

A Baseline Scenario for the Dynamic GTAP Model

(For the GTAP 6 Data Base)

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1. Introduction

The increasing interest in dynamic models and in particular the development of the Dynamic GTAP model at the Center for Global Trade Analysis has highlighted the need for the development of a baseline scenario depicting how the world economy might be expected to change over the next 20 years. The purpose of this paper is to describe in detail the baseline scenario developed for the Dynamic GTAP model (Ianchovichina and McDougall, 2000) and the GTAP data base (Dimaranan and McDougall, 2005).

In the dynamic GTAP model the policy experiment of interest is compared against a counterfactual baseline scenario. The baseline scenario should reflect as closely as possible the changes expected to occur in the world economy, excluding the particular policy of interest. In this baseline we examine the expected changes in macro economic variables such as the growth of real GDP, capital, skilled and unskilled labour etc.

While there is a tendency in this paper to speak of the Dynamic GTAP baseline scenario, it should be understood that in practice each baseline is likely to be unique, incorporating those elements of a baseline which are most relevant to the actual policy question being examined. There are, however, certain key variables which form the basis of most baseline scenarios, it is with these variables that the focus of this paper lies. Despite the fact that baseline scenarios will differ, there are significant benefits to be gained, in terms of time-saved and comparability of results, from sharing a common set of forecasts for these variables.

The paper may also refer to the baseline program. This is the program developed to calculate the growth rates of the macro variables and then aggregates these shocks for use with a GTAP data aggregation.

2. Macro Projections

The first section of the baseline scenario relates to the macro projections. Projected values of gross domestic product, gross domestic investment, capital stocks, population, skilled labor and unskilled labor for the period 2001 to 2020 were obtained for 226 countries. This section is divided into two sub-sections: the first sub-section contains a description of the projections, including the macro projections and macro data; and in the second sub-section, the procedures used to fill missing data are explained.

2.1 Data Sources for Projections

2.1.2 Projections

Projections were obtained for gross domestic product, consumption, gross domestic investment, population, total labor and skilled labor. Descriptions of this data are given below:

- 1) *Gross domestic product, consumption, population (total, less than 15, 15-65 and over 65) projections* were available for 147 regions for the period 2000 to 2015. These projections are consistent with the projections from the Global Economic Perspectives Data (2005).
- 2) *Gross Domestic Investment projections* were available for 148 regions for the period 1992 to 2007. These 148 regions corresponded to 133 of the 226 standard countries. These projections are consistent with the projections from the Global Economic Perspectives Data (2002).
- 3) *Labor force projections* were available for 146 regions for the period 1960 to 2010 (and in some cases 2015). These 146 regions corresponded to 147 of the 226 standard countries.
- 4) *Skilled labor projections* were obtained from two sources.
 - a) For the less developed countries projections of the share of secondary and tertiary educated¹ labor as a proportion of the population were obtained for 71 developing countries. These were five yearly projections from 1990 to 2020. These projections were obtained from Ahuja and Filmer (1995).

¹ Note that the forecasts are based on education while the GTAP Data Base uses occupation to split skilled and unskilled labor endowments. Since we are examining forecasted growth the difference in definitions is not considered substantial, however care should be taken in using the data in other ways in combination with the GTAP data.

- b) For the developed economies skilled labor projections were based on projected skilled labor shares (based on education) for 12 developed/developing regions, corresponding to 25 countries, over the period 1994 to 2050. These were obtained from the CPB (1999).

2.1.2 Other Data Required

In addition to projections, macro data for the base or initial year (2001) was also collected for all standard countries. The macro data is that used in the construction of the GTAP 6 Data Base (Dimaranan, 2005).

2.2 Missing Data

In all cases the projections obtained from the various sources listed above were incomplete and in some cases incompatible. Some processing was required to get them into a common format and to ensure that there were values for all 226 standard countries and for all years of interest (2001 to 2020). In this section, the assumptions made and the steps taken to achieve this are outlined. The macro projections are discussed in turn below.

2.2.1 Gross Domestic Product, Consumption and Population

A number of steps were undertaken to obtain gross domestic product, consumption and population for all standard countries. These included extrapolating, filling in projections for missing countries, scaling and finally calculating yearly growth rates. Each of these stages is discussed in turn below.

Extrapolation

Since projections were only available for the period 2001 to 2015, the first step was to determine the growth rate which should be used to extrapolate from 2015 to 2020. Firstly, it was assumed that the per capita growth rate would be used to extrapolate², with the population projections were used to determine per capita growth rates. The growth rate used for extrapolation was the average growth rate in the final five years, usually 2010 to 2015.

² The difference between extrapolating based on growth rates and per capita growth rates was not significant since population growth rates were also extrapolated.

Filling in missing countries

The next step involved providing projections for those standard countries where projections data was not obtainable. Data was obtained 147 countries, leaving 79 countries to be filled. The growth rates of these 79 countries were assumed to equal the average growth rate of the countries for which data was obtained. It was necessary to estimate the growth rates for the remaining 79 countries in order to ensure that the estimated growth of the Rest of World region was not biased towards the growth rate of one particular country in the region.

Scaling

The GDP and consumption projections data are based on 1995 prices. In addition projections for the base year (2001) were often inconsistent with those implied in the GTAP Data Base. In order to ensure consistency between the projections and the GTAP Data Base all projections were scaled so that the base year projection (2001) was equal to the value implied in the GTAP data base.

Calculate growth rates

Finally these projections were converted into yearly growth rates. The resulting growth rates for selected regions are shown in Figures 1-6.

Figure 1: Gross Domestic Product Growth Rates for 2001 to 2020

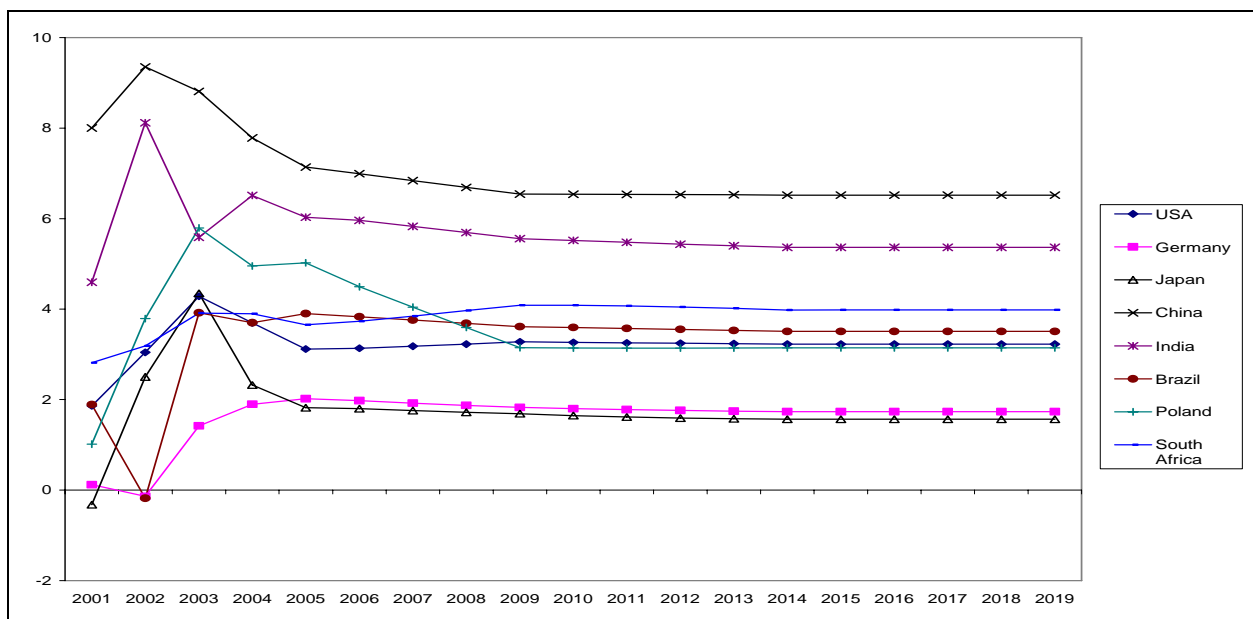


Figure 2: Consumption Growth Rates for 2001 to 2020

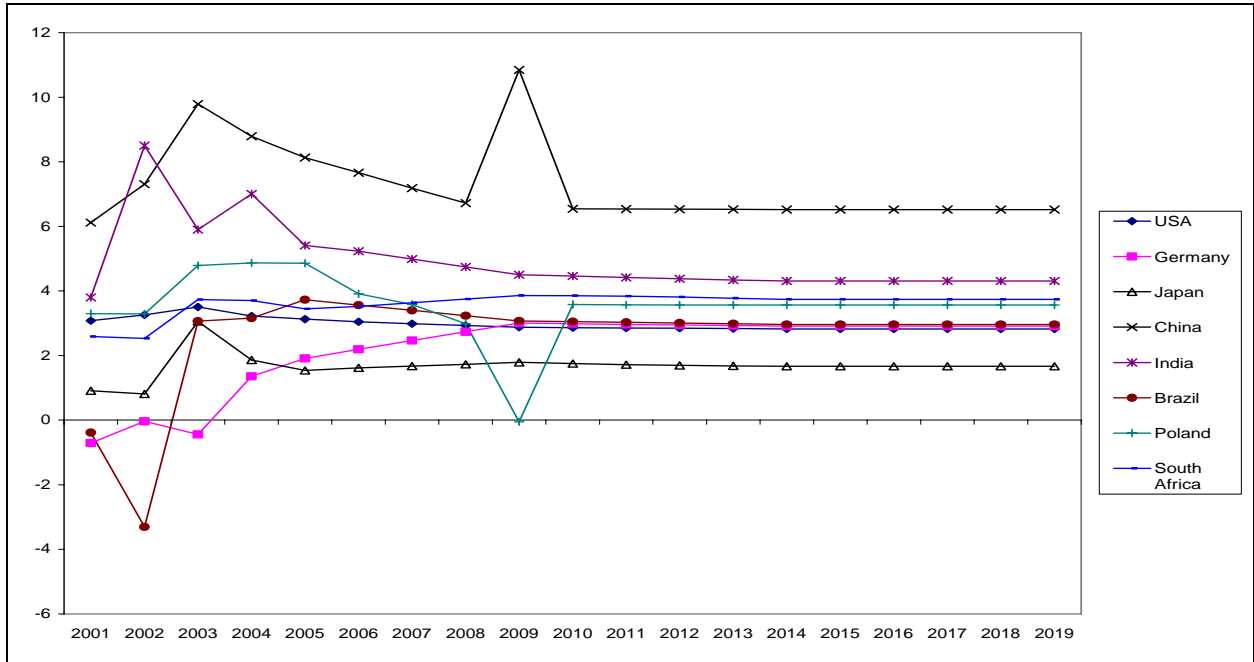


Figure 3: Population Growth Rates for 2001 to 2020

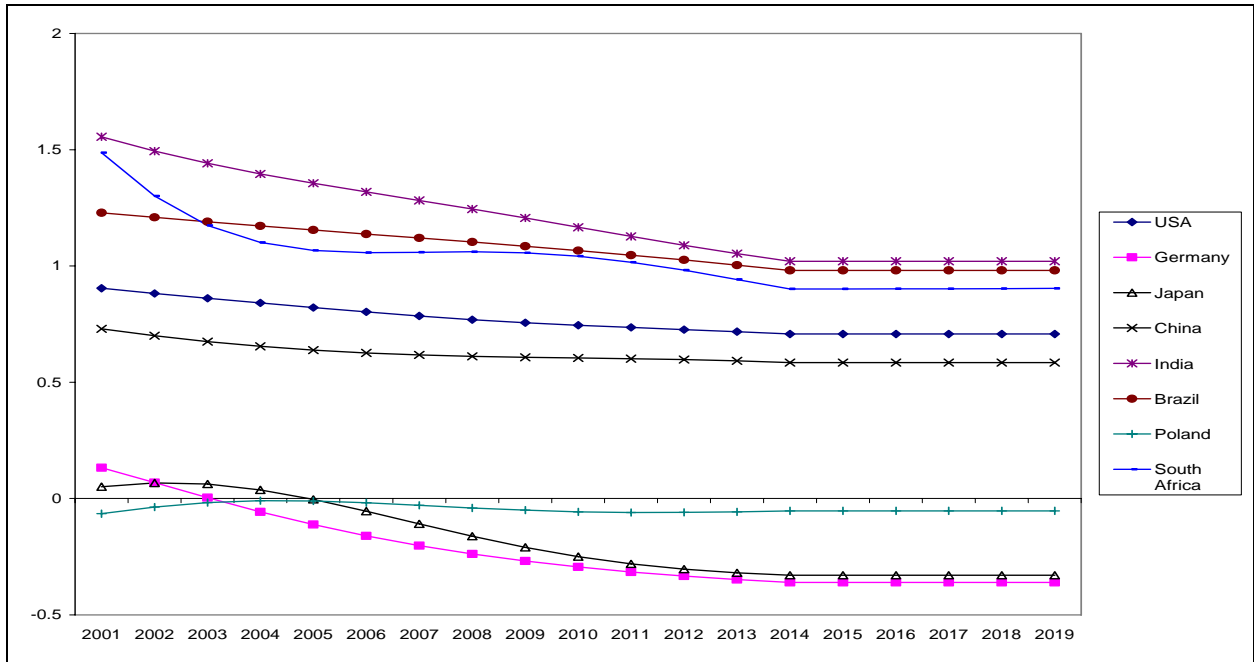


Figure 4: Population less than 15 Growth Rates for 2001 to 2020

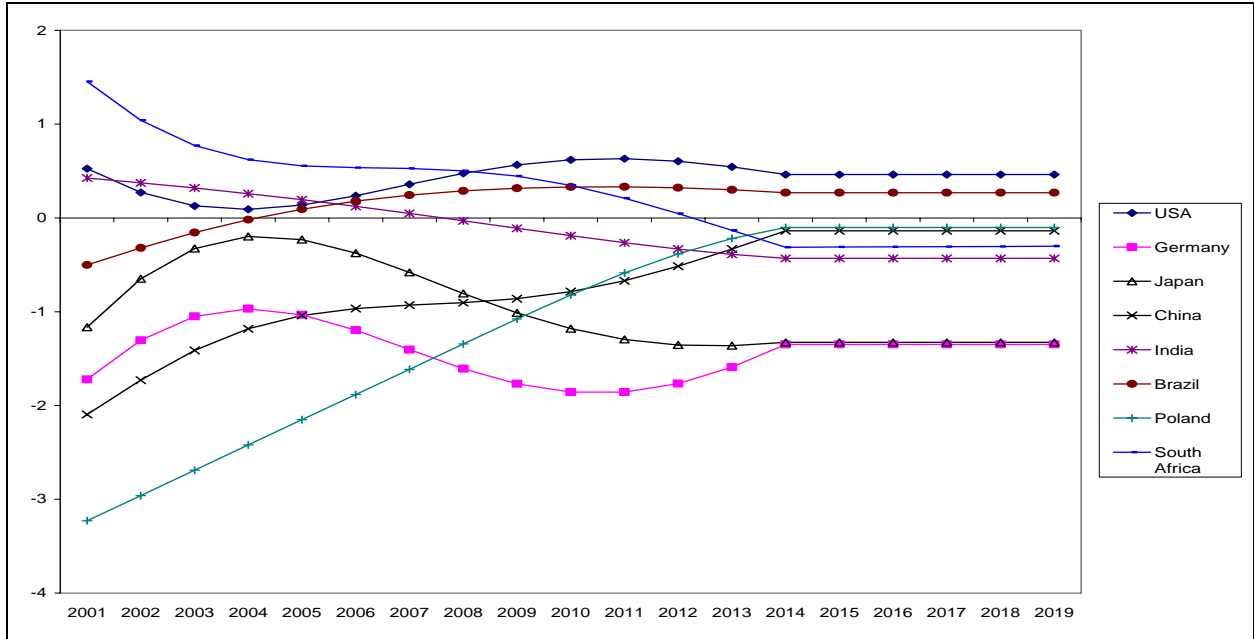


Figure 5: Population 15 to 65 Growth Rates for 2001 to 2020

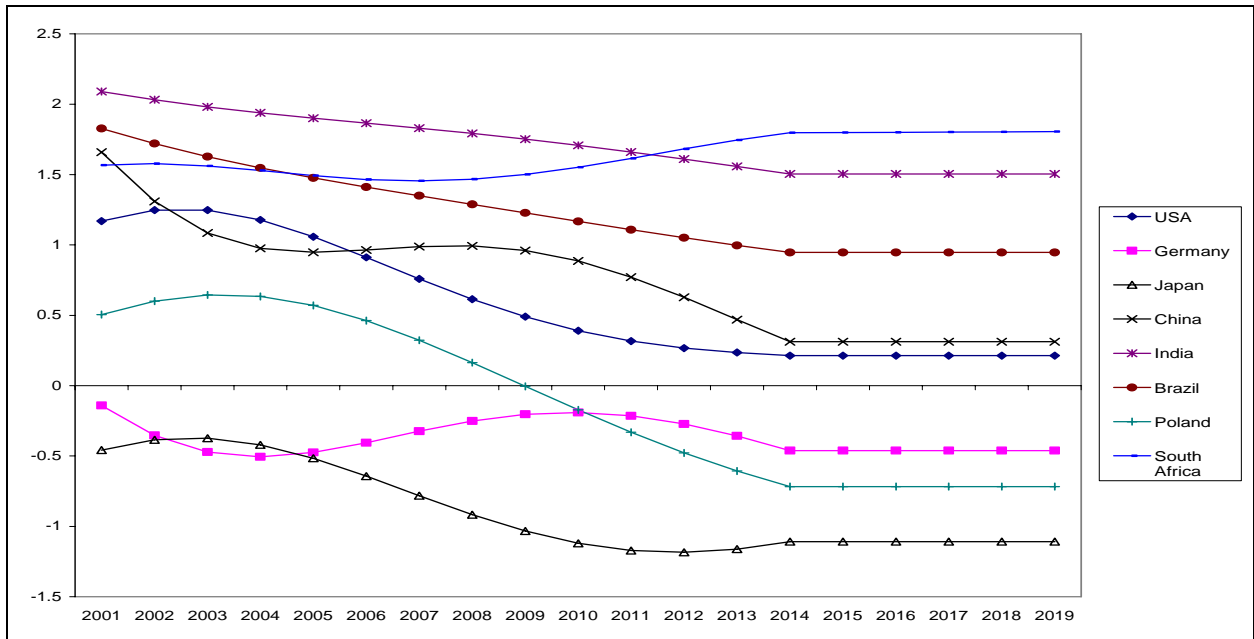
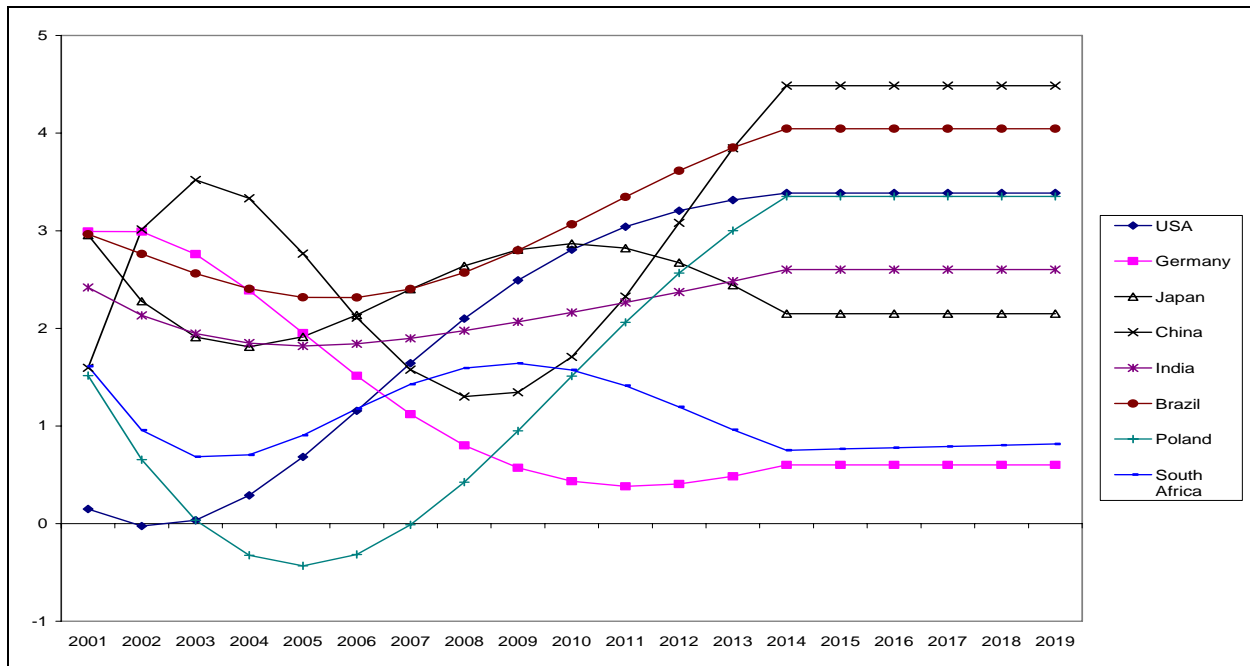


Figure 6: Population 65 and over Growth Rates for 2001 to 2020



2.2.2 Gross Domestic Investment

The projections data for gross domestic investment (GDI) had not been updated since the first baseline was developed in 2000. Hence the GDI data was very old and based on 1992 prices. For this reason it was assumed that the GDI/GDP ratio's forecast previously would remain the same. The data was also extrapolated, regions disaggregated and missing values estimated as in the previous cases.

Extrapolation

The GDI/GDP ratio's were used to obtain estimates for the period 2008 to 2020. The ratio of GDI to GDP in the final period was used to extrapolate to 2020.

Disaggregating Regions

Data was obtained for 133 regions. These 133 regions corresponded to 148 of the standard countries. First these regions were disaggregated using GDP shares. So that the GDI to GDP ratio's were the same for all countries in the region. For example, one of the 133 regions

was blx. This region included both Belgium and Luxembourg. The GDI was divided across the two countries so that the GDI/GDP ratio was the same for both Belgium and Luxembourg.

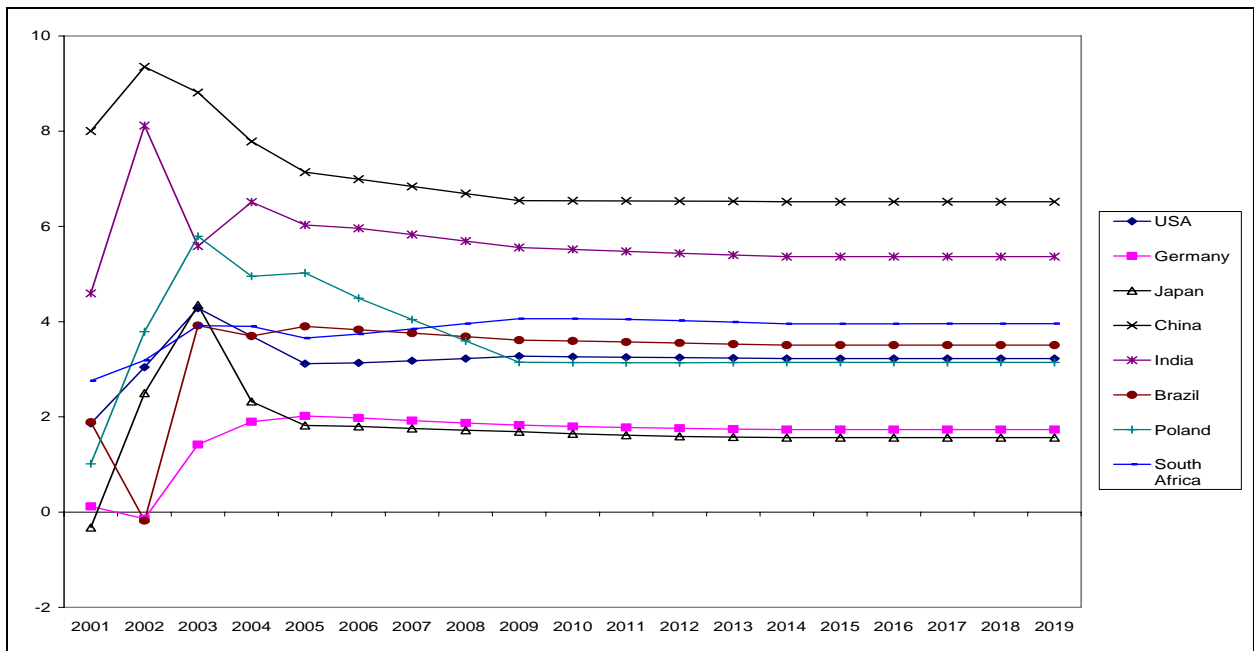
Filling in Missing Data

Following this any missing values were estimated using the same procedures as outlined above for Real GDP. In this case there were many more missing values as projections were only available for 148 of the 211 standard countries. The average GDI/GDP ratio for each period was assumed to apply to all those countries for which no data was available.

Updating

These ratio's were then applied to the new GDP projections to obtain the new forecasts for Gross Domestic Investment. The resulting growth rates are depicted in Figure 7.

Figure 7: Population 65 and over Growth Rates for 2001 to 2020

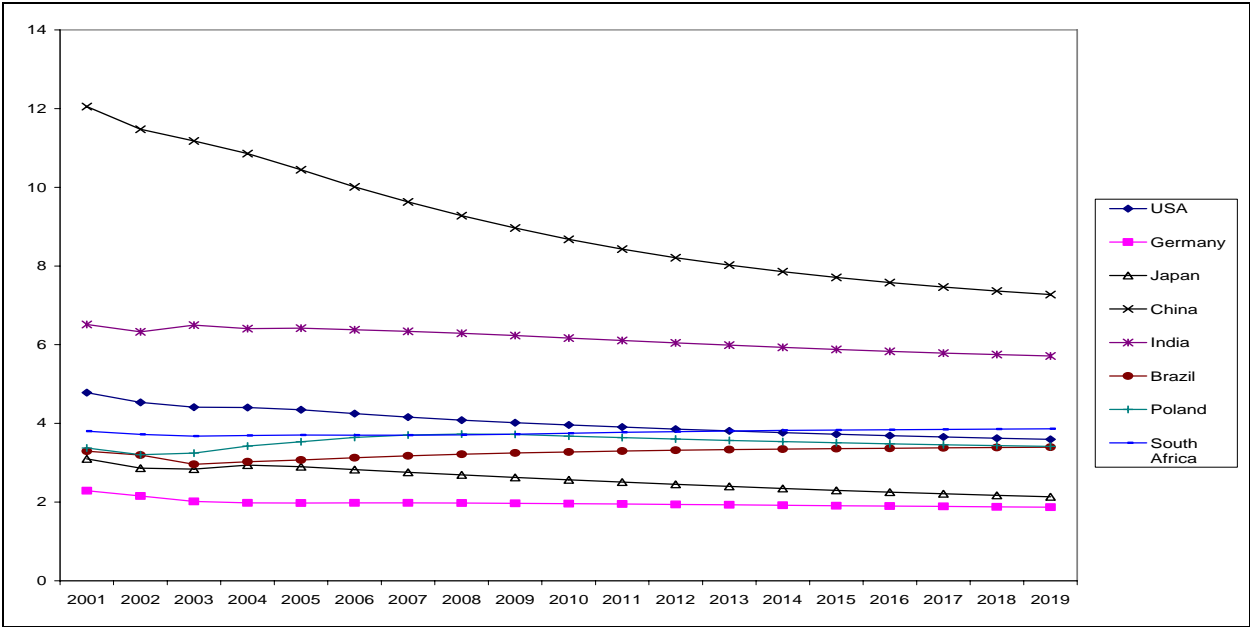


2.2.3 Capital Stocks Projections

Capital stock projections could not be obtained directly from data sources and thus had to be estimated. Projections for capital stocks ($K_t(r)$) were determined by adding projected gross domestic investment ($GDI(r)$) to the previous years projected capital ($K_{t-1}(r)$) stock less

depreciation, where depreciation is 4 percent. Base year capital stocks for all standard countries were obtained from the GTAP data base construction process. The capital stock projections are shown in Figure 8. These figures are consistent with the GDI projections. Countries with high growth of GDI have higher growth of capital. The growth of investment in GDI in the EU commences below North America, hence capital growth rates are also lower. However as investment growth increases in the EU this is shown by higher growth rates in capital.

Figure 8: Population 65 and over Growth Rates for 2001 to 2020



2.2.5 Labor Projections

Projections are made for total labor, skilled labor and unskilled labor. As was the case for gross domestic product, population and gross domestic investment, a number of steps were undertaken to obtain projections for the labor force projections for all standard countries. These included disaggregating regions, filling in projections for missing countries and filling in the missing years. The three types of labor projections are discussed in turn below.

2.2.5.1 Total Labor force Projections

Labor force projections were provided for 146 regions for the period 1960 to 2010 (and in a limited number of cases to 2015).

Disaggregating Regions

The 146 regions corresponded to 147 of the 211 standard countries. The first step was to disaggregate the region – blx – into the two countries Belgium and Luxembourg. This was done using population shares. The resulting growth rates were the same for both Belgium and Luxembourg.

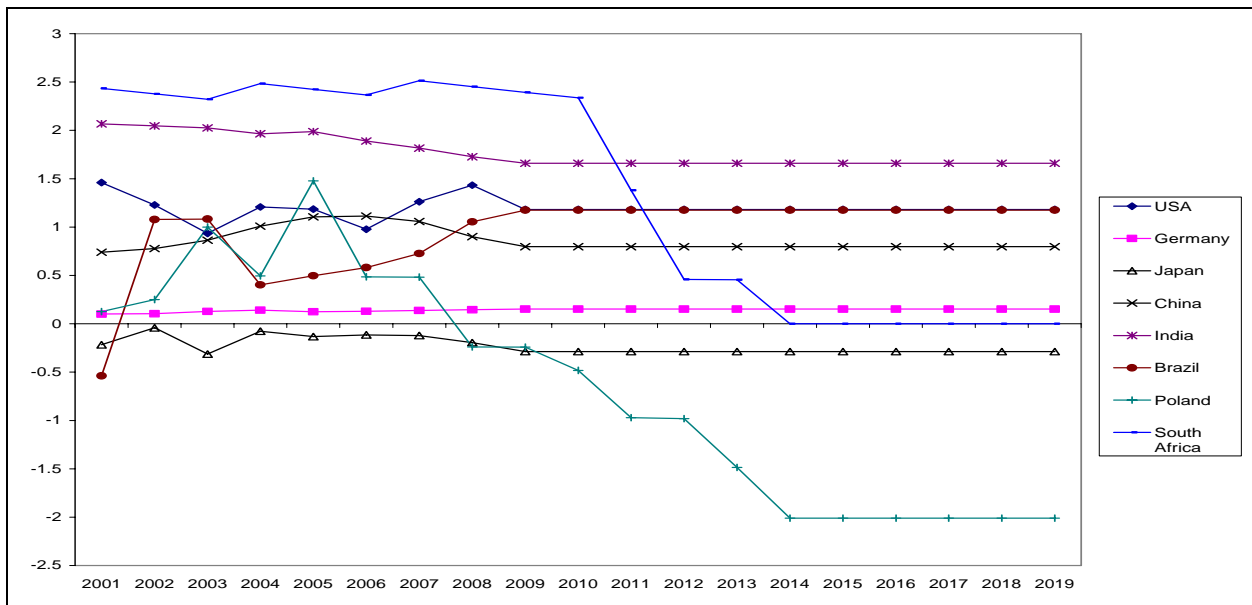
Filling in missing countries

The next step involved providing labor force projections for those standard countries where no labor force projections data was obtainable. Labor projections were filled by assuming that the growth rates for those countries where data was not available were assumed to equal the average growth rate of the countries for which data was obtained.

Filling in the missing years

Labor force projections were then extrapolated assuming that the growth rate in the final year would continue to 2020. The resulting growth rates are depicted in Figures 9.

Figure 9: Labor Force Growth Rates for 2001 to 2020



2.2.5.2 *Skilled Labor Projections*

As mentioned above skilled labor force projections were obtained from two source. Five yearly projected shares of labor force were obtained for the less developed countries were obtained from Ahuja and Filmer (1995); while projected shares were obtained for 12 regions (CPB, 1999). In order to obtain a complete set of projections a number of steps had be taken to both sets of data.

Wherever possible the Ahuja and Filmer (1995) data was used to get specific estimates of skilled labor shares for the developing economies. The data from the CPB (1999) was used to provide estimates for the developed economies.

Less Developed Countries

Data for less developed economies is available for both tertiary and secondary education. In the baseline, tertiary education was used to estimate skilled labor. Projections for less developed countries were initially given as projected shares of the labor force. The shares were available in 5-year intervals from 1990 to 2020. In order to obtain projections two steps are undertaken.

Firstly, it is necessary to fill in projections for the intermediate years. In order to do this it was first necessary to find the average yearly growth rate for each of these 5-year periods. It was then assumed that within a given five year period yearly growth rates of shares for a particular country are equal. These growth rates are then used to obtain the projected shares for each year.

Secondly, the shares are then used to determine the projected number of people with a tertiary and secondary education. This is found by multiplying the projected share with the projected labor force determined above.

Developed Countries

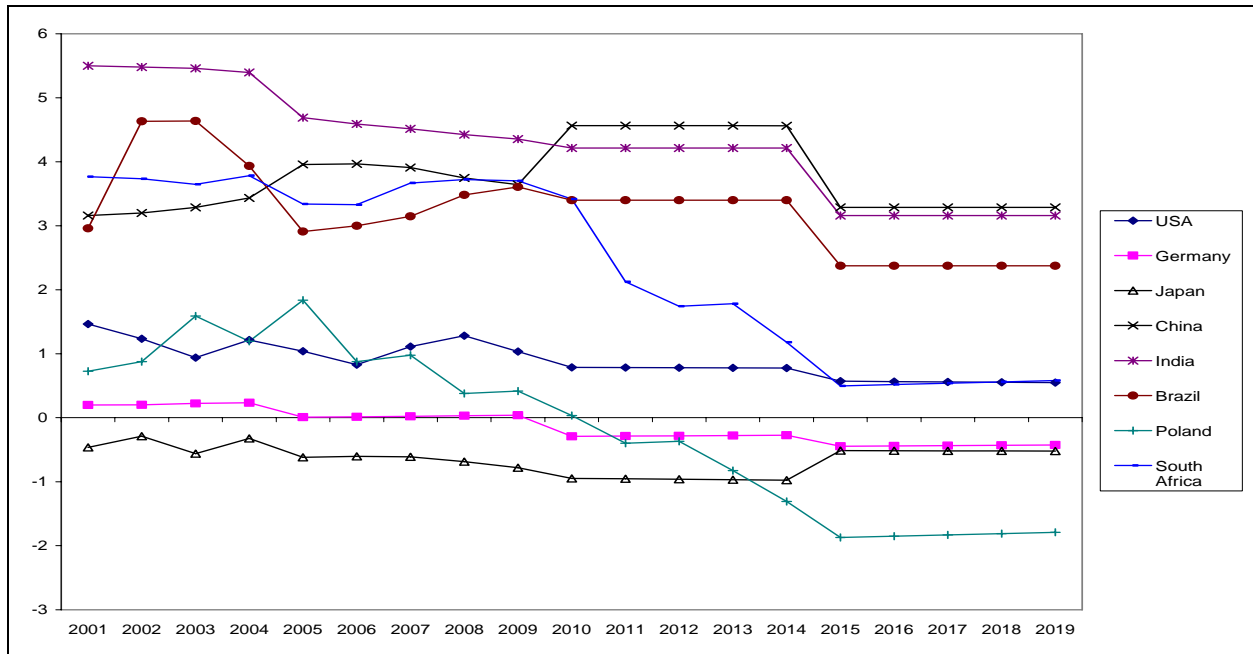
The share of skilled labor in the total labor force were obtained for 12 regions. These regions included both developing and developed regions. 25 developed economies were then given the projected shares of the region in which they were located. These shares were then combined with the labor force projections determined above to obtain projected skilled labor shares.

Combining and Filling

The next step involved providing skilled labor force projections for those standard countries where no skilled labor projections data was available. Skilled labor projections were filled by taking the projected value of labor for that country and multiplying it by the total average share of skilled labor in total labor. The total average share of skilled labor in total labor uses both the projections for the developed and less developed countries.

Figure 10 shows the resulting growth rates for skilled labor. The skilled labor growth rates depict the same patterns as the growth rates in the total labor force.

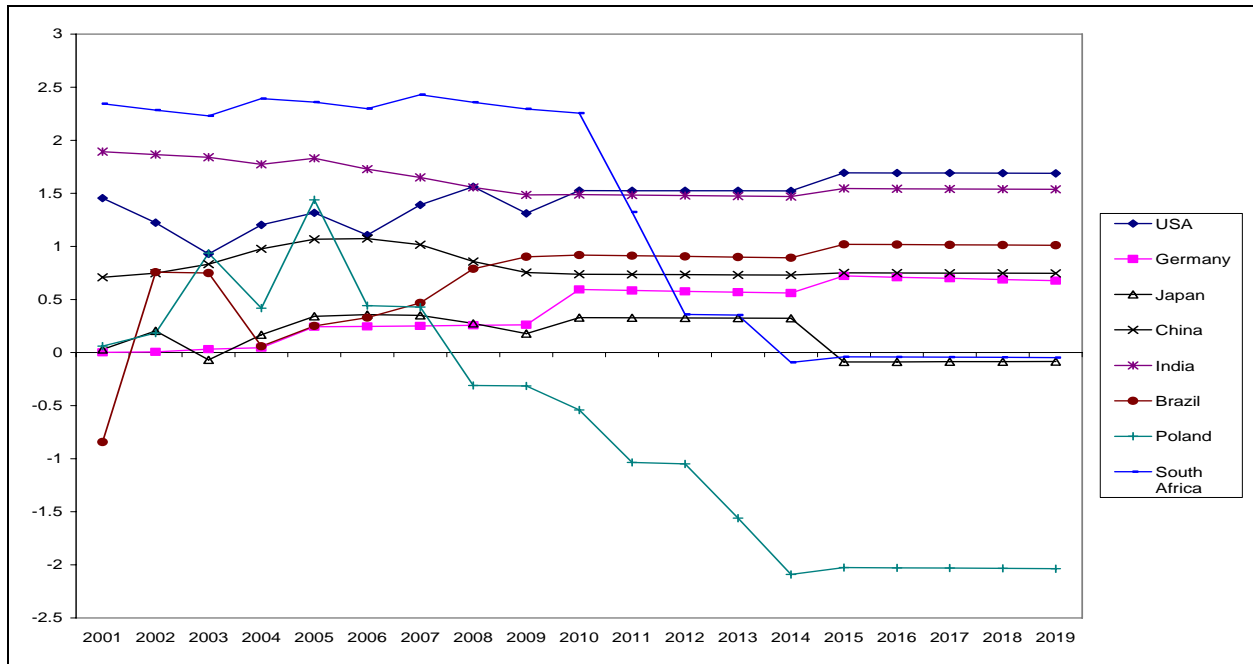
Figure 10: Skilled Labor Force Growth Rates for 2001 to 2020



2.2.3.3 Unskilled Labor Projections

Once total labor and skilled labor projections were determined, unskilled labor projections were calculated as the difference between the total labor and skilled labor projections. The resulting growth rates are shown in Figures 11.

Figure 11: Unskilled Labor Force Growth Rates for 2001 to 2020



3. Conclusions

Finally the macro projections are then aggregated into a GTAP specific aggregation which matches your application. The shocks are then calculated. In addition to aggregating across regions and commodities the aggregation program also allows you to aggregate the shocks over time. The baseline scenario can therefore be used for both the standard and Dynamic GTAP model.

In the future we hope to expand the baseline/projections data available. Work is currently being undertaken on productivity shocks to agriculture and we would like to encourage others to use the GTAP website to collect and share baseline materials.

4. References

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