DEMOGRAPHIC INTERACTIONS BETWEEN NORTH AND SOUTH AND THE IMPLICATIONS FOR NORTH-SOUTH CAPITAL FLOWS

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Abstract

This paper focuses on the macroeconomic consequences of demographic differences between lower- income, less developed countries (the "South") and higher-income developed countries (the "North"). The analysis emphasizes the likely implications in the two regions for aggregate saving- investment imbalances, exchange rates, and the resulting net capital flows between North and South. An optimistic view of asymmetric demographic transitions among Southern and Northern economies suggests that the North can run a current-account surplus sizable in relation to the Northern economy, thereby transferring large net amounts of financial capital to the South. This paper argues that the optimistic view is a plausible summary of demographic influences on North-South capital flows in the historical period between 1950 and the mid-1970s. For historical decades after the 1970s and for the initial decades of the 21st century, however, the analysis suggests instead that asymmetric demography between the South and the North operates to *reduce* rather than increase the net flow of Northern savings to the South as a proportion of the Southern and Northern economies. This conclusion holds broadly for a range of alternative assumptions about the speed of the South's demographic transition. It also appears to hold regardless of whether Southern productivity growth is vigorous or sluggish, and regardless of whether cross-border goods substitutability is moderate or strong. Substantial research remains to be done to refine the paper's analytical framework and to test the robustness of this conclusion.

Every region of the world has been gradually moving from a state of short life spans and high fertility rates to one of longer lives and lower fertility rates. These demographic transitions have been dramatically altering the age structures of populations. Eventually, the entire world is expected to be characterized by few births per woman, long life expectancies, and population structures with more elderly individuals and fewer children.

In the early stages of a demographic transition, both infant mortality and overall mortality decline. As a result, children become more numerous and the population becomes younger. Decreases in infant mortality are often accompanied, typically with a lag, by declines in fertility rates, as mothers choose to maintain a similar expected number of surviving offspring. In later stages, the working-age population and the labor force grow faster than the population as a whole. This development, sometimes termed a "demographic dividend," causes a marked decline in the youth dependency ratio, the fraction of youths as a share of the total population. In the final phases of a demographic transition, further increases in longevity and a low fertility rate slow the growth of the working-age population; the elderly dependency ratio (elderly as a share of the population) rises sharply.

Although now pervasive, the timing and speed of these demographic changes have been highly asymmetric across regions. Western European countries began their transitions at the beginning of the 19th century. Those countries, along with many other industrial countries, are now in the later stages of their transitions with old-age dependency ratios increasing rapidly. At the other extreme, the transitions in some least developed countries have started only in recent decades. Such countries are still experiencing rising youth ratios and are only now beginning to enter the period of demographic dividend. Although substantial heterogeneity exists within each grouping, the largest demographic asymmetries in the world today exist between higher-income OECD countries (the "North") and lower-income, less developed countries (the "South").

Asymmetric demographic change has major macroeconomic consequences. Exchange rates and external imbalances in particular are strongly influenced by demographic differences across countries, which in turn can cause significant effects on countries' welfare.

For several years, I have been carrying out research on these global dimensions of demographic change. This paper draws extensively on that earlier research.[1] Unlike the earlier papers which concentrated on interactions among developed economies, however, this paper takes a new tack: it focuses on the macroeconomic consequences of the broad demographic differences between developed and developing economies. It emphasizes the likely implications in the two regions for aggregate saving-investment imbalances, exchange rates, and the resulting net capital flows between North and South.

The paper begins with a summary of alternative views about the influence of demographic trends on North-South capital flows. It then describes the analytical approach used in the study, provides an overview of Southern and Northern demographic transitions, and identifies key analytical characteristics of Southern and Northern economies. The bulk of the report analyzes the effects of demographic forces on saving-investment balances and key external-sector variables. Initial conclusions are summarized in the final section of the paper. A postscript discusses the agenda for further research.

Alternative Views of North-South Capital Flows

A relatively optimistic view of asymmetric demographic transitions and the resulting North-South net capital flows suggests that the North can run current-account surpluses sizable in relation to the Northern economy, exporting a significant fraction of Northern savings to the South where the capital-output ratio is lower and, arguably, the rate of return to capital may be higher. Such an outcome could be mutually beneficial, permitting asset owners in the North to earn higher returns on their savings than would otherwise be possible and simultaneously permitting investment within the South to be higher, thereby advancing Southern development and welfare.

This view of North-to-South net capital flows stimulated by savings-investment imbalances in the North and South associated with demographic transitions is suggested by, for example, Attanasio and Violante (2000) and Brooks (2003). Higgins (1998), Lührmann (2003), Bosworth and Keys (2004), and Helliwell (2004) provide partial-equilibrium empirical evidence based on reduced-form regressions in which demographic ratios help to explain savings, investment, and current-account

[1] The earlier research in the project is summarized in Bryant (2004a, 2004b); Bryant, Faruqee, Velescu, and Arbatli (2004); Bryant and McKibbin (2004); and Bryant and de Fleurieu (2005). Bryant (2004b) gives references to related work carried out by other researchers.

balances. This evidence has been interpreted, for example by Bosworth and Keys, as supporting the relatively optimistic view.[2]

The empirical regressions reveal that demographic shifts influence saving and investment differently. Countries with high and rising youth ratios and high and rising elderly ratios tend to have saving fall relative to investment; such countries therefore become larger net importers (or smaller net exporters) of financial capital. High dependency ratios, in other words, weaken a country's current-account balance (move it toward larger deficits or smaller surpluses). Conversely, countries with high and rising ratios of working-age adults to the total population tend to have increases in saving relative to investment and thus to become larger net exporters (or smaller net importers) of capital. Life-cycle models predict several influences, partly offsetting, on savings. The elderly begin to consume out of accumulated wealth in the later years of life. Workers at earlier stages of their lives, on the other hand, may anticipate the greater need for retirement saving in economies where elderly ratios are expected to rise further. The higher saving by workers may increase saving more than the consumption of the rising numbers of elderly may reduce it. Saving thus could rise relative to investment, and some part of the increased saving could flow to lower-income developing economies.

Two considerations, however, caution against a highly optimistic view that financial capital will be transferred in large net amounts from the North to the South. The primary obstacle is that the economies and polities of many developing nations have features that inhibit their net absorption of foreign saving. Macroeconomic management of Southern economies is frequently even less sound than the counterpart management of Northern economies. The prudential supervision and regulation of financial institutions and financial markets may be inadequate. Business contracts may sometimes be less secure than in the OECD economies. More broadly, the quality of institutions and collective governance may be weaker on average in developing countries than they are in the higher-income countries of the OECD. While in principle Southern economies might provide substantial investment opportunities at the margin, in practice the South might not be able to absorb enough Northern savings to alter significantly the saving-investment balance for the North. Most analysts agree that investments in the South by Northern owners of financial capital, if feasible, bring advantages to both the North and South through enhanced risk diversification and higher rates of return. For Southern economies to

[2] The special chapter in the IMF's September 2004 *World Economic Outlook* also replicates empirical regressions in a similar vein (International Monetary Fund, 2004).

capture those potential gains, however, the frictions and impediments – economic, political, and legal – that inhibit Northern investment in the South must not be too severe.[3]

A second set of reasons may also prevent asymmetric demographic transitions from inducing large net capital flows running from the North to the South. Net demographic influences within the North and the South may not operate in ways that will move saving-investment imbalances in the required directions.

In recent decades, Northern youth ratios have declined to considerably lower levels than youth ratios in most Southern economies. OECD elderly ratios have risen to much higher levels than elderly ratios on average in the South. On balance, total dependency ratios (youths plus elderly as a proportion of either the total or the working-age population) tend to be markedly higher in the South than the North. Considered in isolation, the differences in dependency ratios between the North and the South thus support the hypothesis that savings will be weak in the South and stronger in the North, thereby leading the North to be a net exporter of savings to the South, for at least the near-term future.

For the medium and long runs, however, the demographic transition for the South as a whole, and certainly the transitions of important individual developing economies, will move just as fast or faster than the continuing demographic transitions within the OECD. The higher youth ratios in the South will continue to fall rapidly. Most of the higher-income advanced countries, in contrast, have already experienced the larger part of their fertility declines. Northern youth ratios are projected to change relatively little in the future; increases in Northern elderly ratios will be dramatic for several more decades. Thus total dependency ratios may well rise in the North relative to the South. The large prospective Southern declines in fertility, moreover, will permit reductions in expenditures for children's consumption and child-related investments (relative to what they would be with higher youth ratios), thereby freeing resources for adults to raise adult consumption, saving, or some of both. The demographic dividend in Southern economies (large numbers of children entering the work force, raising the labor force and output) that has already been prominent in Asia – Higgins and Williamson (1997) – will continue for several more decades. These considerations suggest that, over

[3] Analysts such as Holzmann (2000) and Helliwell (2004) are relatively pessimistic that improvements in institutional quality and collective governance are feasible within a sufficiently short time. The World Bank's (2002, 2004) *World Development Reports* for the years 2002 and 2005 emphasize issues about institutions and the investment climate in developing countries.

the medium run, demographic factors could cause Northern saving to fall relative to Northern investment while Southern saving rises relative to Southern investment.

Today there is a large gap between Northern and Southern demographic transitions. Again, the levels of total dependency ratios are higher in the South than the North. But the effects of demographic transitions depend not only on the absolute *levels* of dependency ratios, and hence on the levels of the underlying birth rates and mortality rates, but also on the sizes of incremental *changes* in dependency ratios and underlying demographic rates. If one focuses on the changes as well as levels, the demographic transitions in Northern economies are beginning to slow down while transitions within Southern economies are just now picking up speed.

Thus the gap between Southern and Northern demographic experiences will gradually diminish through time. Alternatively stated, because of declining fertility rates and their effects on youth ratios as well as changes in elderly dependency ratios, Southern economies will prospectively experience demographic change *more rapidly* – not less rapidly – than Northern economies.

In the analytical world of two identical developed regions studied in Bryant (2004a, 2004b), asymmetrically larger fertility declines and asymmetrically larger adult-mortality declines in one of the regions lead that region to run a current-account *surplus* with the rest of the world. The direction of movement of the exchange rate for asymmetric fertility declines differs from the direction of movement for asymmetric declines in the adult mortality rate. For both cases, however, the region with the larger demographic shocks runs a current-account surplus and builds up a positive net-foreign-asset position with the rest of the world in the shorter and medium runs. That analysis suggests that if the North and South were similar in their macroeconomic characteristics, prospective demographic developments might cause the North to run *smaller* rather than larger current-account balances (*diminished* surpluses or even *deficits*) vis-à-vis the South in the shorter and medium runs.[4] Rather than net "excess" Northern saving flowing to the South to facilitate growth and development in the South, the tendency to net "excess" savings might arise more strongly in the South, with the result that reduced inward capital flows to the South might diminish Southern domestic investment relative to what it might otherwise be.

Helliwell (2004), drawing on Higgins (1998), Lührmann (2003), and his own charts and regressions, argues that, other things equal, *demography-induced* capital movements in the future are likely to flow toward the OECD nations, not away from them. Even Bosworth and Keys (2004), who

[4] This possibility is also discussed in Taylor (1995).

interpret their empirical work as suggesting that net capital flows will initially run from high-income regions to lower-income regions, project in their time-series analysis that after the year 2020 the current-account balance in higher-income Northern economies moves away from surplus to deficit. The Bosworth-Keys cross-national analysis reports significant effects of demographic change on national saving but not on investment; overall, they conclude, "the cross-national analysis suggests that aging has a larger negative impact on national saving than on investment, pushing aging societies toward substantial trade deficits."[5]

Reduced-form empirical regressions in which demographic ratios help to explain savings, investment, and current-account balances, such as those studied by Higgins, Lührmann, Bosworth-Keys, and Helliwell, may not be adequately robust. To be sure, those researchers have investigated several alternative specifications and carried out extensive sensitivity analyses of their results. Nonetheless, the statistical significance of some of the coefficients on dependency ratios is low, especially for some estimates of the effects of elderly dependency. The values of the coefficients vary, depending sensitively on the sample of countries and the time period. The variability of current-account data tends to be markedly higher for Southern than for Northern economies (so that the correlation between national savings and domestic investment is lower for the developing economies). But that result, as Helliwell asserts, is almost surely not attributable to greater capital mobility among the non-OECD countries than within the OECD. The quality of current-account, saving, and investment data for developing economies is poorer than data for the OECD economies.

Even if reduced-form empirical correlations were reliable, they might not be a satisfactory foundation for drawing conclusions about the dynamic effects of demographic changes on saving-investment balances. The dynamic effects of demographic shocks on youth ratios and elderly ratios, and of course more broadly the dynamic effects on key macroeconomic variables, depend on whether the underlying shocks are declines in birth rates or declines in mortality. The reduced-form empirical regressions cannot capture such differences. The regressions estimate the effects on savings and on current-account balances of a decline in youth ratios or an increase in elderly ratios, for example, as invariant to why the ratios change.

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[5] When incrementally higher life expectancy is introduced into their time-series analysis, Bosworth and Keys project that high-income countries would experience even larger current-account deficits in the longer run. They project that middle-income regions would have sizable and continuing current-account surpluses, though these are projected to be smaller under the assumption of an accelerated rate of improvement in life expectancy.

The further into the future one looks, the more the asymmetric demographic transitions in high-income and lower-income countries, taken in isolation, may operate to reduce rather than increase the net flow of capital from the North to the South. That concern, at any rate, is a primary motivation for the exploratory research described in this paper.

Analytical Approach of This Study

As in my earlier research on the cross-border dimensions of demographic change, the analytical framework in this paper is a world composed of two regions with cross-border flows of goods and capital. The exchange rate linking the currencies and economies of the regions adjusts to ensure that the *global* (algebraic sum of both regions) current-account balance and net-foreign-asset position are always zero. All other flow and stock identities are carefully enforced, for each region and the world economy as a whole, ensuring the framework's internal consistency. Within each region's economy, optimizing firms produce a single composite good, determined by an aggregate production function with capital and productivity-augmented labor as its arguments. The composite goods from each region are imperfect substitutes; some production in each region is exported; import demands are a function of regional incomes and relative prices.

Households in each region are assumed to have identical preferences over foreign and domestic goods. The treatments of household consumption, saving, and wealth accumulation build on the overlapping generations framework of Blanchard (1985), Weil (1989), and Yaari (1965) as extended by, among others, Faruqee, Laxton, and Symansky (1997) and Faruqee (2002) to incorporate age-earnings profiles and a more realistic determination of labor income. Population growth and structure are endogenous. The population contains working adults, youth dependents (children for short), and elderly dependents who receive public pension benefits.

This analytical framework permits a focus on the cross-border effects of region-specific changes in demography. One of the previous papers highlighted modifications in the treatment of consumption, saving, and wealth accumulation that are associated with youth dependency and the economic linkages between the child and adult populations. Another paper emphasized elderly dependency and the implications of various public pension arrangements for region-specific and world levels of saving, investment, and interest rates.[6]

[6] Bryant, Faruqee, Velculescu, and Arbatli (2004) and Bryant (2004a).

This paper amends the analytical framework so that the two regions are demographically and economically different. Most fundamentally, the regions differ in the sizes and compositions of their populations and in the sizes of their outputs and capital stocks. One of the regions, labeled the South, incorporates rudimentary efforts to represent the features of economies and polities in developing countries that dampen investment prospects, inhibit growth and development, and therefore limit the net absorption of foreign saving.

The strength of the analytical framework is that it permits analysis of the co-evolution of Southern and Northern economies in a manner that fully allows for the general-equilibrium macroeconomic interactions that determine the outcome of the demographic pressures differing across the regions. Analysis cannot avoid the fundamental difficulty that the macroeconomic effects at issue are inherently general-equilibrium in nature. Notably, the saving-investment imbalance and hence the current-account imbalance in the North obviously cannot change without an associated change in the saving-investment and current-account imbalance in the South, and vice versa. The only analytical frameworks capable of dealing adequately with the issues are general-equilibrium models.

A later section of the paper summarizes the key assumptions used to differentiate the behavior of the South and North regions in the model. Before turning to those differences, I first discuss how demographic trends differ between Southern and Northern economies and summarize the aggregated demographic series used as inputs to the analysis.

Overview of Southern and Northern Demographic Transitions

The Population Division of the United Nations publishes biannual statistical volumes on world and national demographic trends. The detailed data in recent editions are presented for quinquennial averages, beginning with the period 1950-55 for historical data and ending with 2045-2050 for forward-looking projections.[7] The demographic inputs used in this study's analytical framework are derived from these UN data.

Selected Individual Nations. The panels of Figure 1 show data for 3 developed countries – Japan, Germany, the United States – and 5 developing economies – China, India, Brazil, Tanzania, and Mali. These individual countries exemplify differing stages of demographic transitions. Japan and Germany are representative of developed Northern countries in the late stages of their transitions.

[7] For example, United Nations Population Division (2001, 2003, 2005).

The United States, though less typical in some ways, is also in a fairly late stage and has the largest population among Northern countries. India and Brazil are large countries illustrating broad demographic trends among developing Southern economies in the earlier to middle transition stages. The demographic characteristics of China differ somewhat from those of other Southern economies; its population, however, is the largest in the South (and in the world) and thus has a significant influence on aggregate demographic statistics. Mali and Tanzania are two smaller, least developed countries in early stages of their demographic transitions.[8]

Lifetime births per woman are much higher in the South than in the North (Figure 1a). Yet they are falling throughout the world with only a few exceptions. By the 1970s the fertility rate in many Northern economies, as in Japan and Germany, had dropped below a rate (about 2.1 births per woman) that would be consistent with steady-state replacement of the population. The United States, with its rate in recent years close to 2.0, is an exception above the average rate for Northern economies. For most countries in the South, fertility rates today fall into the range 3 to 5. China, with its one-child-per-couple policy and plummeting birth rate in the last decades of the 20th century, is a below-average outlier for developing countries. Countries in early transition stages such as Tanzania and Mali have high birth rates that have only started to decline in the last several decades.

Life expectancy is markedly higher in Northern than in Southern economies (Figure 1b). The differences in levels are striking. For example, a child born today in Japan – currently the nation with highest life expectancy at birth – can expect to live on average some 34-35 years longer than a child born in Tanzania or Mali. No less striking, however, is the rough similarity in mortality trends throughout the world. Life expectancy has been rising persistently almost everywhere; increases are projected to continue. The sharp fall in Tanzania's life expectancy over the last two decades, interrupting the trend increase, illustrates the experience of a minority of developing countries that have been hit especially hard by the HIV/AIDS epidemic. China is an atypical developing nation because of its especially sharp 1970s increase in life expectancy (again related to its policy of one child per couple).

Most countries in the world, South and North, have experienced declines in the annual growth rates of their total populations (Figure 1c). Broadly speaking, decreases in fertility have been more important quantitatively than increases in life expectancy; thus the net effects on growth rates have

[8] The forward-looking projections shown in the panels of Figure 1 are the "medium," intermediate scenarios of the UN Population Division (not the "high" or the "low" scenarios).

been negative. The UN projects the trend reductions in growth rates to continue. Differences in the levels of birth rates and life expectancies, however, can cause major differences in the levels of the growth rates. For developed nations such as Japan and Germany, growth rates have fallen so low as to become negative; the total populations are now beginning to contract. In contrast, many Southern countries, such as Brazil and India, still have annual population growth rates in the neighborhood of 1-1/2 percent or higher. (China with its accelerated demographic transition is again atypical.) At the extreme, the population growth rate in least developed countries such as Mali is very high and is projected to remain high for several more decades before eventually falling.

The youth dependency ratio has fallen fastest and furthest in those Northern economies, for example Japan and Germany, whose demographic transitions are the most advanced (Figure 1d). Conversely, youth dependency ratios in early-stage developing countries such as Tanzania and Mali are still very high; well over half of the population is under the age of 20. On average in middle-stage Southern economies, some two fifths of the total population are youths.[9]

Because of their more advanced transitions, Northern economies have also experienced the greatest alterations in the share of the elderly in their populations (Figure 1e). Japan and Germany, for example, already have one fifth of their populations as elderly (65 years and older), with large further increases projected between now and 2050. The level of the elderly dependency ratio is projected eventually to rise significantly throughout the developing world, but from levels today that are much lower than in Northern economies. For early-stage developing countries, the elderly ratio may not rise at all until several more decades have passed.

The "active ratio" – the proportion of the total population accounted for by adults of working age (20-64 years) – is strongly influenced by the stage of demographic transition (Figure 1f). Differences between South and North are dramatic, both for levels at any point in time and for changes through time. In the second half of the 20th century Southern economies had significantly lower active ratios than Northern economies. Early-stage-transition economies such as Tanzania and Mali have had especially low and often even falling ratios. Japan and Germany reached the maximum values for their rising active ratios in the 1990s; the United States is currently near the peak of its active ratio. For the first half of the 21st century, broad trends in the active ratios of Northern and Southern economies will continue to be contrary, but in reversed direction. The North is

[9] When using the UN Population Division demographic data, one has the choice of defining youths as either age 0-14 years or 0-19 years. Because my analytical framework presumes children pass from youth to adult age at the end of the 18th year, I choose the 0-19 year span.

moving into a stage when active ratios will persistently decline. Most Southern economies are entering decades in which active ratios will be significantly rising, a period that will enable them to reap the so-called demographic bonus associated with plentiful workers relative to dependents.

North and South Regions. We have prepared aggregated "North" and "South" demographic series for this study that are counterparts to the series shown in Figure 1. We define the North as the aggregation of the "more developed countries" classified by the UN (Northern America, Europe, Japan, and Australia/New Zealand). Our South region corresponds geographically to the UN's "less developed" regions (the sum of the "least developed" and "other less developed" countries, comprising all the countries of Africa, Asia except for Japan, Latin America and the Caribbean, as well as Melanesia, Micronesia and Polynesia).[10]

In our analytical framework "youth" cohorts are assumed to be wholly dependent on adults for the first 18 years of life. At the beginning of their 19th year, they enter adulthood, begin supplying labor input, and no longer receive any support payments from older adults. Elderly are defined as adults 65 years and older.[11]

As explained in earlier papers from the project, the analytical framework uses the simplifying assumption of Blanchard (1985) and Yaari (1965) that mortality rates are age-invariant. This simplification has the marked advantage that macroeconomic aggregation across individuals and age cohorts is straightforward and easy. As is well known, however, the assumption that mortality rates are age-invariant rather than age-specific departs seriously from reality. Thus the model's demographic equations cannot reproduce in every detail the actual-life combination of birth rates, mortality (inverse-of-life-expectancy) rates, and population growth rates contained in the UN Population Division's time series. In particular, the age-invariance of the model's adult mortality rate has the undesirable consequence that the numbers of elderly in the model's regional populations are overestimated relative to the actual-life situation in which death rates increase sharply for adults older than middle age.

The UN's demographic projections do not extend beyond 2050. To carry out sensible model simulations, one must define a consistent steady state for the world economy as a whole in which demographic growth rates for regions eventually converge. (Without such convergence, one part of

[10] The UN classifies all of Europe as developed, including Russia, Eastern Europe, and Southern Europe.

[11] The age brackets in the UN data do not correspond exactly with the model's age definitions. We sum the available UN brackets from ages 0 through 19 years to derive a model series for youth; the UN data are not available for ages 0 through 18. Working-age adults are derived from the sum of the UN's age brackets for 20-64 years (though the model's definition of working ages is 19-64 years). The UN and model age brackets for elderly correspond exactly.

the world would continue to increase *permanently* in demographic size relative to other parts.) The analytical requirement for convergence requires demographic projections that extend well beyond 2050. Accordingly, we extrapolate the UN projections, assuming that regional populations and hence the world population eventually stabilize at a growth rate of zero. The assumption of ultimately stationary populations means that the age structures of regional populations also stabilize and converge in the very long run. Birth rates and mortality rates converge to rates that are consistent with the zero growth rates for youth, adult, and total populations.

To create regional demographic aggregates from the UN data for the model, we first derive 1950-2050 growth rates for adult populations that closely match the UN data. Next we make plausible assumptions about age-invariant mortality rates for the model that broadly capture the trends in life expectancy as published by the UN. A benchmark for the relative sizes of regional adult populations is set for the year 2000 based on the UN's actual data for that year. These inputs are then used to derive model-consistent series for birth rates, population levels, dependency ratios, and other demographic variables. Because of our procedures for generating model series, the model's demographic variables are only an approximation to the historical and projected UN data. The approximation is close, however, and the qualitative conclusions derived from model simulations do not appear to be significantly affected by the approximation.[12]

The panels of Figure 2 summarize key aspects of the demographic inputs into our model. Each panel begins with the historical data for 1950-2005; the UN-projection data for 2005-2050 are lightly shaded; the darkly shaded parts for years after 2050 indicate how the UN projections are extended to produce eventual convergence to a steady state with stationary populations in all parts of the world.

Growth rates for the adult populations of the two regions are shown in Figure 2a. Growth in the South is always faster than in the North until long-run convergence. The growth-rate gap widens in the last decades of the 20th century before gradually beginning to narrow during the projections.

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[12] One source of the approximation stems from our derivation of year-by-year data from the UN quinquennial series, smoothing out kinks that are evident in the UN's quinquennial series. More important, as discussed in the text, the assumption that mortality rates are age-invariant leads to a skewness in the numbers of elderly in the model relative to real life. We initially developed our North and South demographic series using the 2000 and 2002 Revisions of the UN Population Division (United Nations, 2001, 2003). The 2004 Revision (United Nations, 2005) became available toward the end of the summer of 2005 and we are now in the process of amending the model's demographic series to correspond to those most recent data. The panels of Figure 1 are from the 2004 Revision. Although the panels of Figure 2 are not yet fully based on the most recent data, the substantive conclusions of the paper will not change when the minor revisions in demographic inputs have been completed.

The UN demographic projections include not only paths based on medium projected fertility, but also ones based on lower and higher fertility assumptions. Figure 2a accordingly shows not only the "medium" UN projections for the regions' growth rates but also the alternatives, labeled here as "faster convergence" and "slower convergence" for the South and "largest decline" and "smallest decline" for the North.

Mortality trends used as inputs to the model are plotted in Figure 2b. In this first stage of the study's research, we develop just a single projected path for each region's adult mortality rate and youth mortality rate.

Combination of the growth rates for adult populations in Figure 2a with the mortality rates in Figure 2b generates the model-equation series for fertility rates shown in Figure 2c. As in Figure 2a, the alternative paths for fertility rates are identified as faster convergence and slower convergence for the South and largest decline and smallest decline for the North.

Trends over time in the dependency ratios (Figure 2d) show the same differences in levels and differences in rates of change that are evident in the individual-nation data. (Figures 2d and 2e show the dependency ratios only for the medium projections for each region.) Youths are a much higher proportion of the population in the South than in the North. Although declining already by the 1970s, the projected level of the Southern youth ratio still remains above 30 percent until the 2030s and only declines to the assumed long-run steady-state level of 18 percent in the beginning of the 22nd century. The Northern youth ratio, by contrast, has already completed much of its eventual decline by 2005; it is even projected to fall briefly below the long-run steady-state level before finally rising to that level.

The levels of the elderly ratios for the regions differ greatly, of course in the opposite direction. The Northern elderly ratio of some 27 percent as of today is almost 4 times higher than the Southern elderly ratio of 7 percent. The Northern ratio is projected to rise persistently to 57 percent in the 2060s before eventually falling back to the long-run ratio of 47 percent. In contrast, the Southern elderly ratio is only beginning its long rise as of today and by the 2060s is still projected to be no higher than 26-28 percent.

Throughout the historical period 1950-2005, the Northern active ratio lies above the Southern ratio (Figure 2e). But already by the 1980s, the gap between the two ratios was narrowing. The Northern ratio peaked around the turn of the century while the Southern ratio had been rising strongly. In the UN medium projections, the Southern active ratio will exceed the Northern ratio

after about 2010 and will keep rising until it reaches a level of around 54 percent in the 2040s. The Northern ratio will continue to fall and will be well below 40 percent by the 2040s.

Analytical Characteristics of Southern and Northern Economies

This section adds to the preceding discussion of demographic differences between the Southern and Northern regions by summarizing our assumptions about the relative economic sizes of the regions in the analytical model and about how their economic behavior differs. Such assumptions clearly influence substantive conclusions generated with the model.

Consensus does not exist about which assumptions are most appropriate when characterizing the behavior of developing economies. Furthermore, actual data are not readily available for macroeconomic variables for aggregates of developing Southern economies (and, in many instances, even for developed Northern economies). Some of the details of our calibration choices are, for practical reasons, rough approximations or stylized assumptions. As the research progresses, we continue to review and amend these calibration assumptions and try to compile better data. The description that follows should be treated as a work in progress, not a settled and authoritative account.

Developing countries in the aggregate have a much larger total population than developed countries. Despite their larger size in terms of numbers of people, the aggregates of developing countries' outputs and their physical capital stocks are markedly smaller than aggregates of outputs and capital stocks in developed economies. The South's share of the total world population in recent years, for example, is in the range of 80 to 85 percent. Yet measured at market prices and at market exchange rates, the GDPs of Southern economies in recent years account for only about one fifth to one quarter of world GDP. Even if output is measured at purchasing-power-parity prices, the share of Southern economies in world output is not more than one half. Our calibration of the model's variables for Southern and Northern regions reflects such broad facts about relative size.[13]

Relative Populations and Effective Labor Forces. The total population in the model's South region in the earliest years of the 21st century is slightly more than 4 times the North's population. (Because of its faster demographic growth for the 1950-2005 period, the South's population relative

[13] Bryant (2004c, Appendix Table) provides data for the distribution by nation of key macroeconomic variables such as GDP (at market prices, and at purchasing-power-parity prices), cross-border trade, international reserves, population, and IMF quotas. For another source of nation-by-nation and world data, see World Bank (2005), Table 1 of the Appendix on Selected World Development Indicators.

to the North's in 1950 is lower, only some 2-1/4 times larger.) By the time both regions eventually settle into a long-run steady state with demographic growth rates at zero, the South's population is 7.6 times larger – see Figure 3.[14]

Effective labor forces in the model represent not just the number of workers but, in effect, the number of labor "efficiency units." Thus the model's levels for the effective labor force in a region are significantly greater than the level of that region's adult population, reflecting the calibration of the labor forces with their incorporation of the age-specific, relative productivities of different workers.[15] In principle, it would be desirable to estimate – or if not estimate, then at least assume – different age-earnings profiles for the South and the North. Because of data difficulties, however, we have not been able to estimate different age-earnings profiles. Nor have we developed a persuasive way to assume different Southern and Northern profiles. For the time being, we assume that age-earning profiles are the same in the South and the North.[16]

During the historical period 1950-2005, the ratio of the South's effective labor force to the North's is somewhat smaller than the ratio of populations. Eventually, in the ultimate steady state, the South's effective labor force, like its population, gets to be 7.6 times that of the North. Notice in the 2005-2050 projection period, however, that the South's effective labor force grows much more rapidly than the North's. By the 2070s, it rises to be some 12 times larger, before eventually falling back – again see Figure 3. The explanation for the different behavior of the total-population and the effective-labor-force ratios is attributable to the operation of the age-earnings profiles. The effective labor force in the South rises so rapidly relative to the North's effective labor force not just because the number of working-age adults is rising faster but also because, as the additional Southern workers move through the age-earnings profile, they supply larger amounts of labor input measured in terms of efficiency units.

The ratio of the effective labor force to the adult population, abbreviated here as ELF/N and shown for each region in Figure 4, is another demographic variable with important significance for

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[14] The model data in Figure 3 use the "medium" UN projections for both regions. The UN data include all of Europe (not just Western Europe, but also Eastern and Southern Europe and Russia) in their classification of more developed countries. Because we base our calibrations on the UN data, the North region's population relative to the South's in the model may be on the high side relative to estimates based on different classifications of developed and developing countries.

[15] As discussed in earlier project papers, the age-earnings profiles are normalized to unity at the time a youth enters adulthood and the labor force. Hence on average all workers supply more labor input in efficiency units than suggested by the number of workers in the labor force.

[16] U.S. data were used to estimate the age-earning profile used in earlier project papers. That same profile is used in this study (for both regions).

the discussion below. For the North the ELF/N ratio is well below that of the South, in part because there are more elderly in the adult population. The Northern ELF/N ratio begins a decline by the 1990s that persists throughout the first half of the 21st century. The South ratio, though in the 1950s above that of the North, declines modestly through 1975 and then rises somewhat through the first decade of this century. Declines in the Southern ratio do not begin until the 2020s. The much earlier decline in the Northern than the Southern ELF/N ratio stems from the fact that the North is in a much more advanced stage of its demographic transition.

Relative Levels of Labor Productivity. Regional outputs and capital stocks in the model are endogenous variables. The levels and the rates of growth of labor-augmenting technical progress are specified exogenously.[17] The single most important determinant of the initial relative sizes of regional outputs and capital stocks, therefore, is the assumption made about the initial values of the indexes of labor productivity. Subsequent evolution of the relative sizes of the outputs and capital stocks through time is increasingly governed by the assumed rates of growth of labor productivity.

For this paper, we assume that an index of the South's level of labor productivity as of the year 1950 is about one third the level of the North's and that the pre-1950 rate of growth of the South's labor productivity was a percentage point *less* than the pre-1950 North's rate of productivity growth. The levels of the two pre-1950 growth rates are, respectively, 0.5 and 1.5 percent per year. In the benchmark-case simulation to be discussed below, the North's productivity growth rate is then assumed gradually to decline monotonically until it eventually reaches a long-run steady-state rate of 1.0 percent per year by the year 2050. The South's productivity growth rate climbs steadily from its initial rate of 0.5 percent; climbs further and surpasses the declining growth rate of the North by the early 1990s; rises still further to a rate of some 1.4 percent by 2025; remains at that higher rate for the next 25 years; and then gradually declines after 2050 until eventually reaching the same long-run steady-state rate of 1.0 percent per year which the North had already attained by 2050. These assumptions about initial conditions and growth rates mean that the level of the South's productivity index relative to the North's falls for several decades after 1950 but thereafter rises during the 21st century. In the very long run, the South's productivity level relative to the North is higher than the 1950 ratio but is not nearly equal to the level in the North.

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[17] Technical progress in the production functions must take the form of labor-augmenting (so-called "Harrod neutral") technical change if our type of model is to generate balanced-growth equilibrium paths with well-specified steady states. This property of balanced-growth models is well understood in the literature on growth economics; see, for example, Obstfeld and Rogoff (1996, pp. 430-431) or Romer (2001, pp. 9-12).

These assumptions about productivity levels and growth rates are, self evidently, preliminary. Issues about the gap between productivity levels in the developing and developed countries and how fast the gap may be closing or should be closing are highly controversial among development economists. A later section of this paper identifies some alternative paths for the South's productivity and demonstrates that the broad conclusions of the study are sensitive to such alternative assumptions.

Investment Climate in the South Region. When calibrating the model, we have introduced three differences between the South and North regions that are aimed at differentiating the regions' investment climates. Each source of difference is motivated by a class of effects that could explain why investment in Southern economies may be more difficult or less profitable than in the North.

First, we force a larger risk-premium wedge on capital in the South economy. The model contains an exogenous risk premium that is analogous to an equity premium, the difference between a low-risk government bond rate and the riskier return on equity claims on physical capital. Other factors held equal, a larger risk premium makes it less attractive for investors to hold physical capital rather than other forms of wealth. In the Northern economy, this risk-premium wedge between bonds and equity capital is set at 200 basis points. For the results reported in this paper, the risk-premium wedge in the Southern economy is set at 500 basis points, two and one-half times higher than in the North.

Second, we assume that the adjustment costs of making new investments are much higher in the South than the North. The model follows much of the literature on investment in specifying that firms incur adjustment costs as they shift from one investment-to-capital ratio to another. Optimal long-run investment is a function of Tobin's *q* variable (defined as the ratio of the market value of a marginal unit of capital to its current replacement cost). If adjustment costs were assumed absent, the value of *q* would remain at unity so that the value of the capital stock would always equal its replacement cost. In contrast, when adjustment costs must be incurred, it is not preferable for firms to keep their capital stock at its optimal equilibrium level period by period. Higher adjustment costs slow firms' adjustment from a past balanced-growth equilibrium path to a new path now deemed appropriate.[18] To dramatize the possibility that investment spending in the South is more difficult, in

[18] Adjustment costs influence how quickly adjustment occurs from one path to another, but do not influence the nature of the equilibrium balanced-growth paths themselves.

our initial exploration of this effect we set the parameter determining the size of adjustment costs in the South at an extreme value ten times greater than the Northern value.

Finally, we assume that the depreciation rate on physical capital in the South is higher than the Northern rate. (Depreciation rates on capital are exogenous in the regional models.) Northern capital depreciates at a fixed annual rate of 4.25 percent. Capital in the Southern region depreciates at 6.50 percent.

Intertemporal Smoothing of Consumption. For this paper, we implement only one additional asymmetry between the North and South regions. Consumers in the South are assumed to be less able than Northern consumers to intertemporally smooth their consumption spending.

The macroeconomic theory underpinning our analytical framework emphasizes the forward-looking behavior of agents and presupposes that both firms and households engage in intertemporal optimization. When implementing the theory, however, the empirical model allows for a fraction of consumers whose consumption is constrained by an inability to borrow and hence are unable to smooth their consumption intertemporally. These constrained consumers can only consume out of their current income.

Earlier research in the project assumed a value of one third for the fraction of consumers unable to smooth intertemporally. In the current study this one-third value is retained for Northern consumers. In the South, however, we double this fraction so that two-thirds of consumers are assumed unable to smooth intertemporally. This difference between South and North is suggested in part by the fact that superior credit institutions and financial markets exist in the North. In addition, many more consumers in the South than the North may not be able to smooth intertemporally because their consumption spending is at or close to the minimums necessary to sustain survival.

Relative Levels of the South's Outputs and Capital Stocks. Given the combinations of assumptions summarized above, the model generates a gross national product (GNP) for the South in the early 1950s that is some 60 percent of the North's. The South's early-1950s capital stock is about 55 percent of the North's capital stock.

By the year 2005, the South's GNP as simulated in the model is still only about two-thirds of the North's GNP. Similarly, the 2005 ratio of the physical capital stock in the South relative to that in the North is not changed much from the early-1950s ratio.[19]

External-Sector Imbalances. Demographic transitions have consequences over very lengthy periods. In the analytical context of the model, moreover, the world as a whole cannot reach a sustainable steady state except in the very long run. Model simulations in this study are accordingly conducted over very long-run horizons, typically for more than 500 years.

We interpret model outcomes for the year 1950 as the "initial conditions" for simulations. The choice of 1950 is dictated by the typical beginning year for the UN demographic data (see Figures 1 through 4). Changes in other key (non-demographic) exogenous variables, such as the growth rates for labor productivity, also begin in the year 1950. It is often most revealing, therefore, to examine *changes* in the model's variables from the values in the initial conditions of 1950.[20] The discussion below proceeds in that manner.

The model generates a 1950 outcome for the world economy in which the South runs a current-account deficit while the North region has the counterpart equivalent current-account surplus. The South's 1950 current-account deficit is 3.1 percent of its nominal GDP. The ratio of the North's current-account surplus to the North's nominal GDP is 2.2 percent. Under these initial conditions, the South pays a substantial net amount of investment income to the North, a situation that is sustainable because the South simultaneously runs a trade *surplus* with the North (some 4-2/3 percent of GDP in real terms).

The pattern of Southern current-account deficits matched by Northern current-account surpluses has been implicitly operative in the model for many years prior to 1950. The South, with a large net foreign *liability* position, is a debtor region. Because of the global balance-sheet identities enforced in the model, the North has a correspondingly large net foreign asset position vis-à-vis the South.

In the 1950 initial conditions with which simulations begin, therefore, the South region has domestic investment that is higher than national saving, in effect importing part of Northern savings through its current-account deficit. The North in the model has the reverse condition. National

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[19] The initial conditions used to calibrate the model cause the South to run a current-account deficit, and hence to have a net foreign liability position, for the historical period 1950-2005. The value of the South's gross domestic product (GDP) is accordingly higher than its GNP throughout the period 1950-2005.

[20] We frequently start actual model simulations in a year well before 1950, to be sure that the model generates a plausible set of initial conditions for 1950 (with key exogenous variables *not* changing prior to 1950).

saving in the North is higher than domestic investment, with a part of Northern gross saving exported to the South through net capital outflows.

Demographic Effects on Saving-Investment Balances

We next analyze outcomes in the two regions resulting from a benchmark simulation with the model. "Benchmark" is shorthand for the combination of calibration assumptions summarized in the preceding section. The demographic paths in the benchmark case are the UN medium fertility paths shown in Figures 2a and 2c ("medium convergence" for the South and "medium decline" for the North).

The goal of the analysis is to understand the dynamic effects of demographic transitions on macroeconomic variables, in particular on savings and investment and the balance between them. An overview of the causal processes can be summarized as follows. Changes in fertility and life expectancy alter the sizes and compositions of populations. Changes in the regions' working-age populations and their relative sizes are critical determinants of changes in the sizes of effective labor forces. The sizes of effective labor forces, however, reflect not only demographic shifts but also the humped age-earning profiles associated with the life-cycle behavior of individuals and employment practices of firms. The macroeconomic aggregates of labor incomes, human wealths, and private savings are determined in a so-called "bottom-up" fashion as demographic shifts pass through the age-earning profiles. The endogenous determination of other key macroeconomic aggregates, such as a region's capital stock and its output, is driven by a combination of changes in the effective labor force and changes in the region's rates of labor-augmenting productivity growth. The size of a region's output relative to output in the rest of the world, determined in part by the relative sizes of the regions' effective labor forces, is a key driver of exchange rates and the saving-investment imbalances, and hence external-sector imbalances and interregional capital flows.

To gain intuition about the effects of demographics on macroeconomic variables, remember that when individuals first enter the labor force, they have relatively low productivity, have relatively low labor incomes, and are relatively low savers. Younger adults on average have lower savings in the early working years in part because of children and child-support expenses. Then as these workers gain experience and seniority and have higher productivity, their effective labor input increases over time; in effect, they ascend the left side of the hump of the economy's age-earning profile. Individuals tend to reach their years of peak earnings and high savings when they are in their

forties, fifties, and early sixties. Saving is high in the middle years not only because of higher labor incomes but also because of anticipation of retirement. Eventually, workers start to descend the right side of the humped age-earning profile so that their labor incomes and saving decline. At that point, their consumption must be increasingly financed out of their privately accumulated financial wealth as supplemented by pension transfers from the government.

The hump-shaped profile of earnings by age influences both the supply side and the demand side of macroeconomic behavior. On the supply side, the earnings profile is an indicator of the changes in a cohort's relative productivity and its supply of labor over its lifetime. On the demand side, the anticipated path of labor income determines the saving plans of consumers over their lifetimes.[21]

Incentives for investment also change in response to changes in demographics and labor productivity. As the effective labor force adjusts, previous levels of the capital stock and output are no longer economically appropriate. Real interest rates must adjust to reflect the new relative scarcity of capital and labor. Investment flows, occurring promptly or sluggishly depending on the size of the changed incentives and the adjustment costs to be paid, change the capital stock and key macroeconomic variables such as the capital-output and the capital-labor ratios.

For the benchmark simulation, Figure 5 plots the evolutions of saving and investment relative to economic activity in the Southern and Northern regions. The variables are measured as changes from the initial-conditions values of the ratios prevailing in 1950.[22] To interpret the changes through time of the saving and investment ratios, one can derive analytical clues from a comparison of changes in the North and South active ratios (Figure 2e) and in the North and South ELF/N ratios (Figure 4, effective labor force to adult population). Remember also that the level of the South's ELF relative to that of the North increases sharply and persistently (Figure 3).[23]

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[21] The hump shape for an economy's aggregate age-earnings profile reflects both of two types of effects: (i) changes over time in the relative productivities of age cohorts (initially, increases caused by rising seniority and experience and then subsequently, decreases towards the end of working life); and (ii) changes by age in the rates of participation in the labor force of cohorts. For further discussion and a graph illustrating the humped age-earnings profile for the Japanese economy for various years in the period 1970-1997, see Bryant and McKibbin (2004, p. 363).

[22] The denominators of the ratios in Figure 5 are Southern nominal GDP for the Southern ratios and Northern nominal GDP for Northern ratios. Saving is nominal national saving, the sum of nominal private saving and nominal govenrment saving or dissaving.

[23] The effective labor force in the North rises gradually from 1950 through the first decade of the 21st century but then begins a gradual protracted absolute decline. The South's ELF grows vigorously from the outset and only peaks by the middle of the 21st century.

For the first few decades after 1950, the active ratio was much lower in the South than the North and was flat or slightly declining. The Southern ELF/N ratio, higher than the North's, also dipped in the first decades after 1950. These Southern dips reflected the large number of children entering the South population in those years. Significantly, Southern saving in relation to Southern GDP was relatively weak (actually fell for the first years after 1950) and did not begin to increase until the active ratio and the ELF/N ratios began rising several decades later. In contrast, the ratio of Southern investment to economic activity rose strongly from the outset and then began a gradual deceleration after the 1970s.

Demographic influences on saving and investment in the North were roughly the opposite in those early years. The North had a high and initially climbing active ratio. The Northern ELF/N ratio had not yet begun its long decline. Northern saving was buoyant and Northern investment was relatively weak during the early decades when the North active ratio was rising strongly.

The savings-investment balances move dramatically in a reverse direction, however, once the Northern active ratio peaks and begins to decline and as the Southern active ratio begins to increase strongly. As noted already, the gap between the Southern and the Northern active ratios was already narrowing by the 1980s. In the medium UN projections, the Southern active ratio exceeds the Northern ratio after 2010 and does not peak until the 2040s. The Northern active ratio and the Northern ELF/N ratios continue their sharp fall. The saving ratio in the South, influenced by the demographic bonus of a fast-increasing effective labor force, begins a persistent upsurge that continues into the middle of the 21st century. In contrast, net demographic influences in the North contribute to a peaking of the saving ratio and then a subsequent decline. The demographic evolutions of the two regions thus contribute to a progressive strengthening of Southern saving and a relative weakening of Northern saving.

The saving-investment imbalance in each region is, by the national income accounts identities, the current-account balance of that region and its net inflow or outflow of capital. Each region's external imbalance in the benchmark simulation, measured as a ratio to the region's nominal GDP, is plotted in Figure 6. These current-balance ratios are implicit in Figure 5, but Figure 6 makes it easier to focus on how dramatically the saving-investment balances change over time. Figure 7 reports the associated path of the real exchange rate.[24]

[24] A downward movement in the exchange rate represents a depreciation of the South's currency (appreciation of the North's). The variables in Figures 6 and 7 are again measured as changes from the values prevailing in 1950. The

The South's currency appreciates by a small amount in the 1950s, peaks, and then begins a depreciation that continues for more than 100 years. In the steady state reached by the world economy in the very long run, the real (and also the nominal) exchange rate settle at a level far below the original initial-conditions value.

The permanent change in the real exchange rate is traceable to changes in the relative sizes of the regions' populations and effective labor forces, which in turn cause changes in the relative size of regional outputs. The demographic shifts studied here are *transitory* in terms of differences between the regions' demographic *rates of growth* (Figure 2a) but cause *permanent* changes in the *relative levels* of demographic variables (Figure 3). The South's population and effective labor force relative to the North's have increased substantially by the time both regions settle down to the same rates of growth in the long-run steady state. Correspondingly, macroeconomic aggregates such as the capital stock and goods output become larger in the South relative to the North.[25] The quantity of South-produced goods available for sale and consumption in the world thus increases relative to the quantity of North-produced goods. With no changes in the preferences of each region's consumers for the two types of goods, relative prices in the world economy have to change to reflect the now relatively more abundant South-produced goods. A permanent real depreciation of the South's currency, representing an improvement in the Northern economy's real terms of trade, is an integral part of the required change in relative prices. The size of the required depreciation of the South's currency depends on the degree of price sensitivity of South and North consumers, in particular on the price elasticities of the regions' import demands.[26]

The benchmark initial conditions for the external sectors of the two regions were described earlier: in 1950 the South starts out as a debtor region, running a current-account deficit large in relation to the size of its economy. Thus at the outset some part of Northern savings flows to the South as the financing for the South's current-account deficit. The benchmark simulation has this

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Southern (Northern) ratios in Figure 6 express the region's current-account imbalance as a proportion of the South's (North's) GDP. The identity which requires the South's current-account imbalance to be equal, with opposite sign, to the North's current-account imbalance does not require the two current-account ratios to be identical in absolute value (because the denominators are of course not equal)..

[25] In part because of differences in the levels of labor productivity between the South and the North, the increase in relative size of the Southern region's economy is considerably smaller measured in terms of the ratio of real GDPs than when measured by the ratios of populations or effective labor forces.

[26] The fundamental explanation for exchange-rate changes summarized here is highlighted in earlier papers; see especially the extended analysis in Bryant and de Fleurieu (2005), who emphasize the dependence of the size of exchange-rate changes on the degree of price elasticity of import demands. A later section of this paper returns to this question.

pattern of large capital inflows to the South in proportion to the Southern economy continuing for two and one-half decades after 1950. In fact, the demographic shifts contribute to a large increase in the gap between the South's investment and national savings ratios.

However, the gaps in the regional saving-investment ratios – the current-balance deficit ratio in the South and the North's current-account surplus ratio – begin to move in the opposite direction around the mid-1970s. Thereafter, for the final two decades of the 20th and the first several decades of the 21st centuries, the South's current-balance ratio improves steadily and persistently. By the middle of the 21st century the South runs a current-balance ratio nearly 1.5 percentage points of GDP stronger than at the outset in 1950.

The key feature of the benchmark simulation that most warrants emphasis here is the dramatic reversal after the mid-1970s of savings-investment imbalances in relation to the sizes of the regional economies. Demographic inputs in the model, mirroring history up to the present, are a major contributor to this reversal. Prior to the mid-1970s, demographic asymmetries between the Southern and Northern regions increase the net flow capital from the North to the South, as postulated by the relatively optimistic view summarized at the beginning of the paper. Beginning in the mid-1970s, however, the demographic factors operate in the reverse direction. As a percentage of their regional economies, Northern saving falls relative to Northern investment while Southern saving increasingly rises relative to Southern investment. Demographic influences progressively operate to *reduce* rather than increase the net flow of capital from the North to the South in relation to the size of the Southern economy.[27]

What If Demographic Transitions Were to Proceed at a Different Pace?

It is natural to ask how the consequences discussed in the preceding section would change if the demographic transition in a region were to occur more rapidly or more slowly. Altered effects associated with the alternative UN demographic projections are of clear interest in their own right.

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[27] When interpreting the ratios in Figures 5 and 6, the reader should not forget that the comparisons are always *in relation to the sizes of the regional economies* and always *in relation to the initial conditions of 1950*. In the benchmark simulation, the South – even by the 2030s – is still running a current-account deficit in absolute terms; the North is still exporting a (smaller) fraction of its savings to the South. Thus the "direction of net capital flows" in absolute terms is still from the North to the South. The more important point analytically, however, is that the capital flows occurring after the mid-1970s are progressively *diminished as a proportion of the Southern and Northern economies*.

Note also that the outcomes for current-account ratios in Figure 6 are, by the medium and long runs, significantly influenced by the depreciation of the South's currency (Figure 7). Were it not for that exchange-rate depreciation, the South's current-balance ratio in the medium run would have been, compared with 1950, a larger negative or smaller positive value.

Studying alternative paths also helps to clarify how the model generates the macroeconomic consequences of demographic shifts.

In our exploratory research so far, we have examined simulations generated with various combinations of the alternative Southern and alternative Northern paths shown in Figures 2a and 2c. In this section we discuss only two of these many simulations and compare the two with the benchmark simulation already described. Each of the two additional simulations differs from the benchmark case only in the assumed demographic path for the South region. One assumes the South follows the "faster convergence" transition associated with earlier and sharper reductions in fertility. The other assumes "slower convergence," smaller and later reductions in fertility, and a hence a much more protracted demographic transition. The North in both additional simulations follows the same "medium-decline" demographics assumed in the benchmark simulation. We select these cases emphasizing the alternative UN projections *for the Southern region* because the outcomes bear significantly on the issue of North-South capital flows.[28]

The active ratios shown in Figure 8 capture a key feature of the differences between the three demographic scenarios for the South. The faster-convergence scenario with its earlier declines in fertility (Figure 2c) and its slower rates of growth of the population (Figure 2a) lead to earlier declines in the youth ratio and an even more vigorous rise in the active ratio than occurs in the medium-convergence benchmark case. The active ratio in the faster-convergence case, however, falls more sharply and converges sooner toward the ultimate situation in which the elderly ratio has risen to high levels. The slower-convergence scenario for the South with its delayed fertility reductions and higher rates of population growth generates a delayed and more gradual rise in the active ratio, a later and less elevated peak, and a more protracted convergence to the ultimate steady state.[29]

As expected, all three simulations generate a large depreciation of the South's currency over the medium and longer runs (Figure 9) but, again as expected, the size of the depreciation is least large for the faster-convergence case and greatest for the slower-convergence scenario. The explanation for these exchange-rate effects was summarized above. Compared with the benchmark case, the faster-convergence outcome results in a less large increase in the South's effective labor

[28] My tentative judgment from examining simulations with alternative demographic paths *for the Northern region* is that the consequences for saving-investment balances and for interregional capital flows, though worthy of further analysis and far from negligible, are quantitatively less significant.

[29] Analogous differences among the ELF/N ratios are observed for the three alternative Southern demographic paths (not shown in a separate chart).

force relative to the North's and hence a less large relative rise in the South's capital stock and output. Thus the amount of South-produced goods available for sale in the world relative to North-produced goods increases less than in the benchmark case. The "required" change in relative prices and hence the "required" depreciation of the South's currency is accordingly smaller. In the slower-convergence case, the effective labor force, capital stock, and output of the South relative to the North are all larger than in the benchmark. Relative prices thus have to change by more, and the South's currency has to depreciate by more.

Figure 10 compares the savings and investment ratios in the South for the three simulations. Differences across the three cases are small for the savings ratio until far in the future (second half of the 21st century). This absence of difference, at first puzzling, is readily explained. Consider, for example, the difference between the faster-convergence and benchmark cases. In the faster-convergence case the South has smaller numbers of adults and a smaller effective labor force; that difference in adult population and labor input will, other things being equal, lead to *lower* aggregate saving. However, the active ratio in the faster-convergence case rises sooner and faster to a higher peak (Figure 8). Other things equal, that higher active ratio encourages *higher* saving. In effect, two offsetting forces are at work, and the net effect of the two produces an outcome for aggregate saving in the faster-convergence case that differs little from the benchmark.

Differences among the investment ratios for the three cases are larger and more readily visible. The faster-convergence simulation relative to the benchmark, because of the smaller effective labor force in the South, has a smaller need for capital to accompany labor inputs in the production function. Less investment in new capital is required, and the South's investment ratio is lower in the faster-convergence case. An analogous argument with the signs reversed explains why the South's investment ratio needs to be higher in the slower-convergence than in the benchmark case.

The differences among the three simulations of greatest interest here are again the consequences for the regions' current-balance ratios and hence for interregional capital flows. As expected from the results in Figure 10 and as can be seen directly in Figure 11, the consequences for current-account balances in relation to the economies differ by only small amounts for the first few decades before and after the year 2005.[30] But thereafter the differences become significant. The gap

[30] Since differences among the demographic paths do not exist for years prior to the UN alternative projections, there are no significant consequences until the demographic paths themselves start to differ. The small differences between the

between Southern investment and Southern saving closes in the benchmark simulation for decades after the 1970s through the 2040s. If the South experiences a speedier demographic transition, converging faster to the later transition stages already being experienced by the North, the gap between Southern investment and Southern saving will close even further and faster after 2020. Thus demographic influences will work even more strongly to *reduce* rather than increase the net flow of capital from the North to the South in relation to the Southern economy. Conversely, a slower-convergence experience for the South can be expected to work in the reverse direction after about 2020; demographic influences would, other things equal, *stimulate* financing from the North for a larger Southern current-balance deficit in proportion to the Southern economy.

Alternative Assumptions about Productivity Convergence between South and North

This section indicates the sensitivity of the analysis to assumptions about the initial relative level of Southern productivity and its subsequent rate of growth. While not qualitatively overturned by alternative productivity assumptions, the conclusions summarized above can be significantly modified.

Figure 12 shows graphically the benchmark assumptions about productivity growth rates described earlier in the text. Figure 12 also shows two alternative growth paths for the South, labeled "vigorous" and "sluggish." The sluggish path has the growth rate for Southern productivity rising only very gradually from its 1950 starting point of 0.5 percent per year. The Southern rate does not reach the long-run steady rate of 1 percent until late in the 21st century (three decades after the North has declined to that rate) and never rises above the North growth rate. The vigorous-path assumption entails a more rapid acceleration of the Southern growth rate relative to the benchmark case, a very long period in which the Southern growth rate exceeds even the initial value of the Northern growth rate, and a still more extended period over which the Southern rate eventually declines to the long-run steady-state rate. With the vigorous-path assumption, the level of Southern productivity eventually rises to 57 percent of the North level (compared with 37 percent for the benchmark path).[31]

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paths in Figure 11 for the years 1990 through 2015 are attributable to the forward-looking behavior of those consumers who intertemporally smooth their consumption and saving expenditures. The differences in the saving ratios caused by differences in saving behavior cannot be seen as readily in Figure 10 as (implicitly) in Figure 11 because of the differing vertical scales in the two figures.

[31] When the simulations are run with the vigorous or the sluggish paths for Southern productivity growth, the Northern productivity growth rate is always the benchmark Northern path.

Many consequences of a more vigorous growth in Southern productivity are straightforward to understand. Other things equal, the higher the growth rate of Southern productivity, the higher the level of Southern macroeconomic aggregates such as output and the capital stock. Similarly, the higher the Southern growth rate, the faster the level of Southern productivity will rise toward the elevated level of productivity in the North. Compared with the benchmark outcome, higher Southern output relative to Northern output will necessitate a larger depreciation of the South's currency. Conversely, more sluggish growth in Southern productivity means lower values for the South's output and capital stock, lower South output relative to North output, and a smaller depreciation of the South's currency. Figure 13 shows these exchange-rate consequences.

Effects on the South's saving and investment ratios (Figure 14) have intuitive explanations analogous to those given earlier. Economy-wide incomes and output are higher. More vigorous Southern productivity growth *raises* the saving ratio relative to the benchmark case. With higher output per unit of effective labor input, the requirements for physical capital are greater. Accordingly there is more Southern investment, and the South investment ratio is *higher* than in the benchmark case. Not surprisingly, with Southern output higher, aggregate Southern consumption and per-capita Southern consumption are also higher. More sluggish growth in productivity, with its associated reduced incomes and output relative to the benchmark case and its reduced requirements for capital, *lowers* the saving ratio and the investment ratio and *reduces* the levels of aggregate consumption and per-capita consumption.

Although the saving ratio and the investment ratio move in the same direction when productivity growth is altered, the change in the investment ratio is larger. Therefore, as can be seen in Figure 15, a more vigorous evolution of Southern productivity *worsens* the current-balance ratio (enlarging a deficit or shrinking a surplus). The South's net foreign liability position declines relative to the size of its economy; the South thus becomes a larger debtor to the North as it uses more of the savings generated in the North to support Southern investment. A more sluggish growth in Southern productivity has the opposite effect on external-sector variables, *improving* the current-balance ratio.

Other things equal, the South will be better off in welfare terms if Southern productivity growth is vigorous rather than sluggish. After all, as has long been understood, Southern productivity and the quality of Southern investment are key drivers of Southern growth and welfare. Do Southern countries have to worry that they could make *excessive* use of foreign saving and thereby incur unmanageably large external debt? No doubt Southern economies can borrow too heavily from

abroad and get into debt troubles. But that possibility does not constitute a reason for wishing that Southern productivity growth would be *less* vigorous.

Note also that the North region is itself better off if Southern productivity grows more vigorously. Northern output will be higher than it otherwise would be, the North will enjoy a substantial improvement in its real terms of trade, and Northern per-adult and per capita consumption will be higher. More of the North's savings will be invested in the South in a world with high Southern productivity growth. But such a scenario is the win-win outcome that has been imagined as being on balance good for both the South and the North.

Two key points are suggested by this analysis of alternative assumptions about productivity growth. First, differing presumptions about the extent of Southern convergence to Northern productivity rates can generate substantial quantitative differences in estimates of the effects of demographic transitions on the direction and size of North-South capital flows. Second, however, the broad features of the influence of the demographics appear to be robust. Look again at the evolution of the current-balance ratios shown in Figure 15. Regardless of fairly extreme alternative assumptions about the speed of Southern productivity growth, it remains broadly true that demographic forces during the period from the mid-1970s through today were working to *diminish* the flow of Northern saving to the South in relation to the South's economy. This trend is predicted by model simulations to continue for several more decades, again regardless of whether Southern productivity growth is highly vigorous or disappointingly sluggish.

The Degree of Cross-Border Goods Substitutability

The preceding analysis of the model's simulations emphasizes the sizes of the South's effective labor force and output *relative to those of the North*. These relativities are important because the model specifies cross-border trade using two traditional, widely used assumptions: (i) domestically-produced tradable goods in an economy are imperfect substitutes in demand for tradable goods produced abroad imported into the economy, and (ii) the preferences underlying the imperfect substitutability between home- and foreign-produced goods are unchanged over time. The substitutability margin between home-produced and foreign-produced goods is encapsulated in the price elasticities of each region's demand for imports. Suppose goods production in one of the model's regions accounts for a larger share of world output over time. Given the traditional assumptions about import demands, that region will experience a faster increase in its imports than its

exports. As explained before, the incipient imbalance in that region's trade with the rest of the world will have to be associated with a real depreciation of the region's currency. With unchanged preferences for the imperfectly substitutable home-produced and foreign-produced goods, such depreciation is required to induce the world's consumers and firms to buy the now relatively less scarce output of the faster growing region and to prevent the region's actual trade deficit from growing larger and larger.

The degree of imperfect substitutability between the two regions' goods, as embodied in the values of the substitutability parameters governing the demand for imports, can have important quantitative effects on the macroeconomic interactions between the regions. This analytical point is emphasized in Bryant and de Fleurieu (2005). Because of the importance of the point for North-South capital flows, I illustrate here by reporting a "heightened substitutability" simulation. That simulation raises the price elasticities in the two regions' import equations from a benchmark value slightly above negative unity (a value typically estimated in aggregate import demand equations) to a value nearly two-thirds larger (-1.65). The heightened-substitutability simulation also puts a positive value on so-called "varieties effects" in the model's import equations; the benchmark simulation sets these effects at zero.[32] Apart from these changes, the additional simulation uses inputs identical to those in the benchmark simulation.

The parameter changes that heighten cross-border substitutability are sufficient to cut the size of the long-run depreciation in the real value of the South's currency by almost two-thirds (Figure 16). And they reduce the South's current-account balance (increase the deficit) and its current-balance ratio (Figure 17).

The differences between the heightened-substitutability and benchmark simulations stem from the greater importance in the former of *quantity* adjustments relative to the adjustments in *prices and price-like variables*. When any exogenous shocks – for example, changes to fertility rates and mortality rates – are put into an analytical economic system, real quantity variables are required to adjust so that regional economies and the world economy as a whole can attain a new real equilibrium. The necessary adjustments in key quantity variables, although not independent of what happens to price variables, are most crucially interdependent with the evolutions of other endogenous quantity variables (with all endogenous variables ultimately driven by the exogenous shocks). If

[32] The rationale for "varieties effects" in trade equations and the way they are incorporated in the analytical model are explained in Bryant and de Fleurieu (2005).

shocks are asymmetric across regions, major adjustments are typically required in both the real and the nominal values of cross-border transactions. The higher is cross-border goods substitutability with respect to relative prices, the less will price variables have to adjust to achieve the necessary adjustments in real quantity variables. Greater sensitivity of behavior to prices means that quantities, both cross-border and domestic, adjust faster and possibly more smoothly to the required new equilibrium. Conversely, if cross-border goods substitutability is weak, then price and price-like variables must adjust by much larger amounts to achieve the adjustments to quantities that are ultimately necessary. Price variables in these generalizations include of course goods prices – domestic prices, import and export prices. But the relevant price-like variables also include interest rates and exchange rates (both real and nominal).

In the heightened-substitutability simulation, price adjustments – including, dramatically, the real exchange rate – are less large than in the benchmark case. The South's output relative to the North's rises less, which is part of the explanation of why there is less incipient pressure on the real exchange rate to adjust. The higher values of the cross-border substitutability parameters simultaneously *reduce* the size of the depreciation of the South's currency and *diminish* the South's current-balance ratio. As can be seen from Figure 17, the heightened substitutability parameters do not reverse the broad influences of the demographic forces on the regions' external imbalances and hence do not reverse the resulting direction of interregional capital flows. In the heightened-substitutability as in the benchmark simulation, one observes an increase in the size of capital inflows relative to the Southern economy during the historical period prior to the mid-1970s and then a long diminution in the decades after the 1970s. However, the levels of the current-balance ratios differ greatly between the two simulations.

Suppose one were to gauge regional welfare by the evolution over time in levels of per-adult consumption (or per-capita consumption for the entire population). The two simulations would differ dramatically in that dimension as well. Relative to the benchmark simulation, heightened cross-border substitutability with its augmented Southern use of Northern savings *improves* welfare in the Southern region. But heightened substitutability *worsens* Northern welfare.

Plainly, analytical inferences about the subject of this paper as well as about many global macroeconomic issues need to pay more attention to the degree of cross-border goods substitutability. In particular, analysts and policymakers require more reliable empirical estimates of the determinants of the degree of cross-border goods substitutability than the estimates currently available.

Initial Conclusions

The analysis in this paper reinforces the increasingly appreciated point that demographic asymmetries across regions can strongly influence macroeconomic outcomes. The contribution of the paper is to develop this theme for regions' saving and investment and for the balance between them, the reverse side of the coin of interregional capital flows. By specifying the regions as aggregations of Southern (developing lower-income) and Northern (developed higher-income) nations, insight is gained into the consequences of the most pronounced demographic asymmetries in the world today.

A relatively optimistic view of asymmetric demographic transitions, as noted at the beginning of the paper, suggests that the North can run a current-account surplus sizable in relation to the Northern economy, thereby transferring large net amounts of financial capital to the South. Such an outcome could be mutually beneficial for both the South and the North. The analysis here argues that this view is a plausible summary of what happened in the world economy in the historical period between 1950 and the mid-1970s. But the analysis casts doubt on this optimistic view for historical decades after the 1970s. Rather, the paper reinforces the conjecture that asymmetric demography between the South and the North, other things being held equal, now operates to *reduce* rather than increase the net flow of Northern savings to the South as a proportion of the Southern and Northern economies. Alternatively stated, demographic factors for the recent past and for several decades into the medium-run future cause Northern saving to fall relative to Northern investment while Southern saving rises relative to Southern investment.

Is this conclusion about the effects of demographic forces on North-South capital flows substantially changed if one presumes a faster demographic transition in the South, for example if Southern fertility rates were to fall faster and sooner than in the medium-convergence scenario of the UN Population Division? Or would the conclusion change substantially if the South experienced a slower, considerably delayed demographic transition? The answer to these questions seems to be no. The conclusion appears robust to plausible alternative demographic assumptions. Faster or slower Southern convergence to the later stages of demographic transition that are now being experienced by the Northern economies would of course alter quantitative estimates of all the macroeconomic consequences. But the broad features are changed in moderate ways, as can be readily seen in Figures 9 through 11. Similarly, the conclusion about the effects of demographic forces on North-South capital flows appears to hold broadly regardless of whether Southern productivity growth is

vigorous or sluggish, and regardless of whether cross-border goods substitutability is moderate or strong.

The analysis also suggests that a faster or slower demographic transition in the South would not greatly change welfare consequences for the South. Faster demographic convergence would be associated with a marginally higher path for Southern per-capita consumption in the medium run. But the difference from the medium-convergence demographic path would be fairly small. And faster convergence would, again, tend to diminish (other things equal) the relative extent to which the Southern economy makes use of Northern savings to facilitate Southern development.

It may be just as well that the welfare differences between faster or slower demographic transitions appear to be modest. Southern governments do not have much of a policy handle over the speed of demographic developments. For example, it is unclear what policy measures might make the fertility rate fall faster (apart from radical policies such as the Chinese one-child-per-couple restriction). Precisely how to increase life expectancy through delivery of better health care services is also problematic.

If Southern governments aspire to promote growth and welfare, their best hope is presumably to aim policies at improvements in infrastructure capacity, labor education and skills, and institutions nurturing and protecting investment. Indeed, one general inference from the simulations presented above incorporating alternative productivity paths is that much the surest recipe for improving Southern welfare is to lift the level and growth rate of Southern productivity. Such a statement is too general to have direct policy relevance, but it does point the development of policy recommendations toward the most promising areas.

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Postscript: The Agenda for Further Research

This paper is a preliminary report on the latest stage of our project's research on the global dimensions of demographic change. The questions with which it deals are self-evidently complex. Much remains to be done to refine the analytical framework and the conclusions that can be robustly derived from it.

As described, the model in its current revision embodies several salient asymmetries between the South and North regions in addition to obvious differences in the relative sizes of key demographic and macroeconomic variables. The treatment of some of these asymmetries can be refined. And in any case further sensitivity tests need to be conducted before it is possible to understand the consequences of each asymmetry considered in isolation. For example, the three differences between investment climates in the South and North introduced into the model – differing risk equity premiums, differing rates of depreciation, and differing adjustment costs for investment – are crude ways of capturing the idea that the investment climate in the South is less favorable. Given the inevitable simplifications in the analytical framework, these assumptions seem a useful place to start. But at the least we need a better understanding of the significance of each of the assumptions taken separately.

Our assumptions about productivity levels and growth rates for the regions, as stated already, are tentative. For subsequent updates of the research, we are contemplating paths for Southern levels and rates of productivity growth even more radical than the alternatives used above.

The initial conditions for model simulations also need further refinement. I plan to continue reviewing and amending calibration assumptions and trying to compile better background data. The careful reader will have noticed that this report deemphasizes the calculated *levels* of variables associated with calibration of the initial conditions (for example, the South's large current-account deficit and large net foreign liability position at the outset of the simulations). Rather, I emphasize the *changes* in model variables measured as deviations from the initial conditions of 1950. I feel more confident about the validity of inferences about these changes than I do about the initial-conditions levels themselves.

In future extensions of the research, we not only will refine the existing model asymmetries between the regions but will probably introduce additional asymmetries as well. Differences between the Southern and Northern regions could feasibly be implemented, for example, in all of the

following ways: estimation or specification of the age-earning profiles that determine aggregate labor incomes and the sizes of effective labor forces; calibration of the parameters governing the consumption of children and the support of child consumption by adults; calibration of the parameters determining the operations and generosities of public pension systems; and assumptions about government-sector budgeting and debt policies. Such changes in the analytical framework would be implemented to try to capture still other ways in which Southern relative to Northern economies may have less effective institutions and may be somewhat less hospitable places for economic activity.

For reasons already given, it seems especially important to carry out further research on how the degree of cross-border substitutability affects inferences with the model. Cases merit examination where the substitutability parameters not only are varied similarly for all regions but also where they differ across the regions. The relevant parameters include those governing import demands (elasticities with respect to relative prices), export supplies ("varieties effects"), and the intertemporal elasticities of substitution in consumption behavior.

This agenda is long and complex. But it is preferable frankly to acknowledge unfinished business than to pretend that loose ends have already been sewn up into a well-knit garment.

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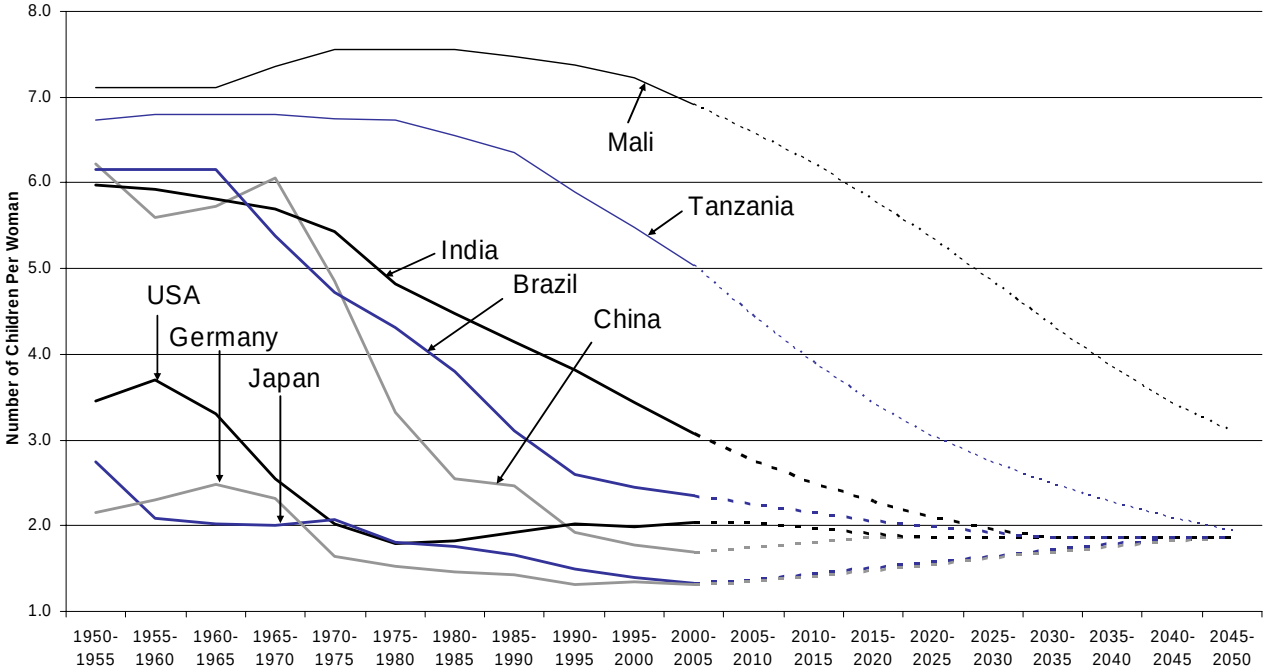
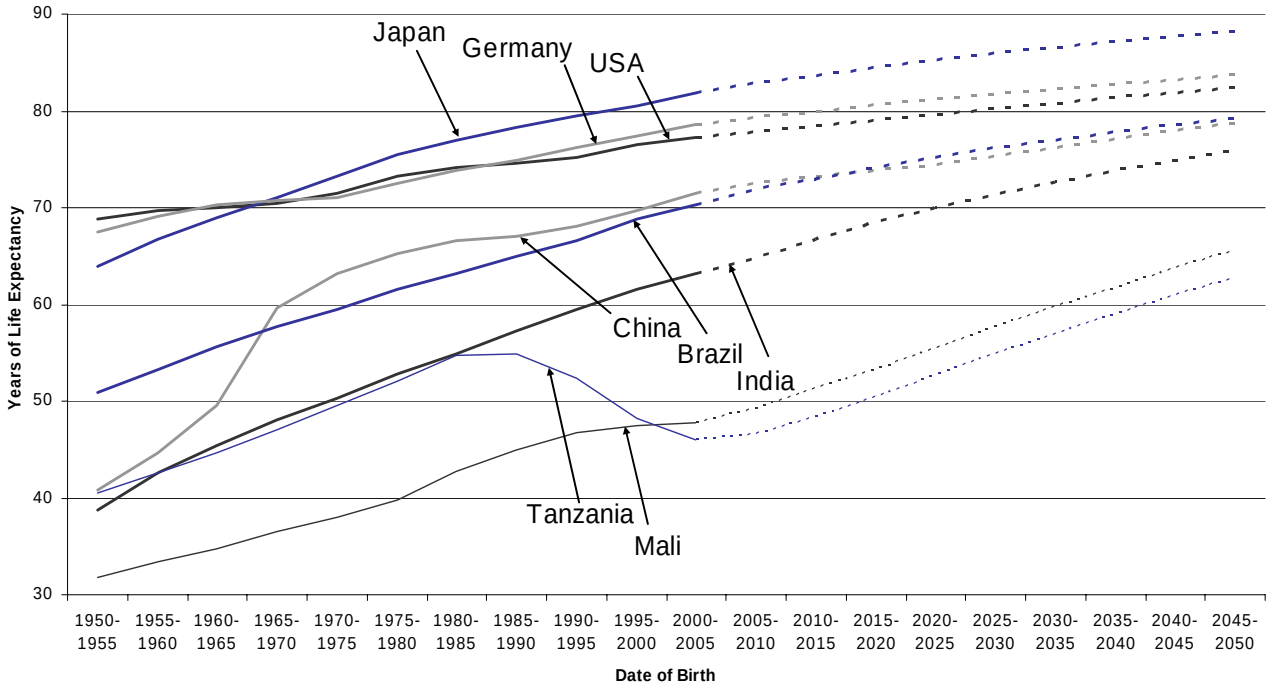
Demographic Profiles for Selected Individual Nations
Historical and Projected, Quinquennial Averages 1950 – 2050

1a. Fertility Rate (Lifetime Births per Woman)

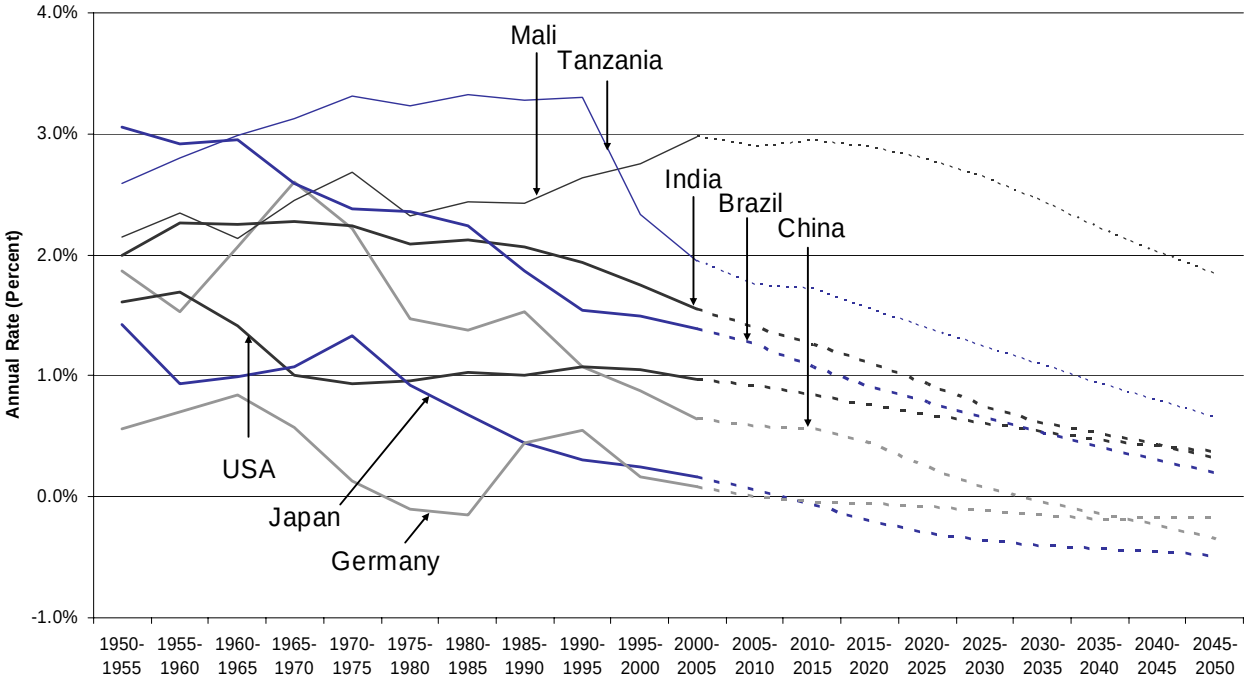


1b. Expectation of Life at Time of Birth

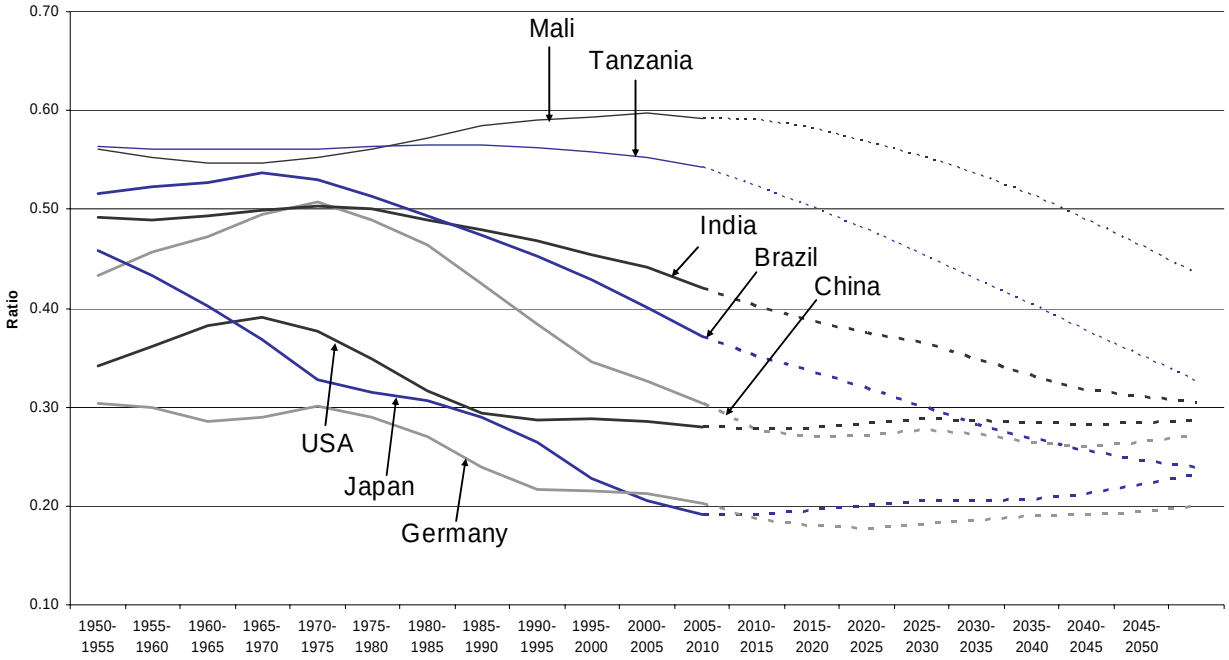


Demographic Profiles for Selected Individual Nations
Historical and Projected, Quinquennial Averages 1950 – 2050

1c. Average Annual Growth Rate of Total Population

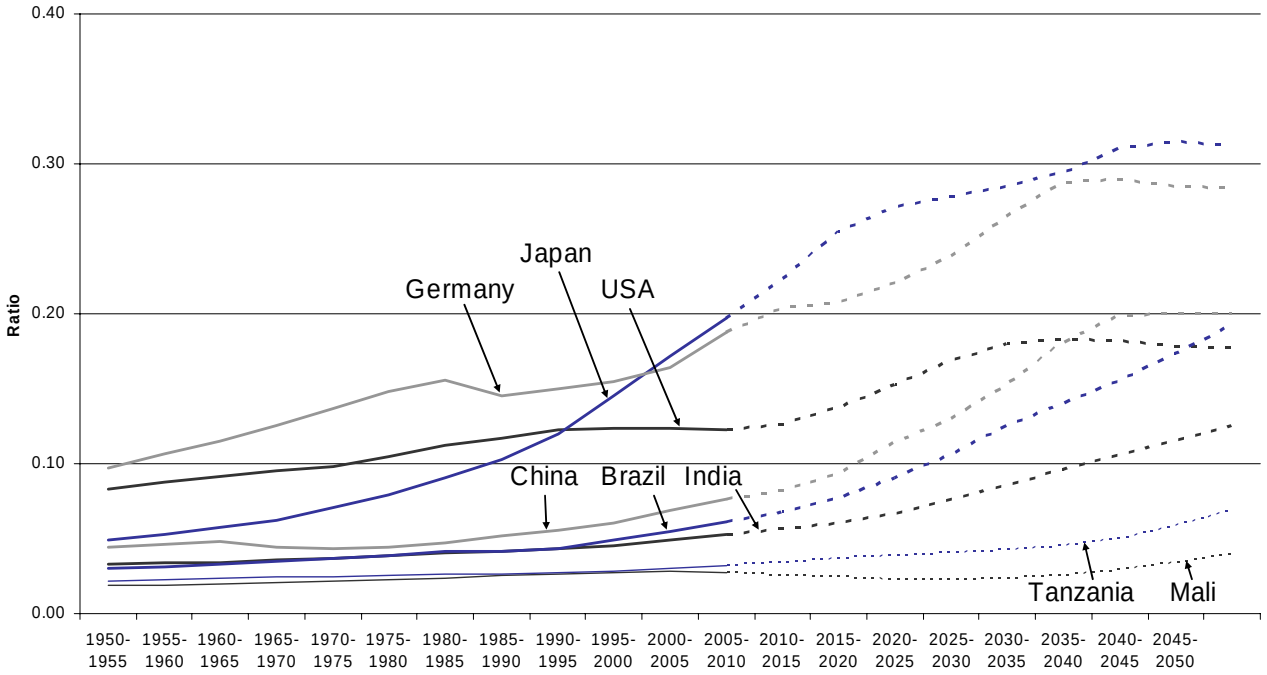


1d. Ratio of Youths (Age 0-19) to Total Population

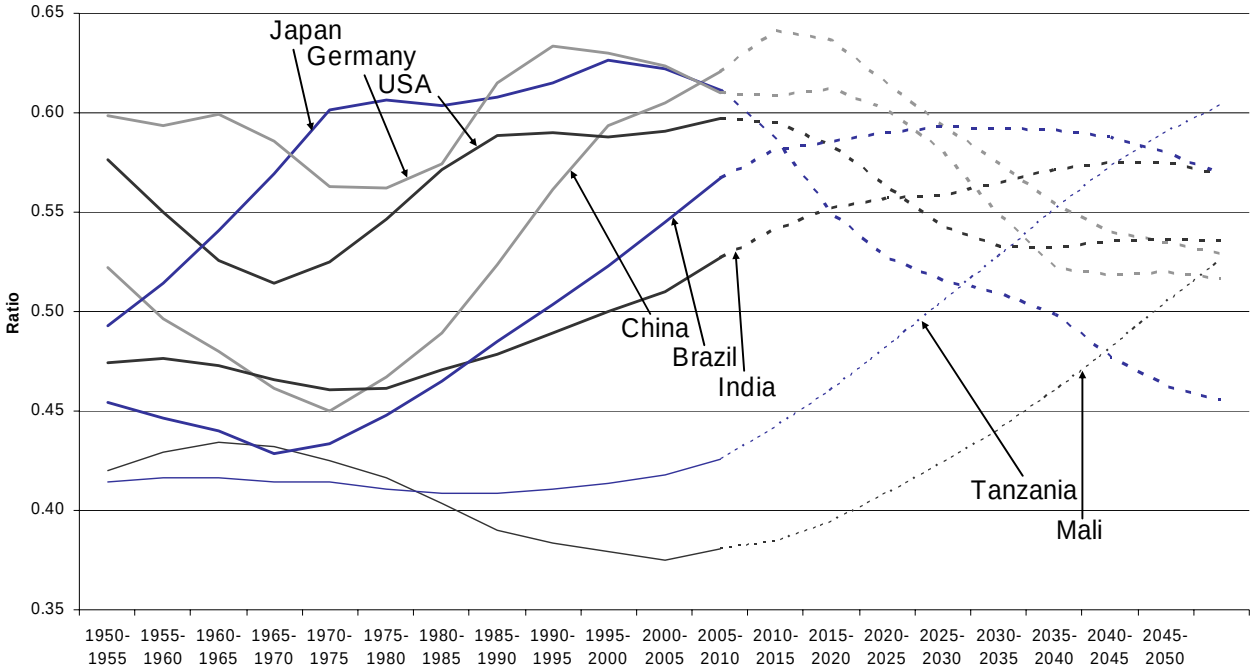


Demographic Profiles for Selected Individual Nations
Historical and Projected, Quinquennial Averages 1950 – 2050

1e. Ratio of Elderly (Over Age 64) to Total Population

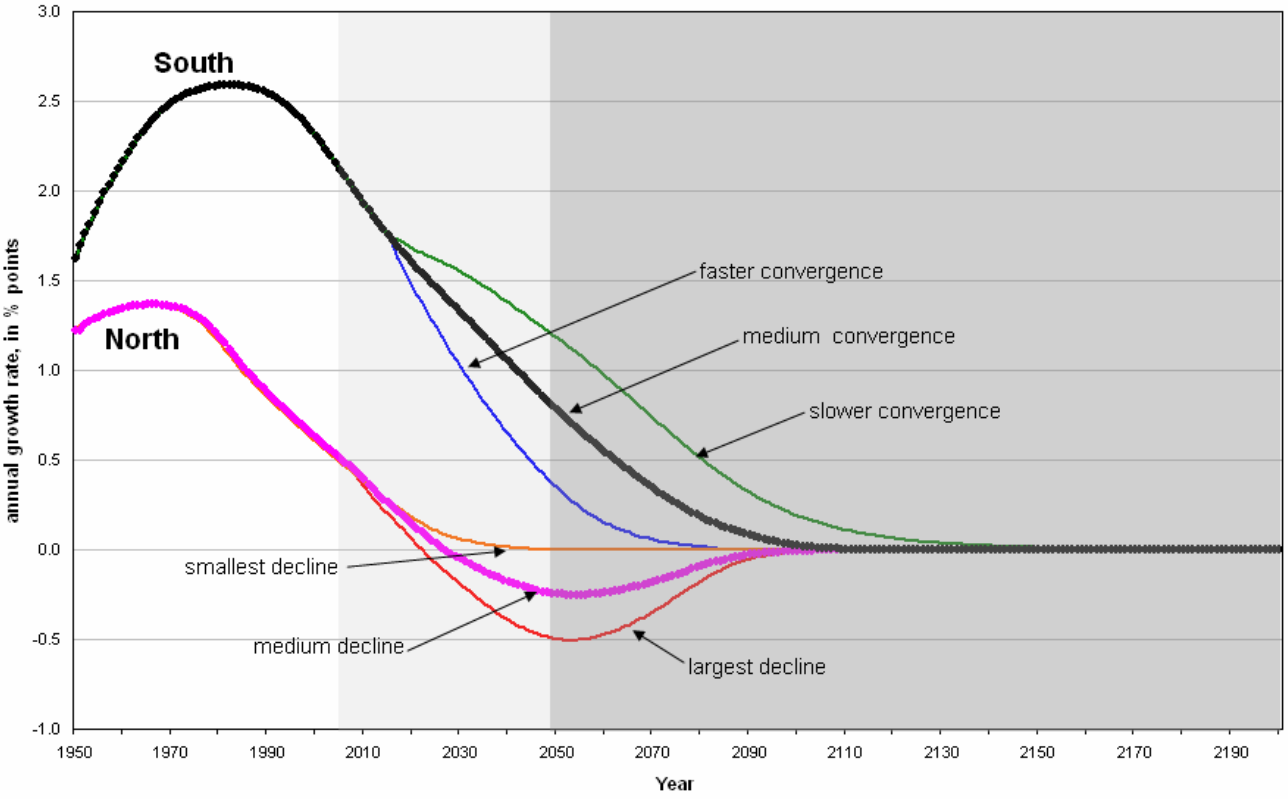


1f. Active Ratio: Adults Aged 20 – 64 as a Proportion Of Total Population

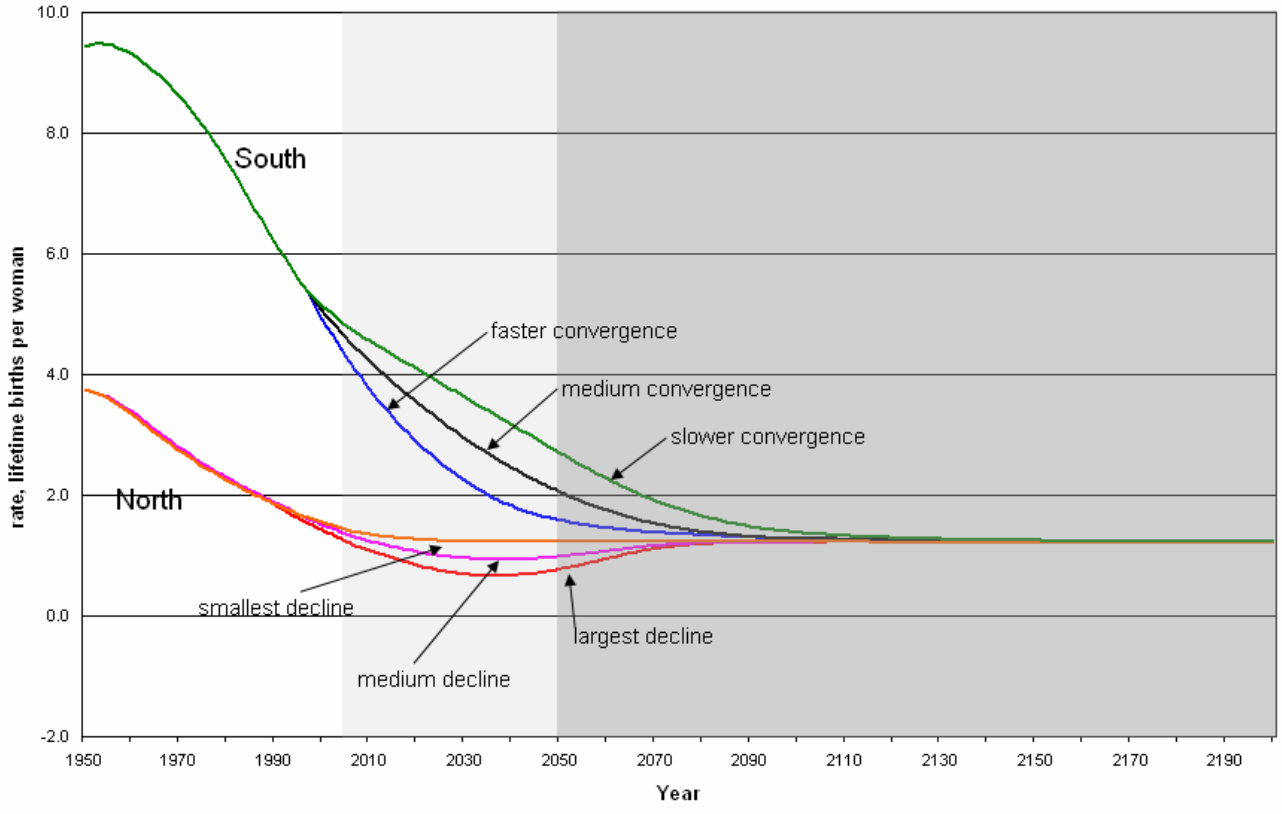


2a. Annual Growth Rate of Adult Populations

History 1950-2005. UN Projections 2005-2050. Author's Extrapolations 2050-2200.

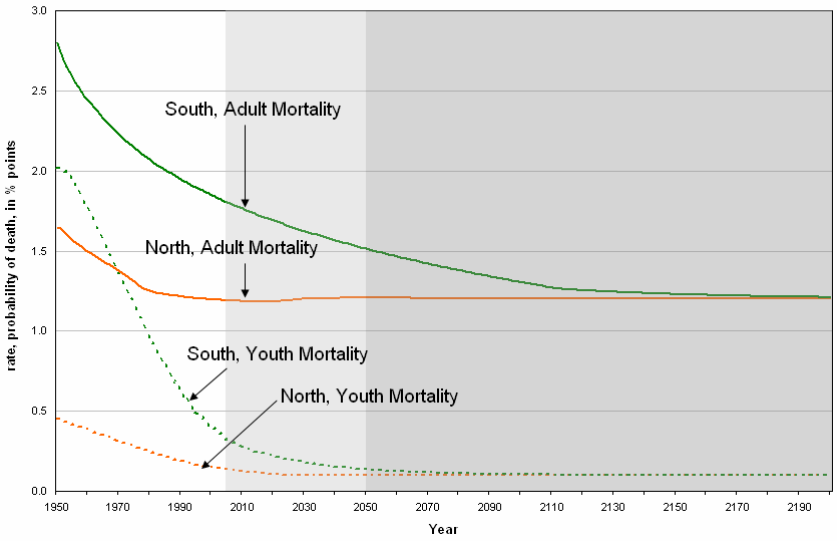


2c. Fertility (Birth) Rates

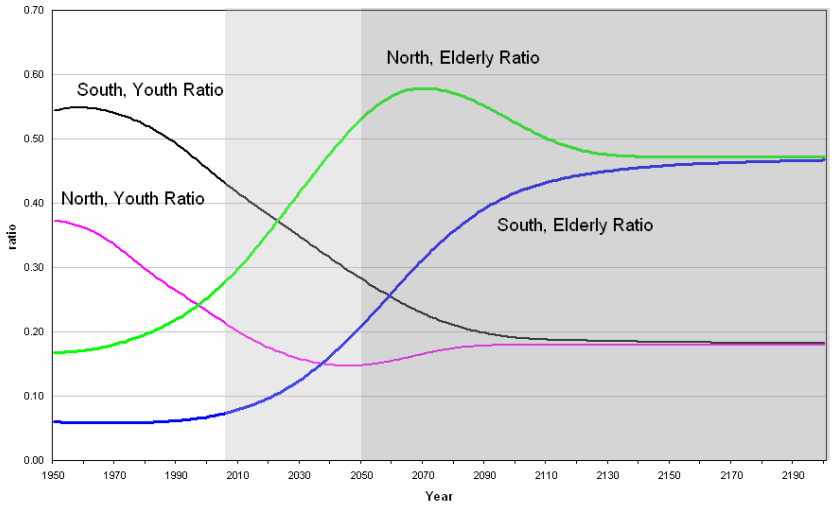


2b. Assumed Mortality Rate Assumptions

Based on UN Historical and Projected Data for Life Expectancy

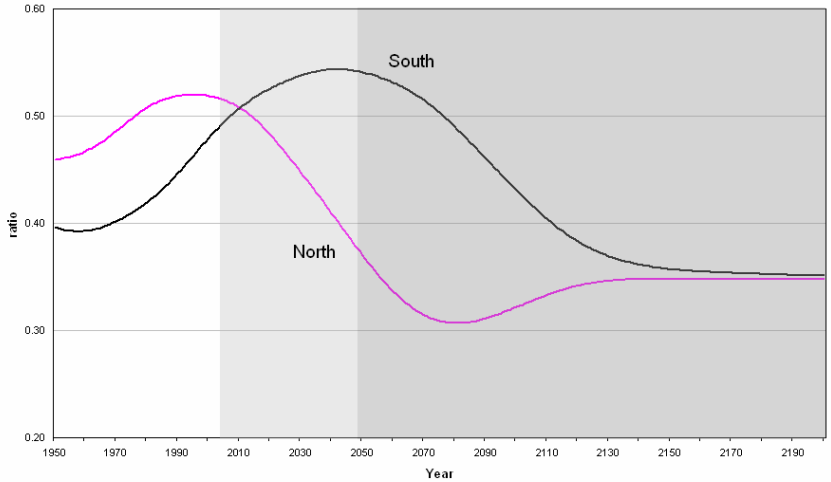


2d. Dependency Ratios: Youths to Total Population, Elderly to Total Population



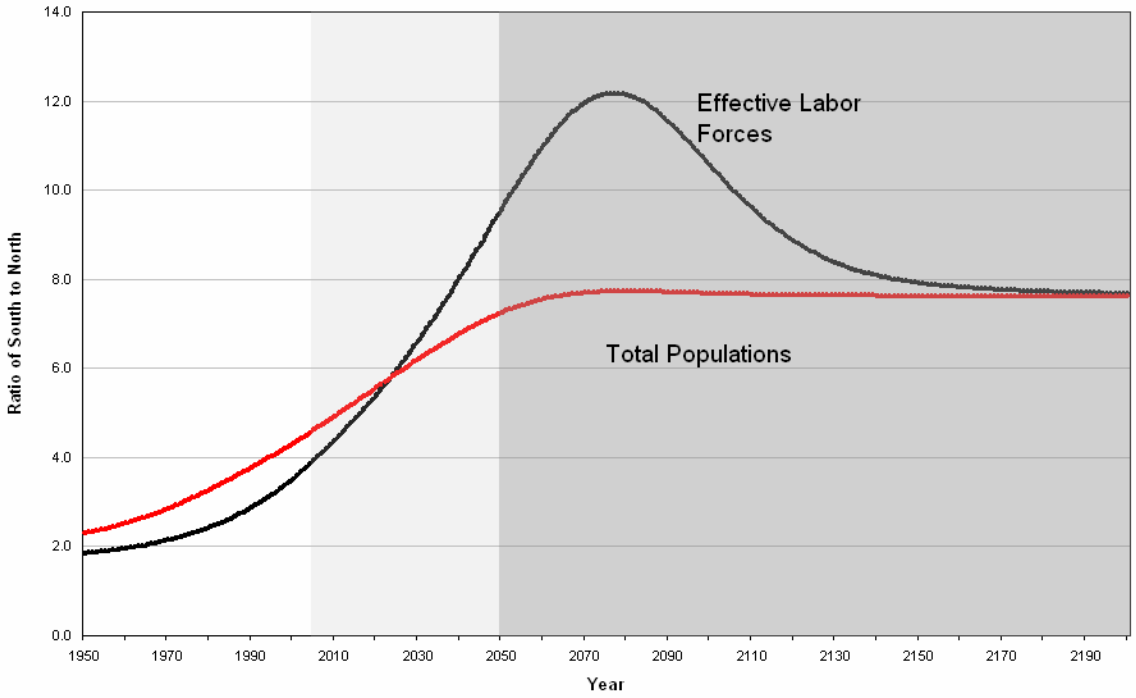
UN fertility paths underlying these ratios: "medium convergence " for South and "medium decline" for North.

2e. Active Ratios: Adults of Working Age as a Proportion of Total Population



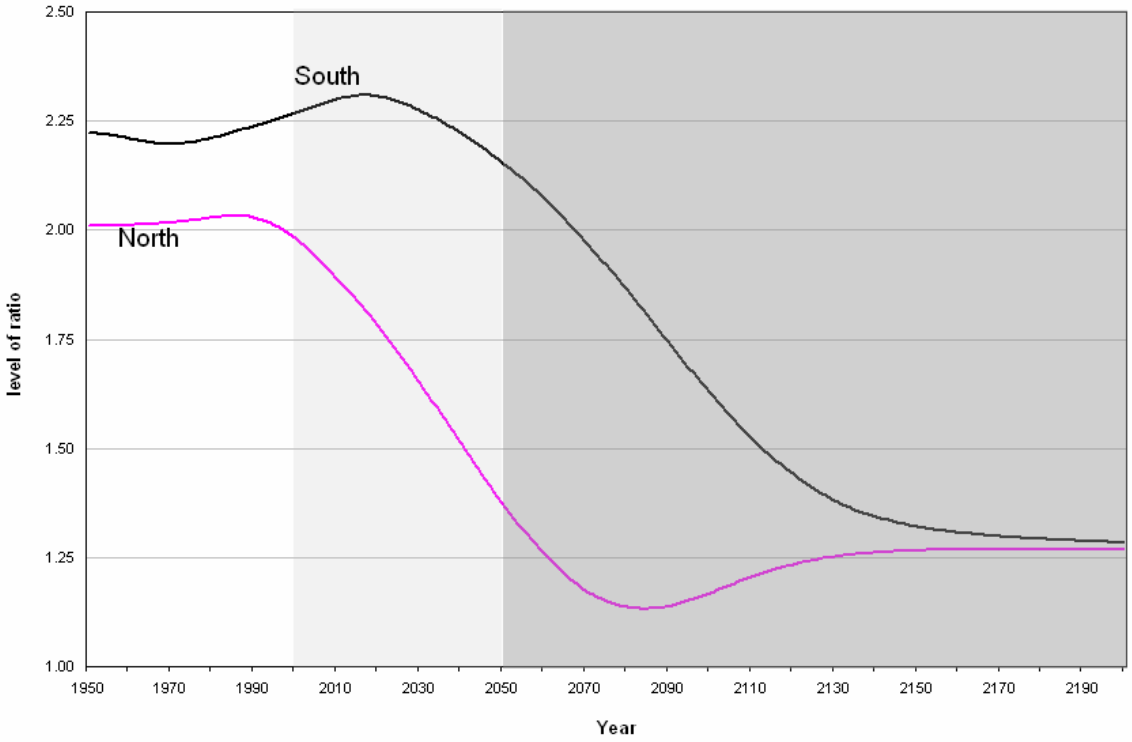
UN fertility paths underlying these ratios: "medium convergence " for South and "medium decline" for North.

3. Ratios of South to North: Total Populations and Effective Labor Forces



UN fertility paths underlying these ratios: "medium convergence " for South and "medium decline" for North.

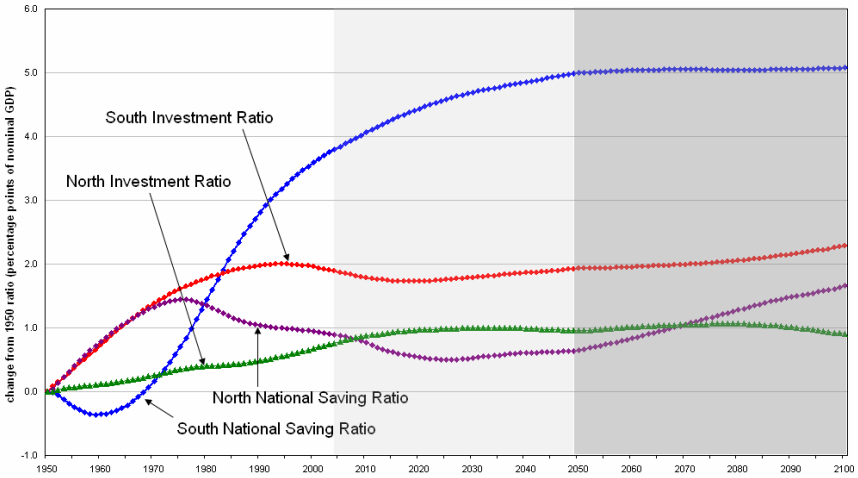
4. Ratios of Effective Labor Forces to Adult Populations



UN fertility paths underlying these ratios: "medium convergence " for South and "medium decline" for North.

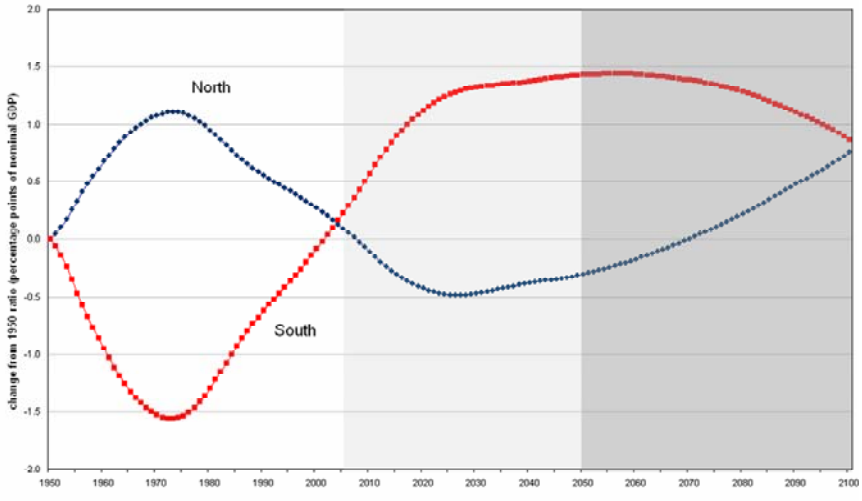
5. Ratios of Domestic Investment and National Savings to Nominal GDP, South and North

benchmark simulation, change from 1950 value of ratios



6. Ratios of Current-Account Balance to Nominal GDP, South and North

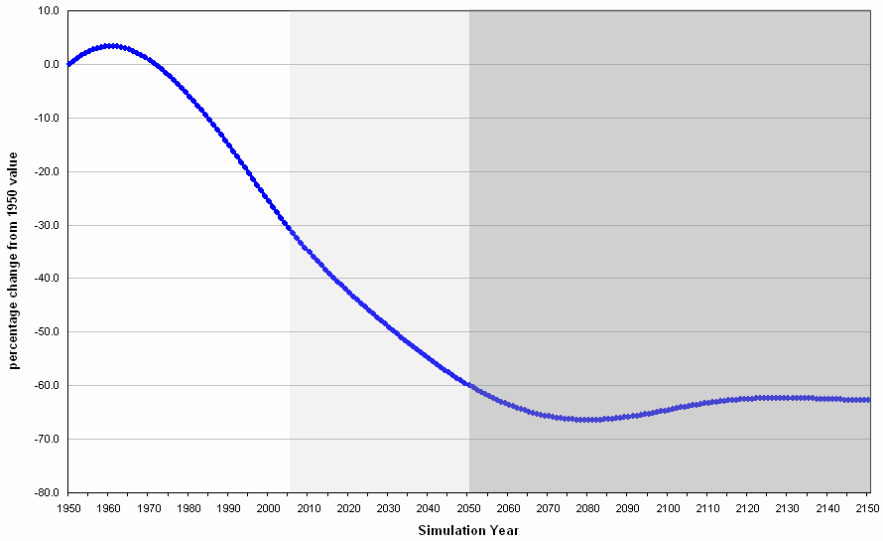
benchmark simulation, change from 1950 value of ratios



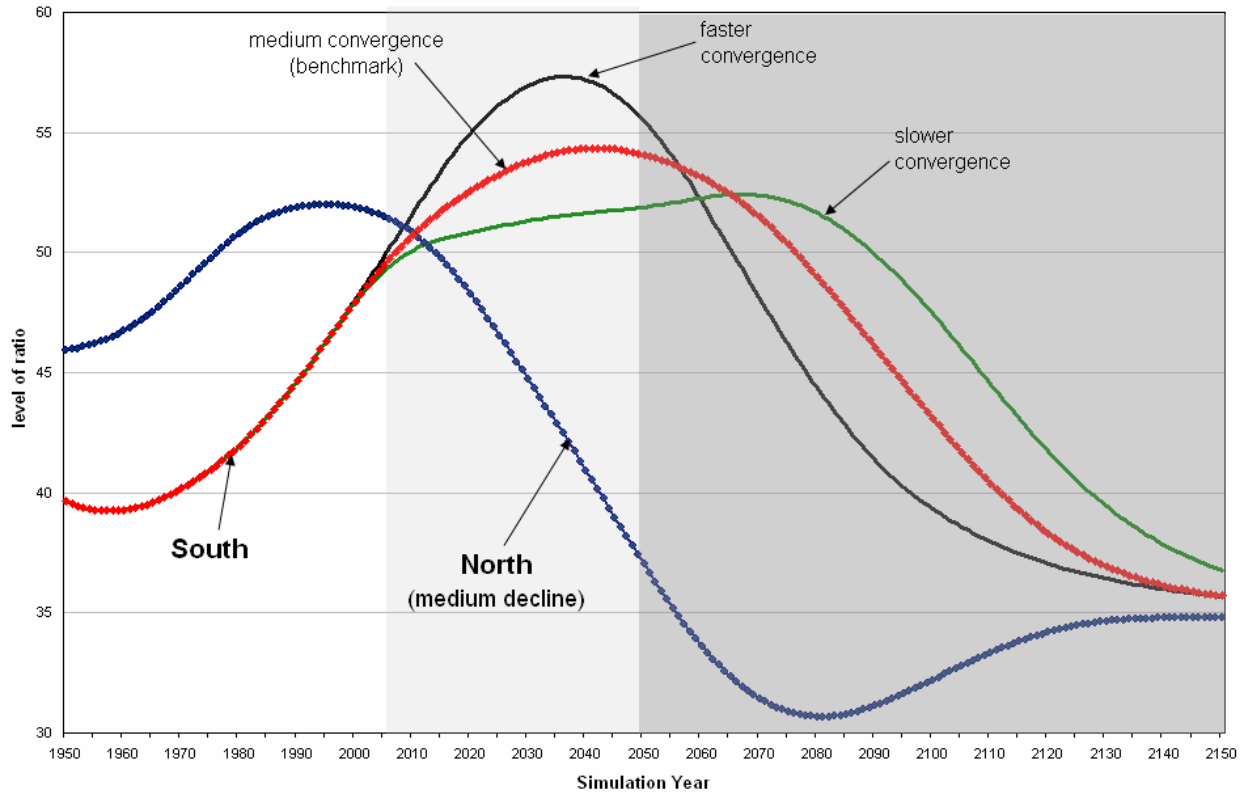
7. Real Exchange Rate, Percent Change from 1950 Value

benchmark simulation

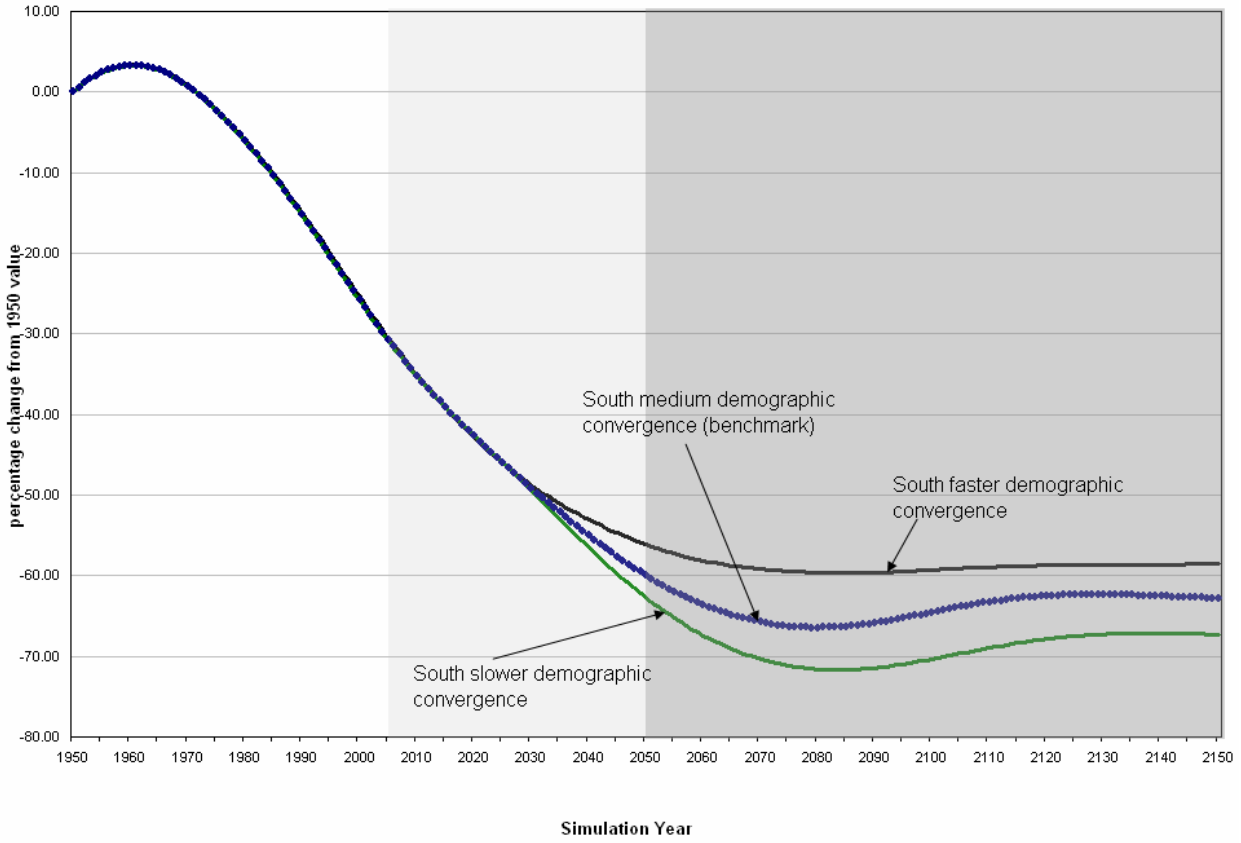
(- = depreciation of South currency)



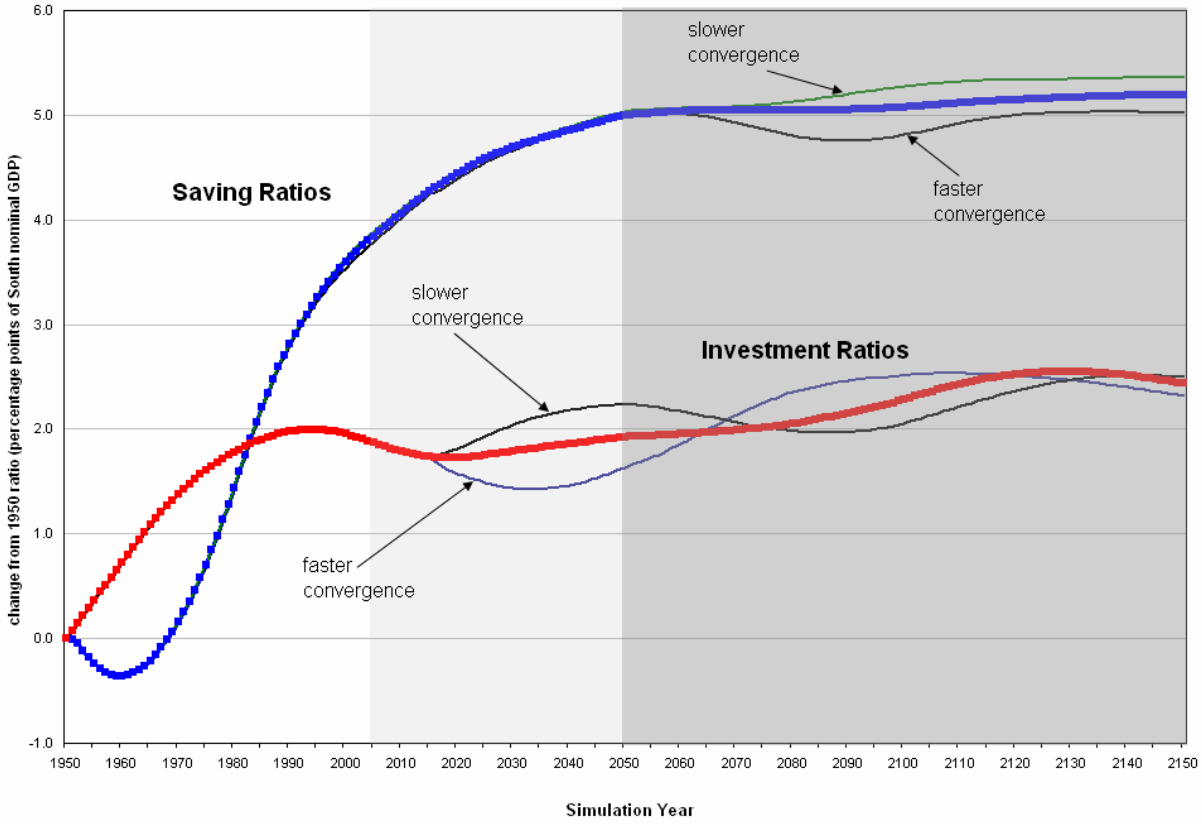
8. Active Ratios in South and North:
Three Alternative Paths for South Demographic Evolution



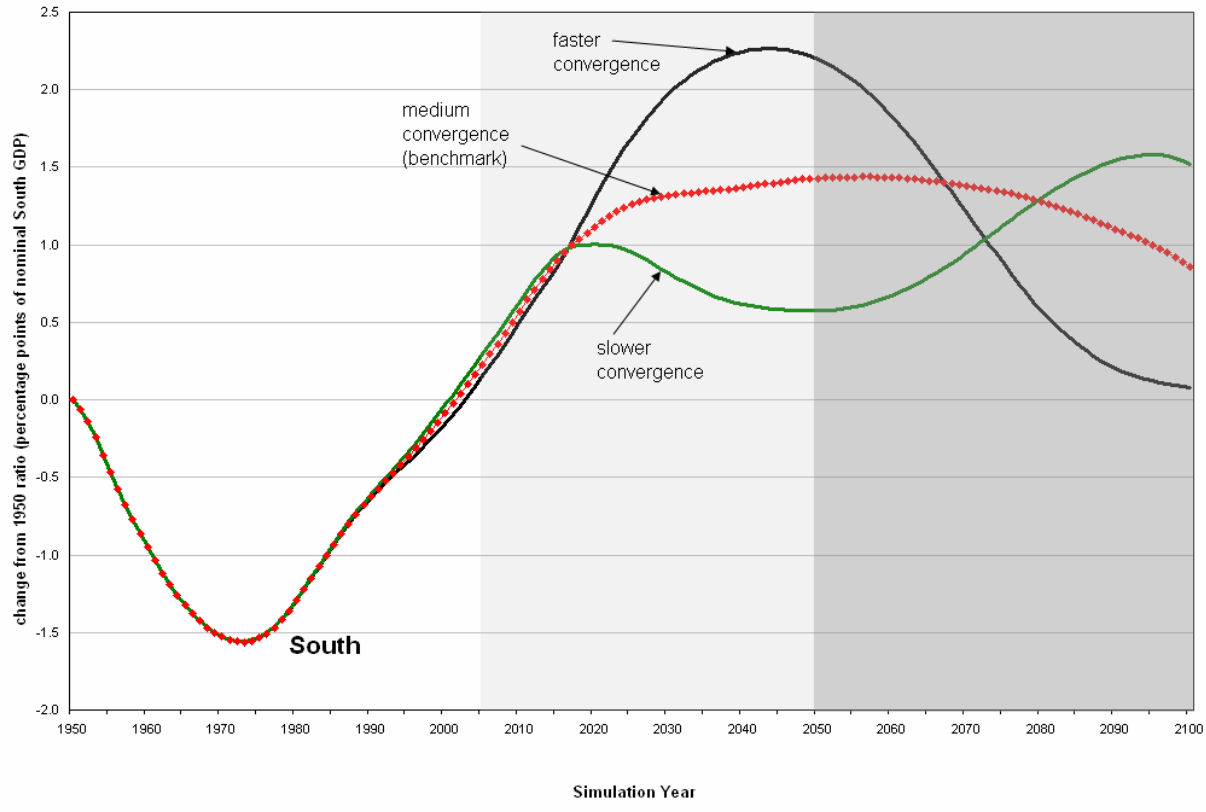
9. Real Exchange Rate, Percent Change from 1950 Value
Three Alternative Paths for South Demographic Evolution
(- = depreciation of South currrency)



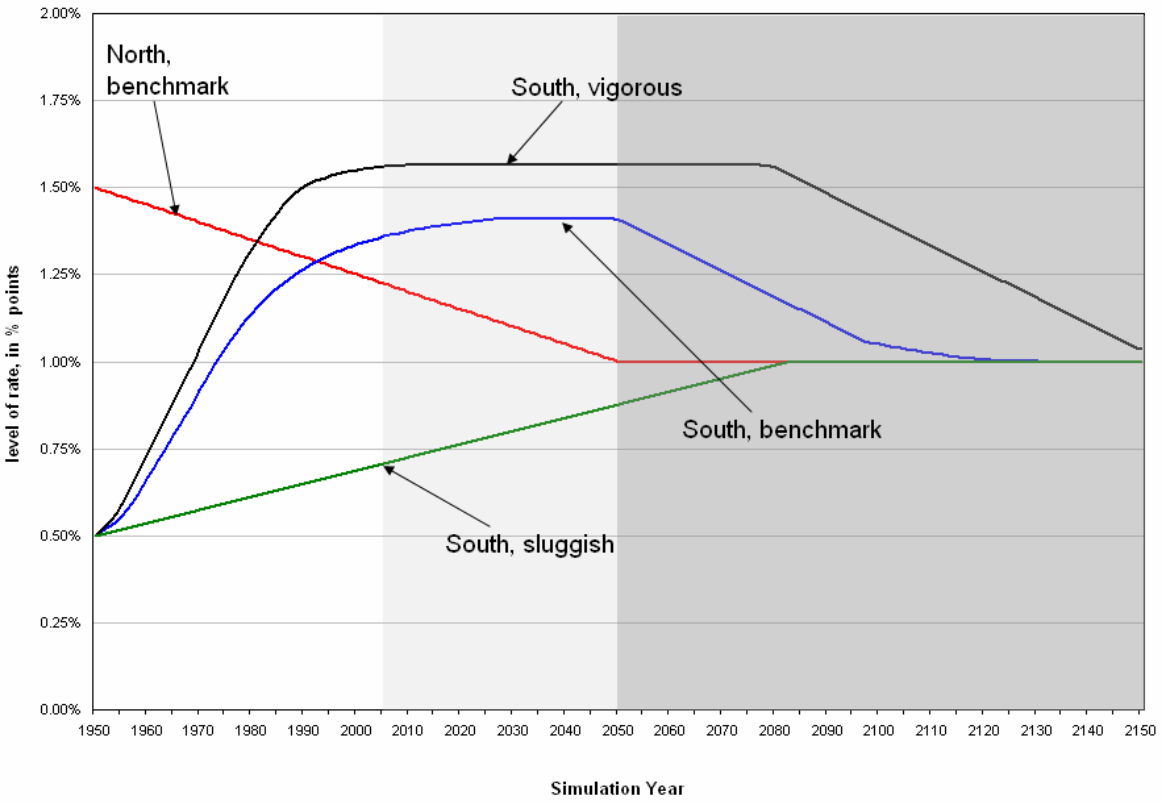
10. South: Ratios of National Saving and Domestic Investment to Nominal GDP
Three Alternative Paths for South Demographic Evolution
change from 1950 value of ratios



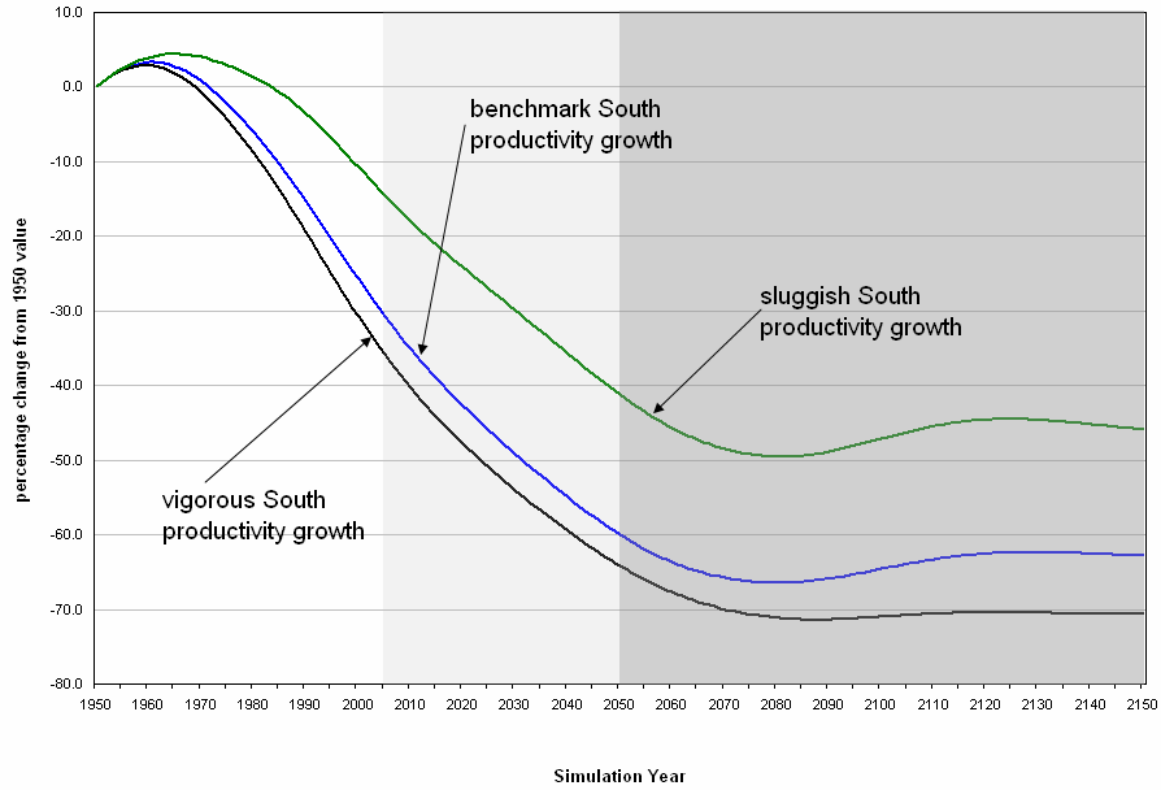
11. South: Ratio of Current-Account Balance to Nominal GDP
Three Alternative Paths for South Demographic Evolution
change from 1950 value of ratios



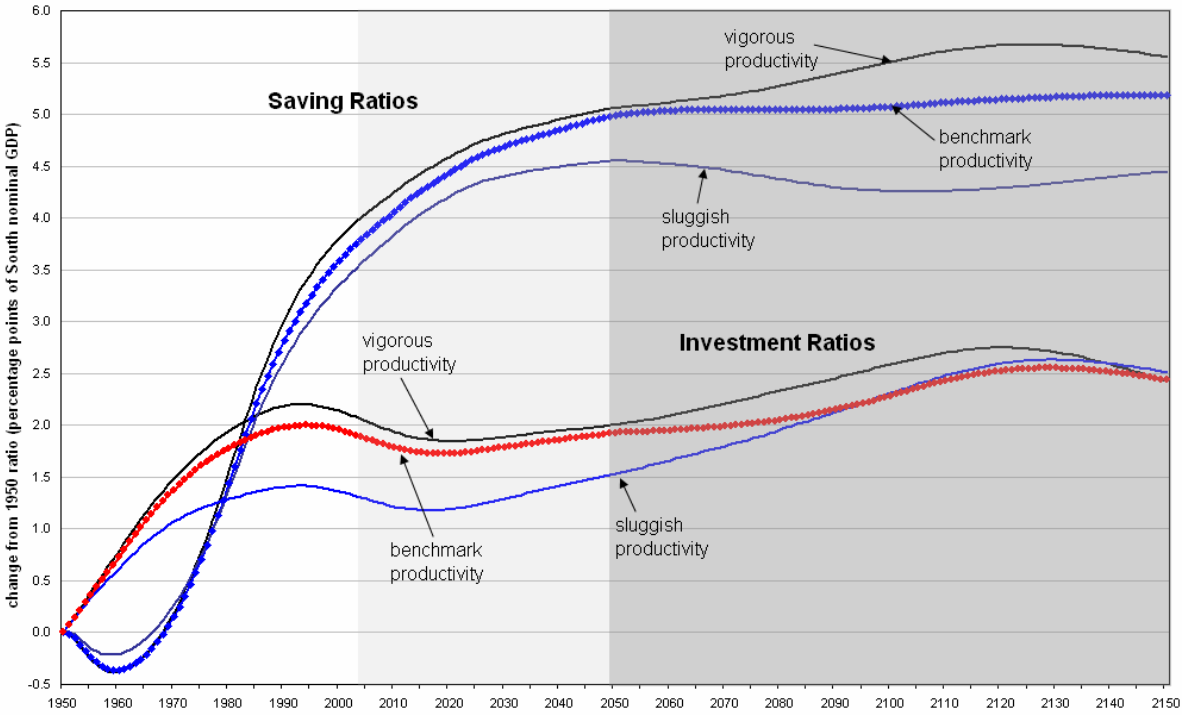
12. Growth Rates for Labor Productivity
Three Alternative Assumed Paths for South Convergence to North



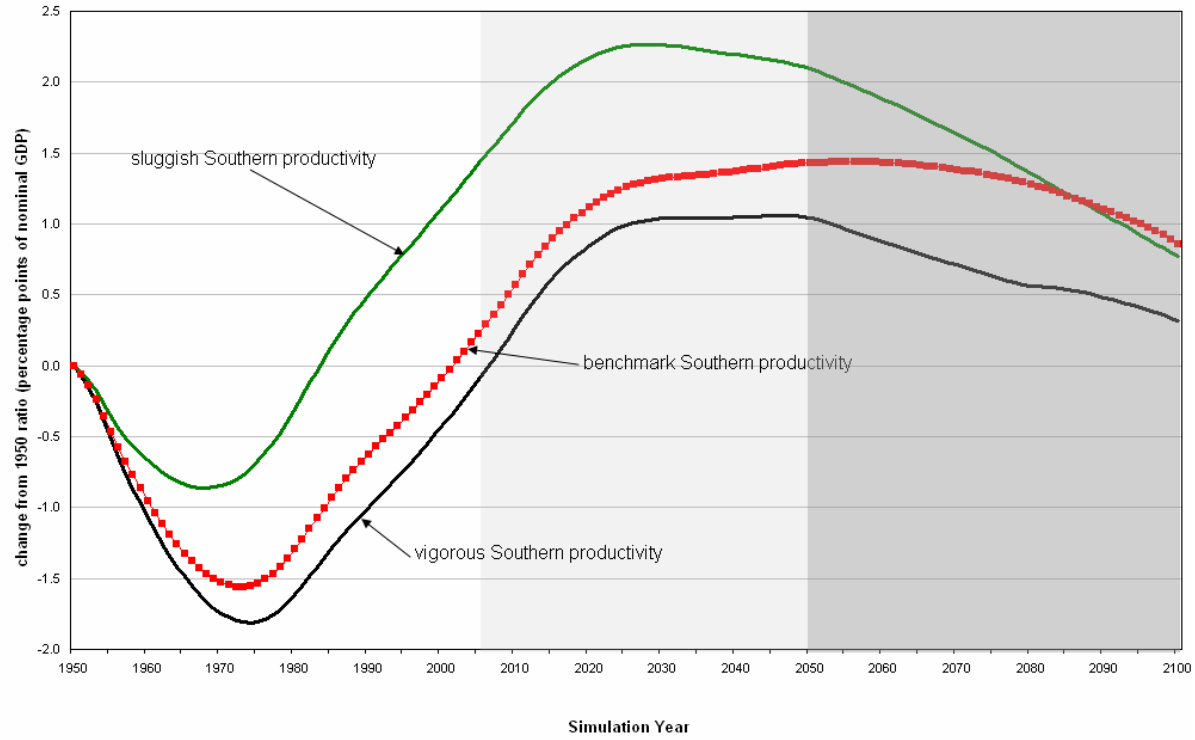
13. Real Exchange Rate, Percent Change from 1950 Value
Alternative Scenarios for South Productivity Growth
(- = depreciation of South currency)



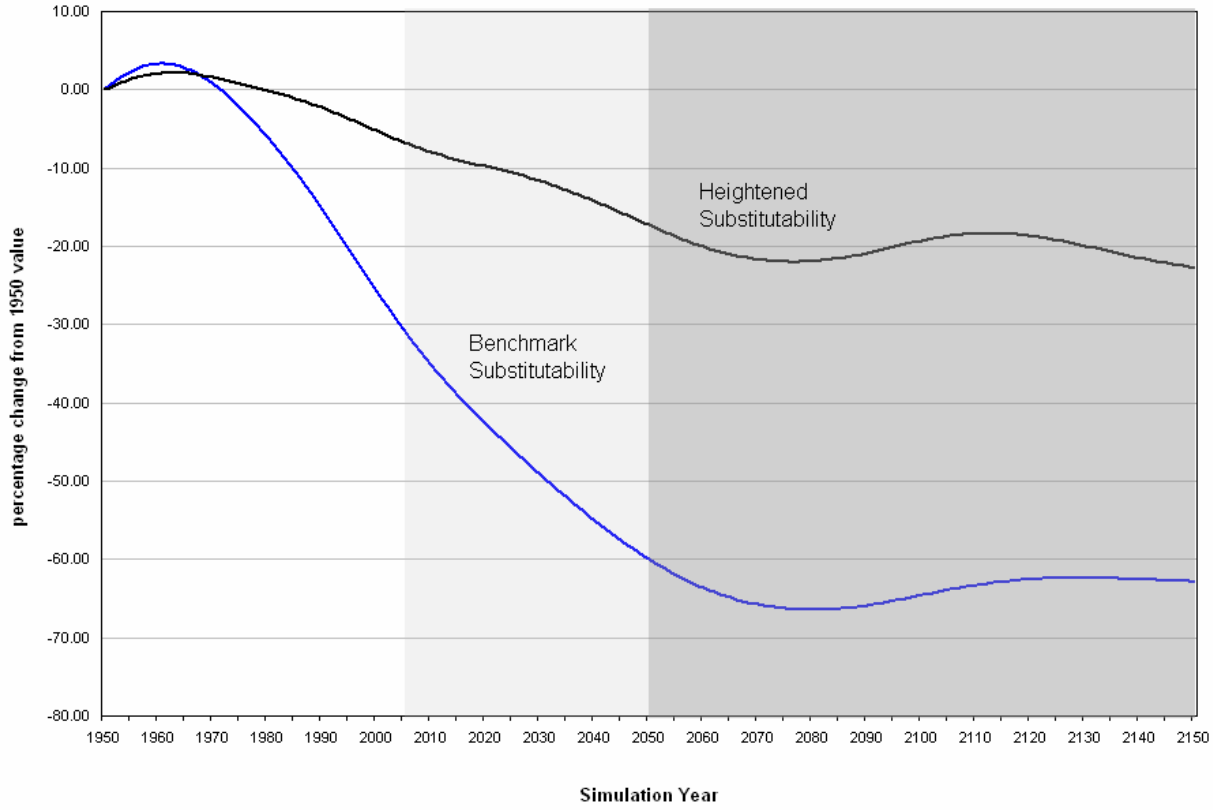
14. South: Ratios of National Saving and Domestic Investment to Nominal GDP
Alternative Scenarios for South Productivity Growth
change from 1950 value of ratios



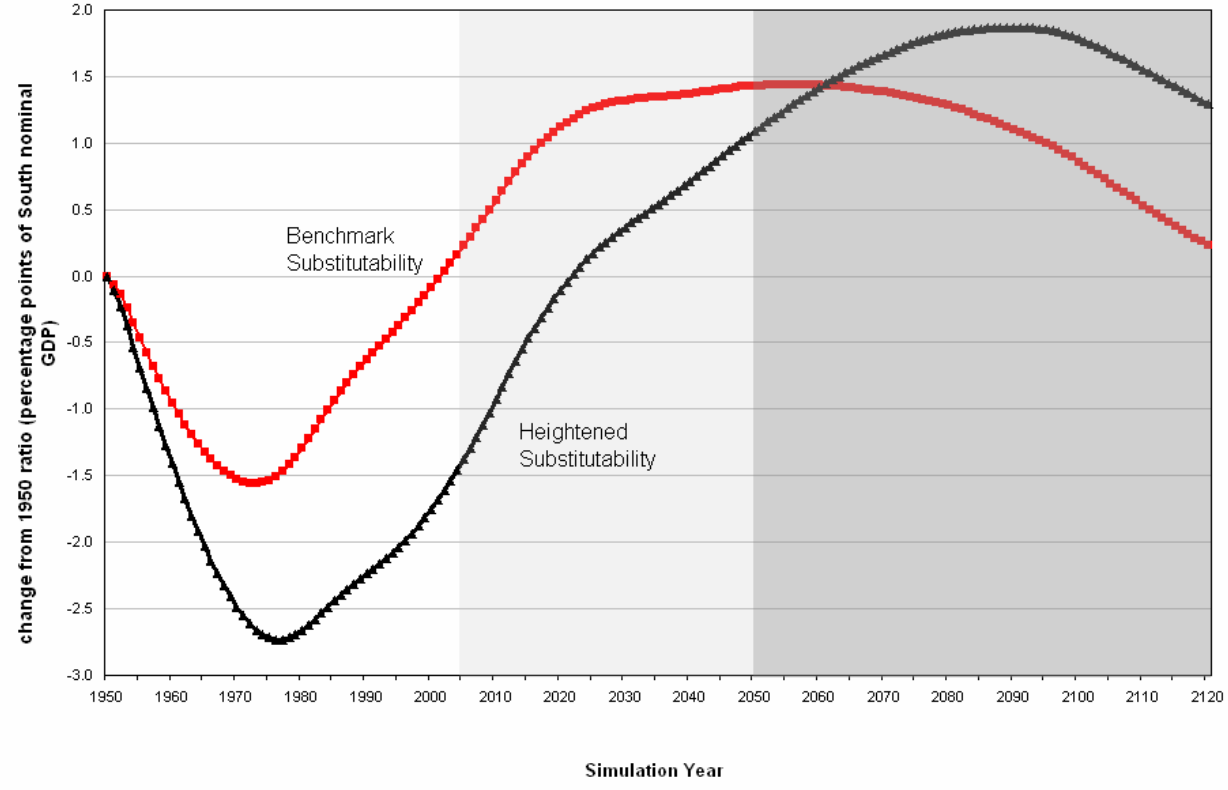
15. South: Ratio of Current-Account Balance to Nominal GDP
Alternative Scenarios for South Productivity Growth
change from 1950 value of ratios



16. Real Exchange Rate, Percent Change from 1950 Value
Alternative Assumptions about Cross-Border Substitutability Parameters
(- = depreciation of South currrency)



17. South: Ratio of Current-Account Balance to Nominal GDP
Alternative Assumptions about Cross-Border Substitutability Parameters
change from 1950 value of ratios



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