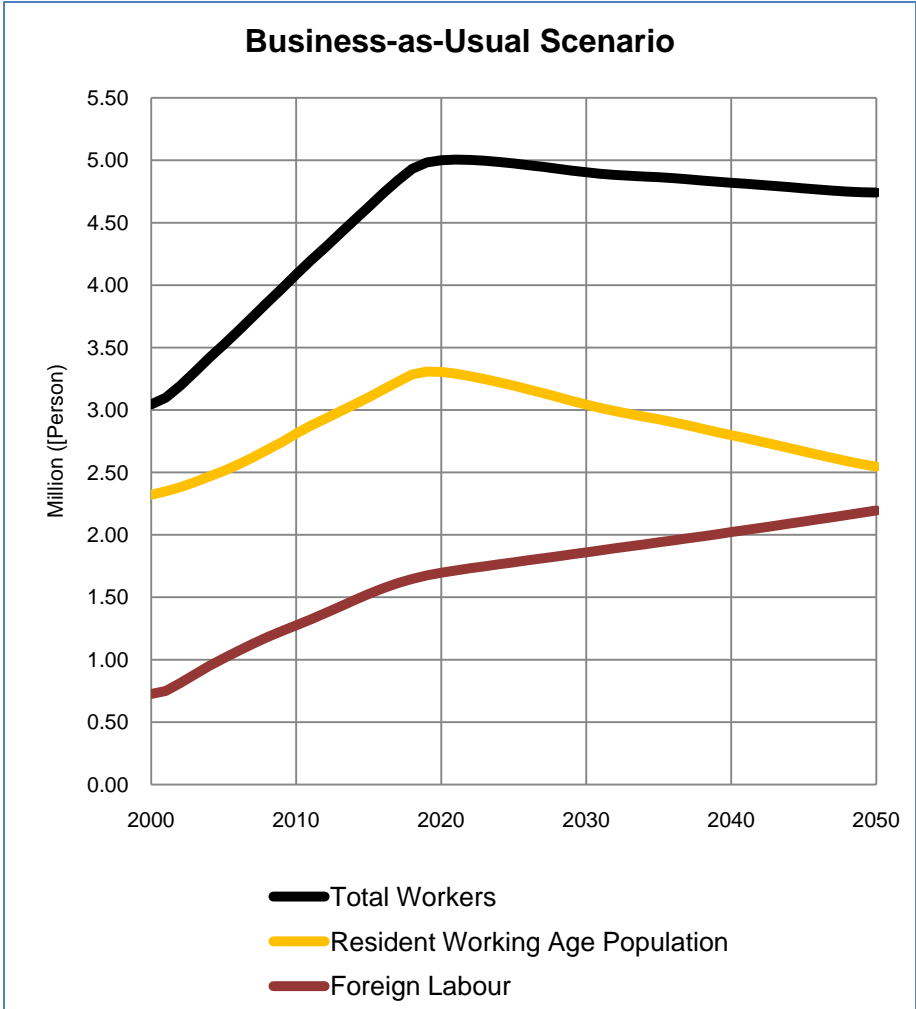
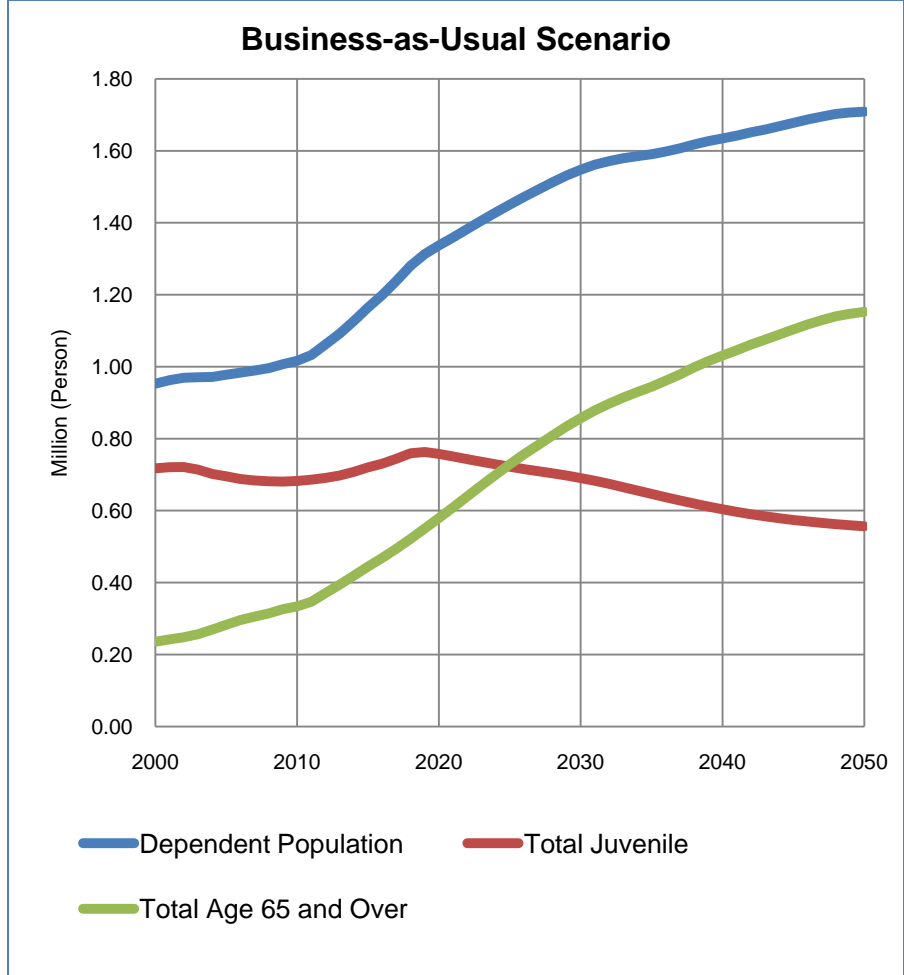
Resident Dependency



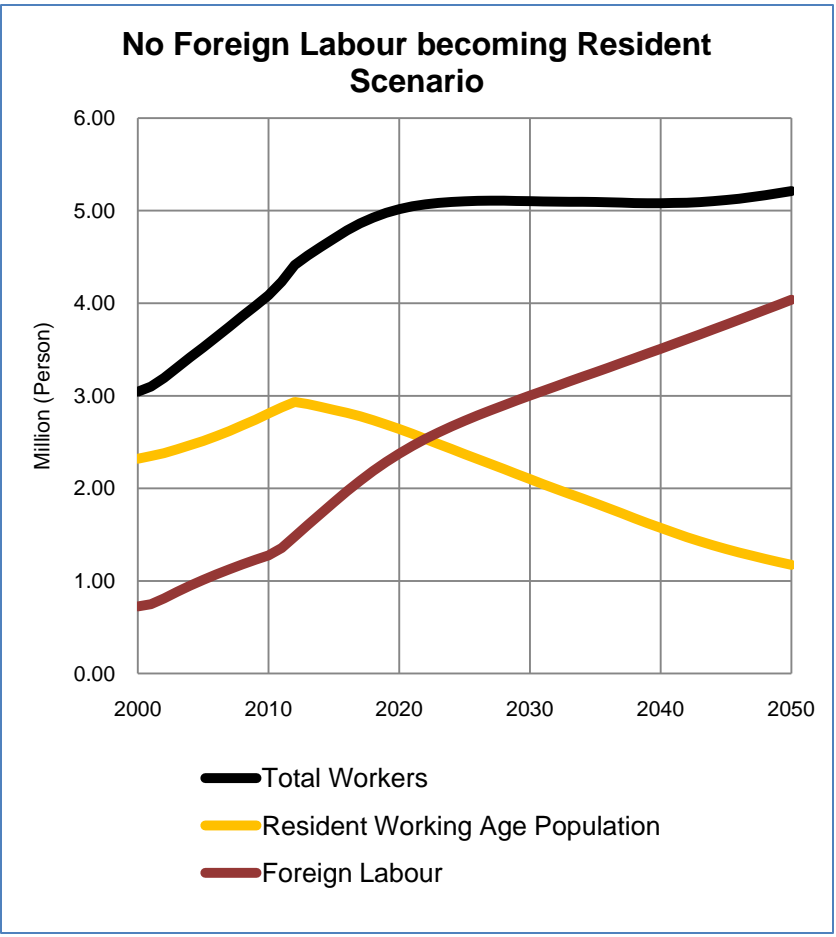
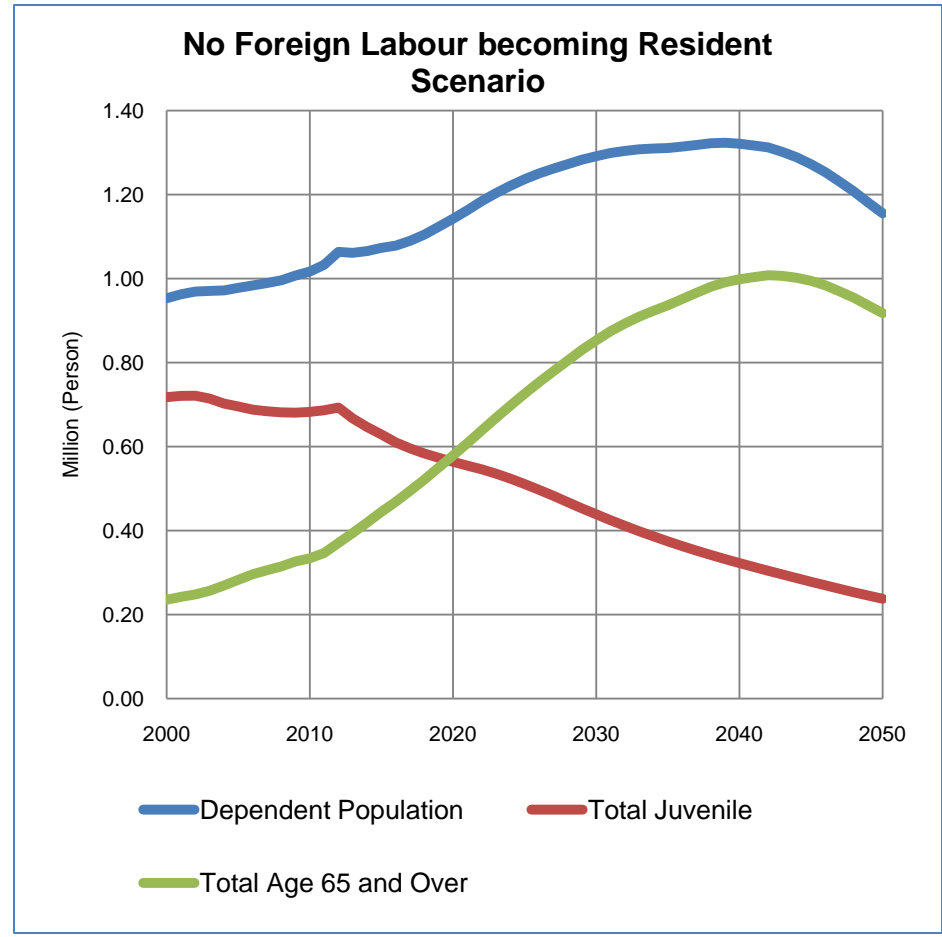
Scenarios

- Business-as-Usual
- No foreign labour becoming resident
- Replacement Birth Rate
- No-emigration

Scenario Output

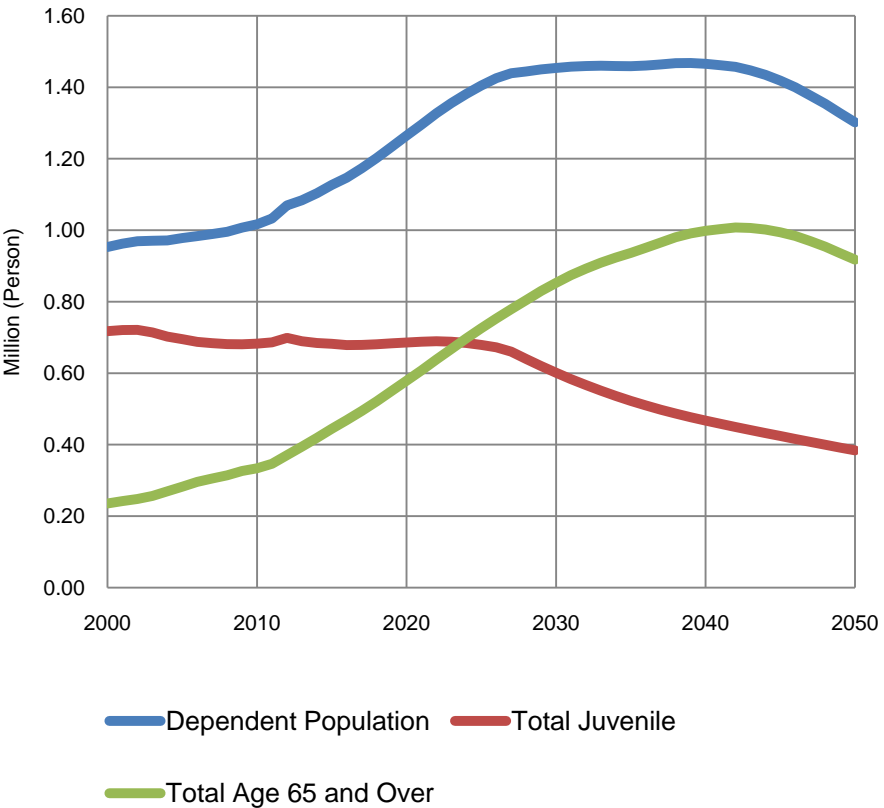


Scenario Output

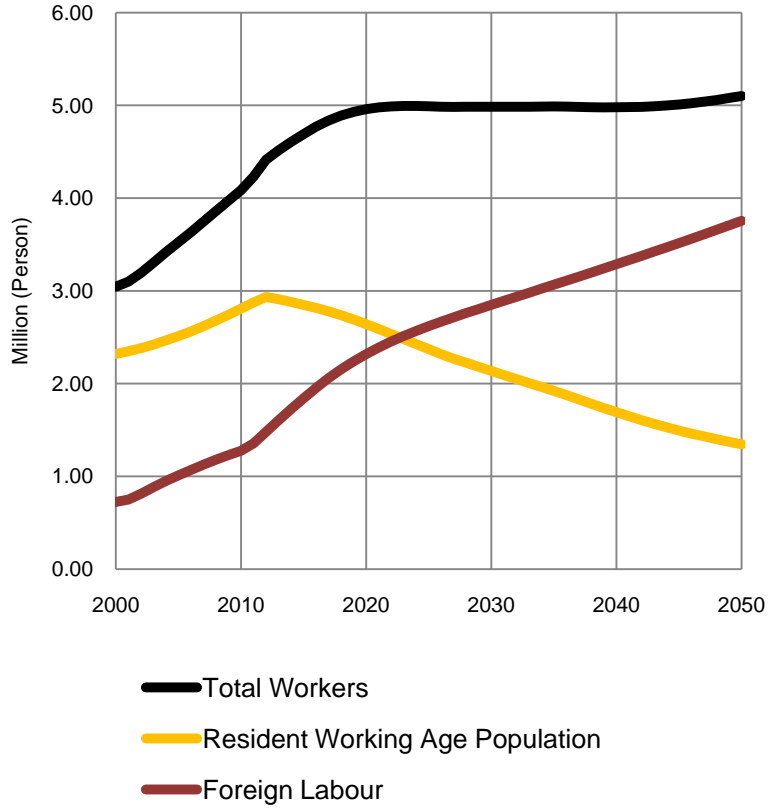


Scenario Output

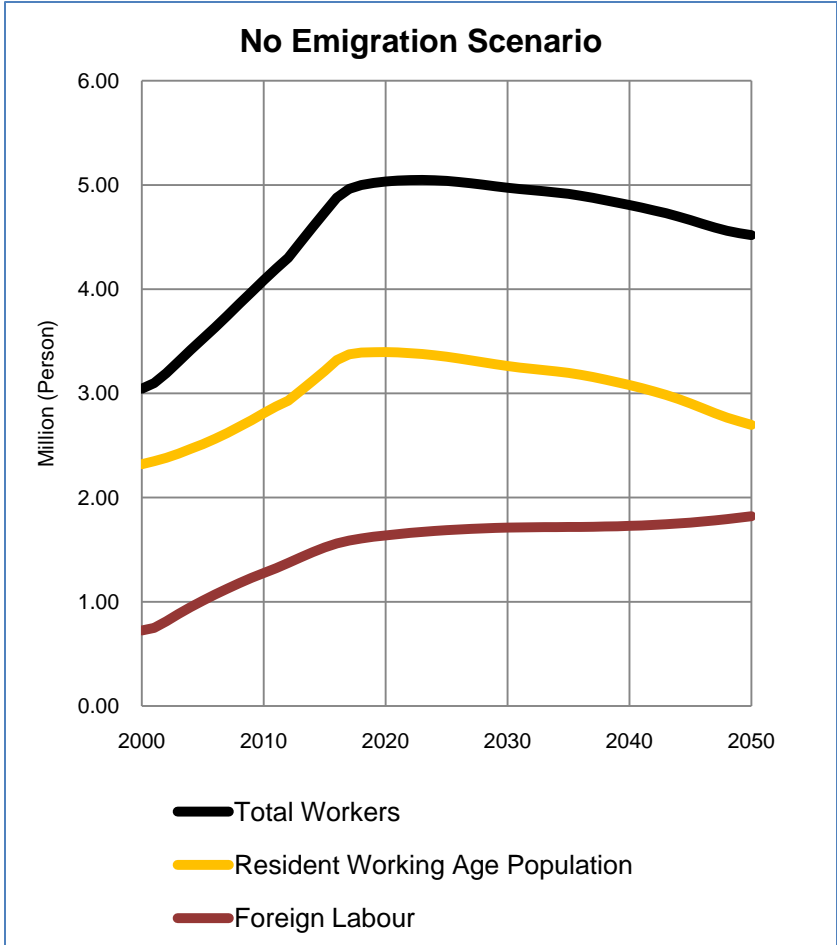
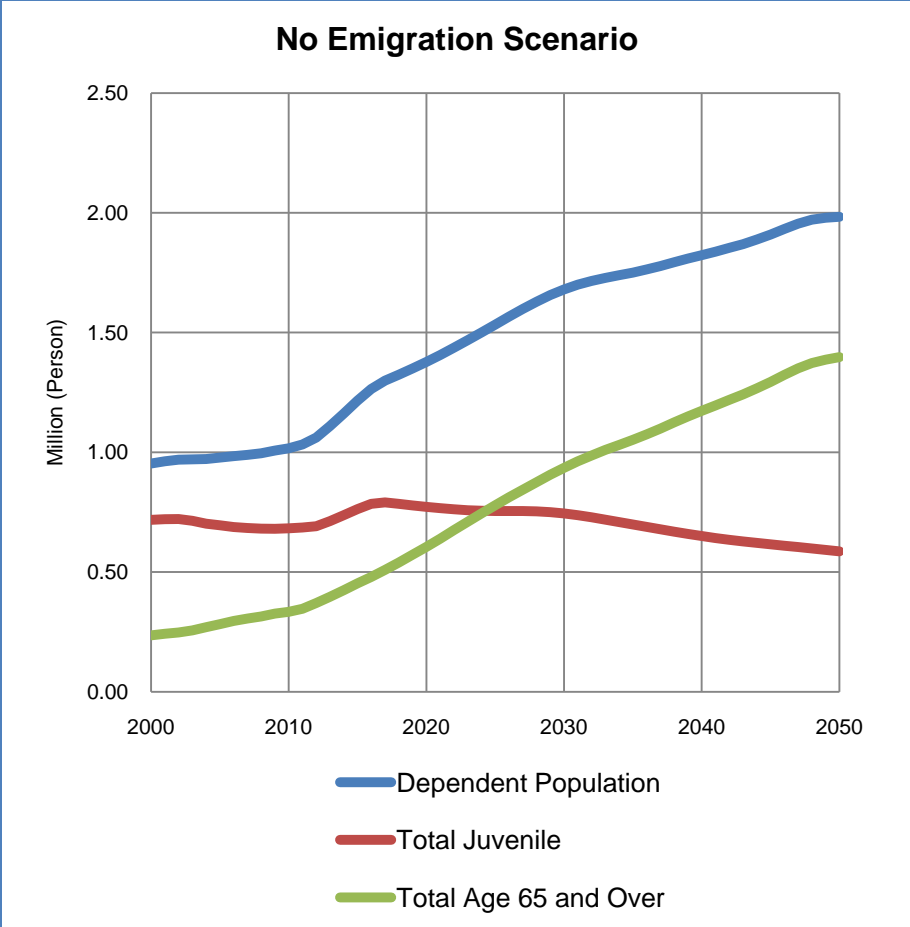
Replacement Birth Rate Scenario



Replacement Birth Rate Scenario



Scenario Output



Further Research

- Disaggregate model by gender and origin (native born, permanent resident and naturalized citizens)