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Can the Poor Countries Catch Up? Sources of Growth Accounting Gives Weak Convergence for the Early 21st Century

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Abstract: Projections of per capita income gaps between nine regional groups of transition/developing economies and the rich economies for the period 1998-2030 are made on the basis of an extended sources of growth equation taking into account Kaldor-Verdoorn effects, possible impacts on labor productivity of trade liberalization and/or astute industrial policy, human and physical capital accumulation, employment and population growth, shifting shares of labor in income and traded goods in output, shifts in capital productivity, productivity growth retardation due to convergence, and specific regional effects. Under optimistic assumptions about all these factors and in the historically unprecedented absence of adverse macroeconomic shocks over three decades, modest relative convergence of all regions to the rich countries may be possible. However, except for one region (the "Tigers") absolute income gaps are projected to widen.

In the wake of Lucas's (2000) hymn to technological grace, the idea has spread that diffusion of knowledge should allow the income distribution across the nations of the world to narrow substantially – according to Lucas by the year 2100 we should all be "equally rich and growing." Without venturing so far as to offer forecasts for a century, in this paper we apply an extended growth accounting framework based on simple theory and accounting identities to try to say something about economic prospects for major regions of the world over the next 20-30 years.

The projections, although derived from a model biased towards optimism, are far more modest than Lucas suggests. Their bottom line is that over the next generation or so, narrowing

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of their *relative* income gaps with the rich economies is possible for nine poor regions (or individual large countries) that we consider. However, *absolute* income gaps are likely to grow larger for almost all of them. The projections are depicted in Figures 9 and10 below. The former shows ratios of per capita income levels in developing regions to the per capita income of the developed members of the OECD over the period 1998-2030. Projected absolute differences in per capita GDP of poor and rich regions are shown in Figure 10.

It is important to recognize, moreover, that even relative per capita income growth of poor countries as compared to the rich can only occur under very favorable circumstances. There would have to be positive, non-linear feedback among several potential sources of productivity increases – Kaldor-Verdoorn effects, more rapid labor productivity growth due to astute industrial policy and/or economic opening, and physical and human capital accumulation - taking place consistently over time. Absent such interactions, baseline projections generate stable or widening relative income disparities between rich and poor regions. Also, the gaps will narrow only if poor countries' growth is steady and uninterrupted over several decades – certainly not the case during the latter part of the 20th century (Weisbrot et.al., 2001; Taylor, 2001). In effect, we rule out all adverse shocks that could divert a region its projected "full employment" growth path. Finally, specific features of the extended supply side methodology we use for projecting growth rates may generate implausibly favorable estimates for specific regions and countries – Eastern Europe, Russia, and China most notably.

The analysis is presented as follows: Section 1 gives a brief review of historical growth experience for major regions of the world, based upon Maddison's (2001) canonical compilation of country-level data on per capita GDP at purchasing power parity (or PPP). Section 2 sets out the basics of our projection methodology, with technicalities added in Appendix A. To illustrate how the model functions, section 3 presents the details of projections for two regions – Latin America and Eastern Europe – which in the year 2000 had per capita incomes respectively equal to 0.31 and 0.25 of the OECD average. For reasons to be explained, Eastern Europe is projected to perform somewhat better, since both regions may reach one-half of the rich countries' (growing) income by 2030.

Section 4 summarizes results for all regions – the two just mentioned, along with Russia, upper middle income Asian countries (or "Tigers"), China, the Middle East, East Asia, South Asia, and sub-Saharan Africa. Section 5 pulls together the analysis and offers conclusions.

1. Historical Growth Experience

When it comes to economic convergence for the last 180 years we can at most hope to find supporting evidence *within* major regions. Convergence *between* the rest of the world and the advanced regions of 1820 - Western Europe and its Western Offshoots - did not take place. Instead the gap widened considerably in both relative and absolute terms. If we take a look at growth rates of GDP per capita, we see that the countries that were most advanced in 1820 grew fastest throughout the 19th and 20th centuries. According to Maddison (1995), Western Europe by 1992 had a 13-fold increase in GDP per capita over its level in 1820. The Western Offshoots enjoyed a 17-fold increase, while Latin America and Asia respectively increased seven and six times compared to 1820. Figure 1 shows ratios of per capita incomes at purchasing power parity in the regions emphasized by Maddison (2001) to per capita income in the "old" OECD or his "Group A" of countries (Western Europe and Western Offshoots but not Japan) for reference years during 1820-1998.

The generally negative slopes of the curves are disheartening. Over the long period, PPP per capita income ratios for Latin America and Eastern Europe fell by more than 50%, and the proportional loss for Africa was even greater. Toward the end of 20th century the ratios for China and India began to go up from levels of less than 0.1. "Asia" which includes about 12.5% of Asia's population without Japan, China and India (with Indonesia as the most populous country followed by Korea) moved parallel at a somewhat higher income ratio.

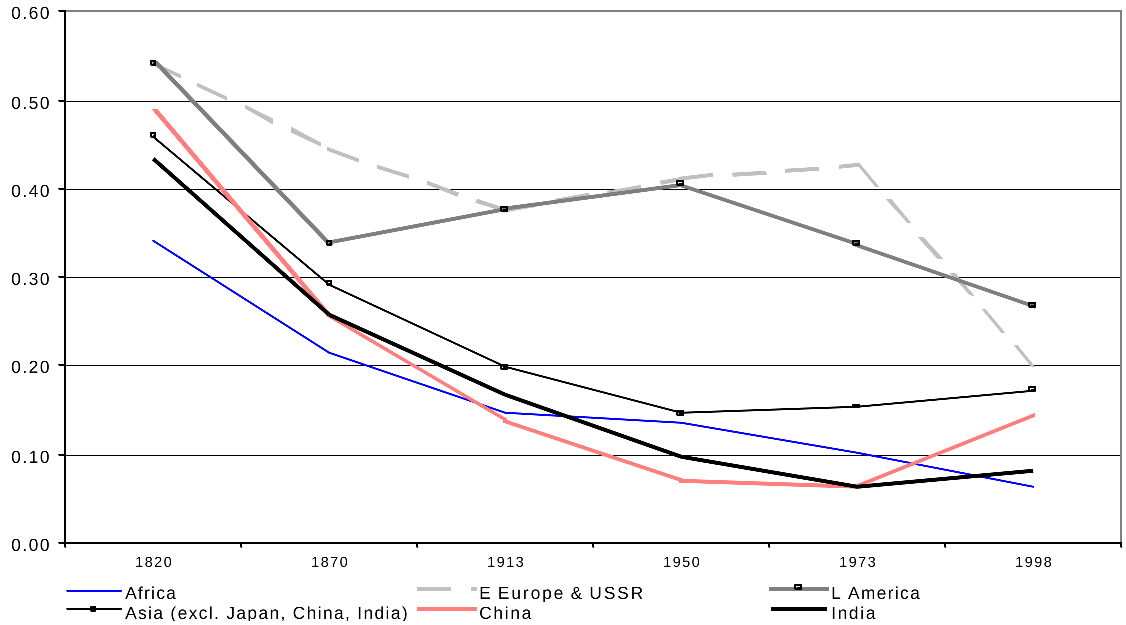

Figure 1: Ratios of GDP per capita (Developing countries/OECD)

Figure 2 shows PPP ratios for our selected regions in the second half of the last century (the rich country group now includes Japan). The "Tigers" are the only group showing a sustained increase over most of the period, with modest catching-up on the part of the Asian regions in the last 25 years. The ratios for the other regions declined, most notably for the Middle East and the formerly socialist countries after 1975. The diagram is disturbing especially because the downward paths of the ratios in several instances are due to stagnation or a decrease in the absolute value of GDP per capita of the follower countries. For example, Africa's GDP per capita decreased from a high of 1,433 Geary-Khamis dollars[1] in 1977 to 1,217 in 1998. The Middle East

[1] Geary-Khamis dollars for the year 1990 are Maddison's preferred benchmark numeraire for computing PPP income levels.

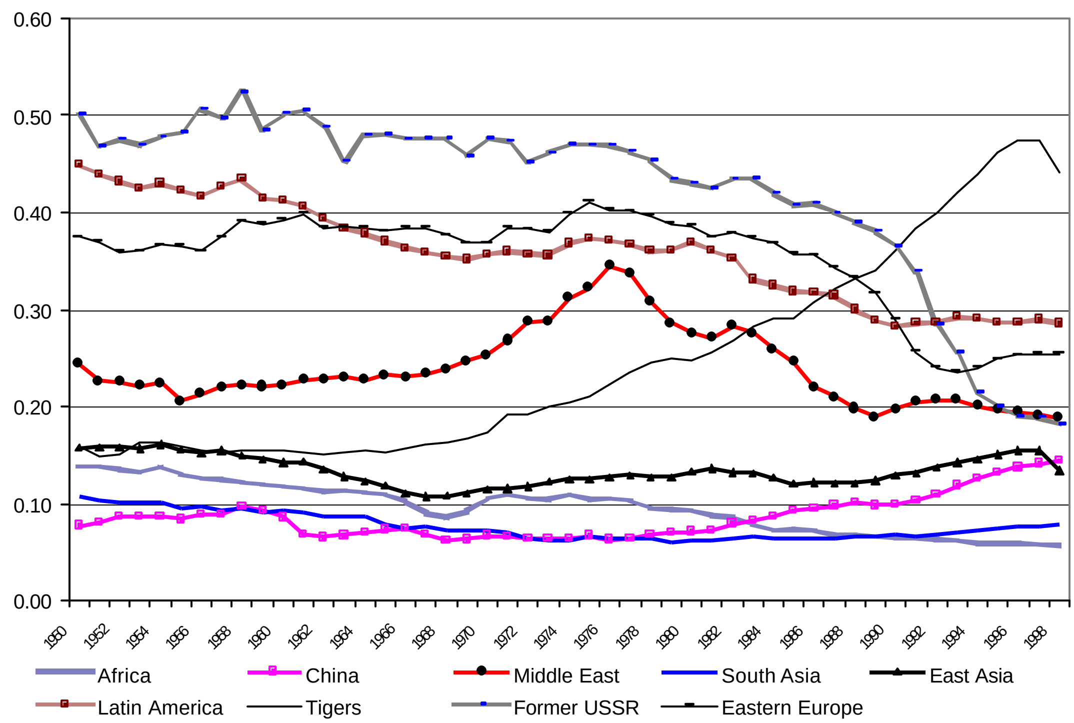

Figure 2: Catching up: GDP per capita of developing countries vs OECD (1950-1998)

fell to 4,053 in 1998 from 4,716 in 1977. Lastly, the former USSR lost ground in record time, from 7,078 Geary-Khamis dollars per capita in 1989 to 3,893 in 1998.[2]

There are a few success cases from which we can learn about potential factors that help economic convergence become reality. After 1950, the Tiger countries considerably narrowed the gap between themselves and the Western advanced economies and Japan. Japan itself, more or less miraculously, caught up with the other advanced economies. The purported sources of growth that the economic literature emphasizes are technical progress, levels of physical capital and labor productivity, the quality of human capital, the extent of trade openness, economic structure, the institutional framework, and last but not least the "insertion" of a national economy into the global framework (aid and debt relationships, patterns of trade, commodity price shifts,

[2] Needless to say, Figures 1 and 2 run completely counter to Lucus's (2000) ahistorical optimism. His model resembles a horserace with a staggered start. Each successive group of poor countries leaves the gate some time after its immediate predecessor and then appropriates existing technology to run faster than all

access to technology, etc.). The theoretical implications of these factors will be discussed in the section on our model of catching-up. By way of introduction, it makes sense to review historical trends for some of them as summarized by Maddison (1995).

Capital stock and technological progress

The Japanese case in which the stock of machinery and equipment per worker (K/L) increased 207-fold (at an annual growth rate of about 5.4%) from 1890 to 1992 is the clearest example of the importance of capital stock for growth. Unfortunately data for capital stocks are not available for developing countries for same period but only for the last decades of the 20th century. Even so, one cannot ignore the differences in the accumulation of physical capital between different countries and regions for the recent period.

The most impressive examples are the Tiger countries where between 1968 and 1998 the capital stock grew on average at a rate of 9.2% per year (calculation are based on Extended Penn World Tables, by Marquetti, 2002), East[3] and South Asian countries and China accumulated physical capital at rates varying from 8.5% per year between 1973 and 1998 for East Asia, 8% annually between 1965 and 1998 for China, and a more modest but still high 5% annual increase between 1963 and 1998 for South Asia. For the other regions the increase in capital is not so spectacular, with some countries even experiencing decreases in their total stocks. Latin America's annual rate of accumulation was 3.8% per year between 1964 and 1998, while selected African countries[4] had a rate of 2.8% between 1968 and 1998. Capital stock for Eastern Europe and former USSR republics apparently decreased recently, mostly because of difficulties that came with its revaluation during the transition period. No strong conclusions can be drawn regarding the former communist countries' records of accumulation during the last two decades of the 20th century.

It is also worth emphasizing that the positive effects on growth of rapid capital accumulation often appear to be offset by negative capital productivity growth rates. This feature

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the rest to catch up. Because the USSR must now be reckoned a failure, Japan and possibly the Tigers are the only observed examples over almost 200 years.

[3] Data for Vietnam were not available. The estimate for the region's capital growth rate is based on data for Indonesia, Philippines and Sri Lanka.

[4] Indicators are calculated based on capital stock estimates for Ghana, Kenya, Nigeria and Zimbabwe.

contributes to a “Marx bias” in the pattern of productivity growth discussed below. Nevertheless, capital accumulation remains one of the most important factors for economic growth.

Human Capital

Japan’s average years of education[5] increased from 1.50 in 1820 to 14.87 in 1992 meaning almost a 10-fold increase. The numbers for the USA are 1.75 in 1820 and 18.04 in 1992. Data for our regions are not available for the same period but only start in 1950 for selected countries. For Latin American and Asian countries for which Maddison (1995) provides estimates, the education level rose considerably. Argentina’s years of schooling increased from 4.8 in 1950 to 10.7 in 1992, Chile’s from 5.47 to 10.93, and Venezuela’s from 2.21 to 10.18. In Asian countries education increased from 3.62 years in Taiwan in 1950 to 13.83 in 1992, in Korea from 3.36 to 13.55, while in India from 1.35 to 5.55.

Two observations arise from these data. First, we see that there is a certain intra-regional convergence between countries in terms of educational level, e.g. Venezuela caught up with other Latin American countries. Second, as with physical capital and GDP growth, Tiger countries surpassed Latin America in raising their levels of education. One may argue for the importance of human capital accumulation for economic growth but a strict causal relationship is difficult to establish. In the model simulations, we postulate a direct linkage between growth rates of the level of education and labor productivity.

Trade openness

Trade openness is another important explanatory factor (at least for orthodox economists) for economic growth. All the countries represented in Maddison’s data set had positive growth rates in the value of merchandise exports. The volume of exports, at constant prices, of Latin America had a 105-fold increase from 1870 to 1998, Eastern Europe’s a 113-fold increase, Asia’s exports grew 225 times by 1998 compared to 1870, and Africa’s exports were 66 times higher in 1998 relative to 1870.

[5] The data on education presented in this section come from Maddison (1995) who uses a different computational procedure for average years of schooling than does the UN *Human Development Report* from which we got the education growth rates used in the model simulations.

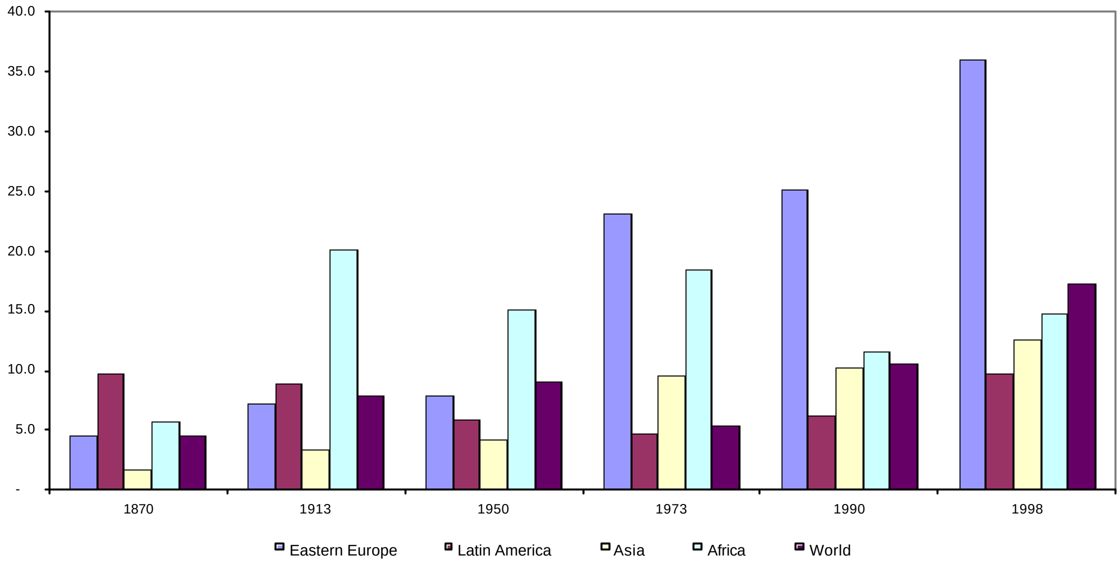

Figure 3: Merchandise Export as Per Cent of GDP

Scaling the value of exports to the GDP, we see in Figure 3 that exports generally increased more rapidly then output. Therefore, we include increasing openness to trade as a potential source of growth in our model, satisfying the orthodox paradigm which postulates positive effects of trade integration on overall labor productivity.

2. Potential Sources of Growth

Our basic methodology was to set up simulations from 1998-2000 until 2030 of per capita income ratios for the regions illustrated in Figure 2. Base period levels of regional output in PPP terms, population, employment, investment, capital stock, and mean years of schooling were obtained from various sources (described in Appendix B), along with their average rates of growth during the 1990s. These growth rates were extrapolated forward "through" the base period level variables, starting in 1998. During the simulation period, the rates were modified by several factors to be discussed immediately below. Projected levels of per capita output followed from the growth rates. Per capita growth in the rich economies was set exogenously to allow us to simulate future income ratios.

Differential growth rates of labor productivity have historically been the most important force behind diverging income levels across countries. Following Ocampo (2001), productivity growth in the medium run can be viewed as the outcome of two positive feedback loops building up from basic input factors such as the accumulation of physical and human capital, jumps in productivity resulting from successful industrial and trade policy, and the exploitation of technological backwardness. One loop is from output and/or capital stock growth to productivity growth, as emphasized by Verdoorn (1949) and Kaldor (1957). We build this linkage into the simulations at the aggregate level, and also follow these authors in treating industrial expansion as a key factor in transmitting technological advance.

The other loop runs from productivity growth to output growth. Ocampo points to three channels: stimulation of investment and export demand, increasing international competitiveness, and growing aggregate supply. Following the dominant tradition in making projections of long-term growth, we concentrate on factors that influence aggregate supply assuming that all the available labor force will be fully employed. Of course, steady growth with full employment has distinctly *not* been observed in much of the developing world since the 1980s. In future work, we plan to take up effective demand and external restrictions on growth.[6]

A form of negative feedback that may become important over a longer time frame centers on the dynamics of "catching-up" or "convergence." During the period 1960-75 labor productivity growth in Japan fell from levels exceeding 10% per year to the 2-3% more characteristic of rich countries. This productivity slowdown happened while the ratio of Japan’s per capita income to that of the United States rose from about 0.4 to 0.75. The usual interpretation is that Japan was able to absorb existing Western technologies rapidly during its "miracle" but ultimately that well went dry as its per capita income level caught up. Looking forward, it becomes of interest to examine the effects of a narrowing income gap on their productivity growth when ratios of per capita incomes in poor regions to those of rich regions are simulated to rise.

[6] Demand-driven growth models are discussed in Taylor (2003). External constraints could be modeled in a “gap” model framework (Taylor, 1994), taking into account foreign aid, capital movements, and shifts in the terms of trade.

2.1 A Model of Catching-up

Our model specification (details in Appendix A) restates the standard sources of growth equation in terms of identities from the national income and product accounts (NIPA) instead of a mythical aggregate production function, and includes the forces just mentioned: short- and medium-term labor productivity dynamics and a longer run story about technological backwardness and convergence. The accounting is set up in discrete time, incorporating “interactions” among variables as they move from step to step. Time subscripts are written as t at the beginning of a period ($t = 0$ at the beginning of the simulation's base year) and $t+1$ at the end.

Output growth “X-hat” or $\hat{X} = (X_{t+1} - X_t) / X_t$ is decomposed into a weighted average of the growth rates of the inputs, $a_t\hat{L} + (1 - a_t)\hat{K}$, plus a similar average of rates of productivity growth of labor, $x_L = \hat{X} - \hat{L}$, and capital, $x_K = \hat{X} - \hat{K}$, with a_t as the observed wage or labor share of output at time t. That is, NIPA data by construction will satisfy the accounting identity

$$\hat{X} = a_t[\hat{L} + (\hat{X} - \hat{L})] + (1 - a_t)[\hat{K} + (\hat{X} - \hat{K})]$$

or

$$\hat{X} = a_t(\hat{L} + x_L) + (1 - a_t)(\hat{K} + x_K) = a_t\hat{L} + (1 - a_t)\hat{K} + x \qquad (1)$$

in which $x = a_t(\hat{X} - \hat{L}) + (1 - a_t)(\hat{X} - \hat{K})$ is total factor productivity growth as conventionally measured.

This growth equation can be combined with an inter-sectoral labor productivity decomposition. Briefly, let q_t^i and e_t^j respectively stand for the shares of sector j in total output and employment. Then (1) can be restated as

$$\hat{X} = a_t[\hat{L} + (1 + \hat{L})^{-1}(S + R)] + (1 - a_t)(\hat{K} + x_K) \quad . \qquad (2)$$

In this expression, $(1 + \hat{L})^{-1}$ is an interaction term arising from the discrete measurement of time,

$$S = \sum_i q_t^i (\hat{X}^i - \hat{L}^i) \qquad (3)$$

is a weighted average of sector-level rates of productivity growth, and

$$R = \sum_i (q_t^i - e_t^i)\hat{L}^i \quad (4)$$

represents shifts in productivity growth due to reallocation of labor across sectors (Syrquin, 1986). A sector with relatively high labor productivity will have a higher share of output than of the labor force, $q_t^i > e_t^i$, so that if its employment growth is positive, $\hat{L}^i > 0$, reallocation of labor toward the sector generates a positive contribution to labor productivity economy-wide.

Historical data coming into the model's base year will satisfy the decomposition $x_L = (1+\hat{L})^{-1}(S+R)$. We focus on just two sectors, traded (*T*) and non-traded (*N*), so that *i* takes the values *T* and *N* in (3) and (4).

In the "future" simulation period, productivity growth rates in the two sectors are assumed to obey the rules

$$x_L^T = \hat{X}^T - \hat{L}^T = \overline{x}_L^T + \Gamma + g\hat{X} + h\hat{H} + Z \quad (5T)$$

and

$$x_L^N = \hat{X}^N - \hat{L}^N = \overline{x}_L^N + \Gamma + g\hat{X} + h\hat{H} \quad . \quad (5N)$$

The terms $\overline{x}_L^T$ and $\overline{x}_L^N$ are trend rates coming into the base year. Over the simulation period, they are shifted by the growth factors Γ, $g\hat{X}$, $h\hat{H}$, and *Z.* The term Γ refers to technological backwardness, and is discussed immediately below. In sector 2.2, we take up the analytics of Kaldor-Verdoorn effects ($g\hat{X}$), human capital accumulation ($h\hat{H}$), and possible productivity-enhancing effects of external openness and/or industrial policy aimed at raising productivity in the traded goods/manufacturing sector (*Z*).

Because $q_t^T + q_t^N = 1$, overall labor productivity growth (in discrete time) can be written as

$$x_L = (1+\hat{L})^{-1}(\overline{x}_L + \Gamma + g\hat{X} + h\hat{H} + q_t^T Z + R) \quad (6)$$

with $\overline{x}_L = q_0^T \overline{x}_L^T + q_0^N \overline{x}_L^N$ in the base year and *R* standing for productivity changes in the simulation period due to reallocation effects. The shift term *Z* gets weighted by q_t^T, the share of traded goods in total output. To avoid double counting when the human capital growth rate $\hat{H}$

has a non-zero incoming value, we "purged" the base year labor productivity growth rate $\overline{x}_L$ *by* subtracting the incoming growth rate in human capital, $\overline{x}_{LP} = \overline{x}_L - h\hat{H}$, which replaces $\overline{x}_L$ in the equation (6).[7]

Plugging (6) into (1) gives the following equation for output growth,

$$\hat{X} = A + B\Gamma \tag{7}$$

with

$$A = [1 - a_t(1+\hat{L})^{-1}g]^{-1}\{a_t[\hat{L} + (1+\hat{L})^{-1}(\overline{x}_{LP} + h\hat{H} + q_t^T Z + R] + (1-a_t)(\hat{K} + x_K)\} \tag{8}$$

and

$$B = [1 - a_t(1+\hat{L})^{-1}g]^{-1}a_t(1+\hat{L})^{-1} \quad . \tag{9}$$

These expressions involve many terms that in a simulation will change over time. However, their basic role can be illustrated in a fixed coefficients scenario about catching up which will be discussed at the end of this section.

To complete the model, we employ the ratio l_t between GDP per capita in the poor countries relative to rich countries.

$$l_t = (X_t / L_t)/Y_t \tag{10}$$

in which Y_t is per capita income in the rich region and it is assumed for the moment that participation and employment rates in the poor region stay constant so that its labor force L_t is strictly proportional to its population. Taking differences and substituting from (7), one has

$$\hat{l} = (1+\hat{L})^{-1}(\hat{X} - \hat{L}) - (1+\hat{Y})^{-1}\hat{Y} = (1+\hat{L})^{-1}(A + B\Gamma - \hat{L}) - (1+\hat{Y})^{-1}\hat{Y}$$

As already noted, Japan's experience in catching-up with the then-rich regions of the world sheds light on the dynamics of economic convergence. The productivity history is illustrated in Figure 4, which suggests a simple relationship of the form

$$\Gamma = D - El \tag{11}$$

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[7] In regional simulations in which human capital accumulation is assumed to accelerate, a low value of purged incoming labor productivity is offset by a high value of $\hat{H}$. However, for some regions, human capital accumulation is assumed to decelerate through the simulation period, causing productivity growth to slow

with an approximate slope E of 0.12. The intuition is that as the income ratio l increases there is less room for technological catching-up, i.e. there is "convergence." Setting $\Gamma = 0$ in the base year of the simulation model permits D to be identified as $D = E\,l_0$ from the slope parameter E and the initial value l_0 of the per capita income ratio. Japan's "miracle" was very unusual, so in

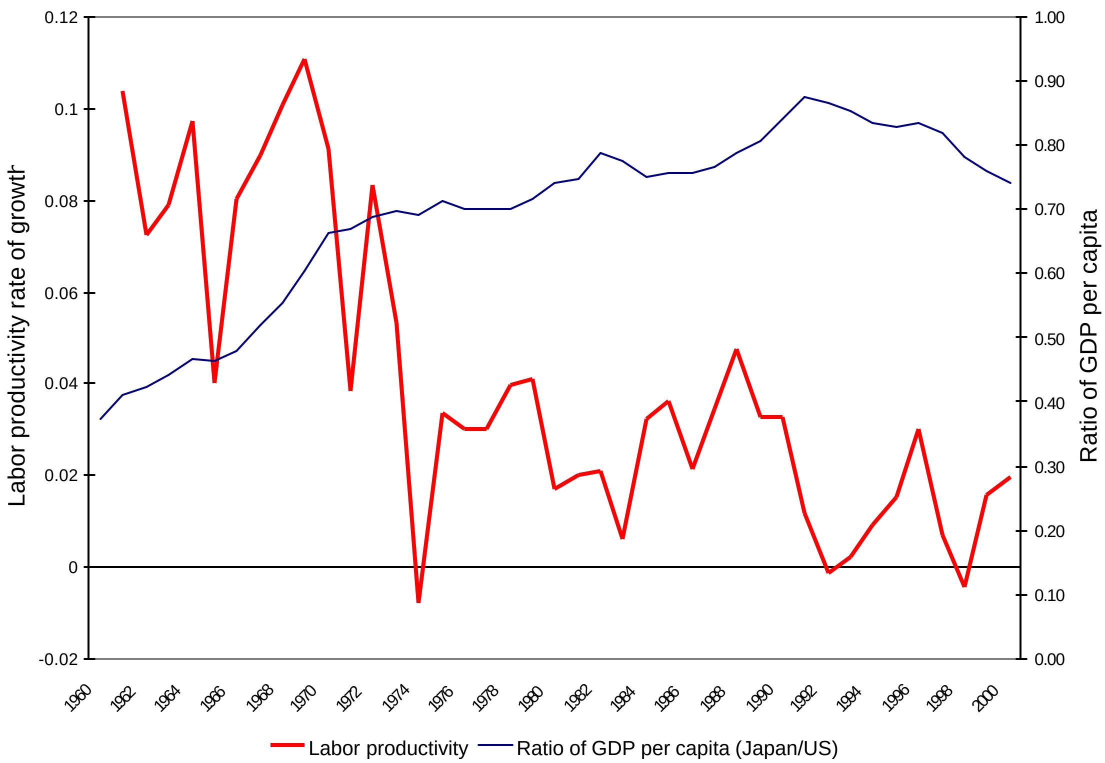

Figure 4: Japan's growth rate of labor productivity and ratio of Japab vs US GDP per capita

model simulations for most of the developing regions we set E to a value of 0.06.[8]

Plugging (11) into (10) gives a final equation for the growth rate of l,

$$\hat{l} = (1+\hat{L})^{-1}[A + B(D - E\,l) - \hat{L}) - (1+\hat{Y})^{-1}\hat{Y}$$

or in difference form,

down. In our base runs, we maintain the purged labor productivity growth rate throughout the entire simulation period.

[8] Exceptions are China which has a significantly high incoming productivity growth rate and Eastern Europe and Russia where a negative population growth rate leads to very rapid catching-up in the model's supply-driven specification.

$$l_{t+1} - l_t = [(1+\hat{L})^{-1}(A + BD - \hat{L}) - (1+\hat{Y})^{-1}\hat{Y}]\, l_t - [(1+\hat{L})^{-1}BE]\, l_t^2 \quad . \tag{12}$$

If its coefficients stayed constant, (12) would be a discrete time analog to the well-known Bernoulli differential equation $d\,l/dt = a\,l - b\,l^2$ with solution $l = [(b/a) + const(e^{-at})]^{-1}$ and *const* as a constant of integration. The solution trajectory for l rises steadily from its initial value to an asymptote a/b. The path is a concave function of time in the sense that $d^2 l/dt^2 < 0$ (or water would run off the top of the curve). As will be seen below, the non-linearities and feedback loops built into the simulations based on equations (7)-(9) can visibly perturb this simple pattern.

2.2 Details on the Sources of Growth

In practice the simulation model includes nine potential contributing factors to growth, which we discuss in this section. They take into account both heterodox and orthodox traditions of economic analysis as they apply to aggregate supply (with some effects coming in from demand as well).

1. **The effect of Verdoorn elasticity (g):** On the heterodox side, the labor productivity growth rate x_L in (6) is assumed to respond to the output growth rate $\hat{X}$ with a "Verdoorn elasticity" g. Under favorable circumstances (including the policy environment) g could rise over time. Since the terms A and B in (7) increase with g, $\hat{X}$ speeds up. Econometric estimates of g in industrialized economies are typically in the range of 0.5. Because of short time series and on-and-off growth performances, few estimates are available for the rest of the world. In the simulations, we assume that the incoming value of g is zero for all regions (except the Tigers where it is assumed to be 0.5) and that it increases thereafter.

2. **The effect of industrialization (*Z*):** We introduce the effect of industrialization from both heterodox and orthodox perspectives: Heterodox authors emphasize a potential positive effect of industrialization (measured, say, by the industrial sector's share of output or the labor force) on economy-wide labor productivity. As already discussed in connection with Figure 3, the analogous orthodox idea is that greater openness to trade (say the ratio of imports plus exports to GDP) is supposed to enhance labor productivity, with foreign

direct investment (FDI) at times emphasized as the transmission mechanism. Although orthodoxy described reality badly in the 1990s when greater trade openness was *not* associated with faster economy-wide labor productivity,[9] we still optimistically assume that output per worker in the traded goods sector (in which manufacturing plays a major role) will rise over time. Perhaps due to opening the economy or the application of astute industrial policy there may be an autonomous upward shift *Z* in the rate of productivity growth in (5T). The effect on output growth via a shift in *S* in (2) at time *t* is given by $a_t(1+\hat{L})^{-1}q_t^T Z$ where q_t^T is the share of traded goods in total output[10]. The reallocation effect *R* in (6) may also change from its historical value over time.

3. **The effect of human capital accumulation ($\hat{H}$):** Also as pointed out above, the orthodox view is that labor productivity growth can be accelerated by human capital accumulation, e.g. more average years of schooling. Because the industrialized economies grow no faster now than they did decades ago despite notably higher levels of education, it is realistic to assume that a more rapid *increase* in average years of schooling ($\hat{H}$) leads to faster productivity growth. The rate in both traded and non-traded sectors is supposed to rise by an amount $h\hat{H}$ so that from (1) output growth goes up by $a_t(1+\hat{L})^{-1}h\hat{H}$ [11]. Adopting Maddison's (1995) optimism, we set the elasticity $h = 1$.[12]

4. **The effect of wage shares in GDP (a_t):** Increases in per capita income tend to be associated with a rising share of wages in GDP. More precisely, there is a shift in labor from agriculture to industry and services, from low to high productivity sectors. As a result, there will be a decrease in self-employed and an increase in number of employees which contributes to a growing measured wage share in GDP. This shift alters the impacts of growth rates of capital and labor supplies and productivities on overall output

[9] The correlation coefficients for productivity growth rate and share of tradables in total output for our regions during 1990s have negative signs, meaning that the positive effect of greater openness was absent.

[10] When the Verdoorn effect is present as in (6), this expression is multiplied by $[1-a_t(1+\hat{L})^{-1}g]^{-1}$

[11] Again multiplied by $[1-a_t(1+\hat{L})^{-1}g]^{-1}$ if the Verdoorn effect is present.

[12] By contrast, Ros (2000) suggests a value of 0.3 for the product ah, consistent with $h \approx 0.5$.

growth as conventionally measured. In the simulations, a_t is given a positive upward trend over time.

5. **The effect of capital accumulation ($\hat{K}$):** As discussed in section 1, all sides agree that more rapid accumulation of physical capital (a greater flow of net investment) usually leads to faster output growth. This effect is captured by a larger $\hat{K}$ which raises A in (8), contributing to a higher $\hat{X}$. Its strength diminishes over time, insofar as the labor share a_t trends upward. Our main source of data on capital is Marquetti (2002) which provides information on the non-residential stock only. Implicit in an exogenously specified $\hat{K}$ is a rate of non-residential capital formation $I/X = (\hat{K} + d)(K/X)$ with d as a "radioactive" depreciation rate for fixed capital and K/X as the current capital/output ratio. In side calculations to the simulations we tracked I/X to make sure it maintained "reasonable" values.

6. **The effect of capital productivity (x_K):** Long-term data suggest that growth in some regions – especially in Asia - appears to be subject to a "Marx bias" (Foley and Michl, 1999) in which labor productivity rises but capital productivity (or the output/capital ratio) falls[13]. Measured capital productivity will also fall if adverse macroeconomic conditions hold output below its potential. Conceivably such trends could be slowed or even reversed. Where they exist, Marx bias or macroeconomic misadventures are signaled by the condition $x_K < 0$ in historical data. In the simulations, x_K may be set to zero or a positive value.

7. **The effect of labor force growth ($\hat{L}$):** Suppose for the moment that the labor force and population maintain a constant ratio. If in line with neoclassical production theory,

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[13] Caution should be exercised in generalizing the Marx bias conclusion of Foley and Michl. In poor developing countries, PPP calculations tend to over-estimate residential capital because in effect they re-value non-traded relative to traded goods. To compensate, stocks and flows of non-residential capital may be under-valued, thereby artificially increasing its apparent productivity. Estimates of non-residential K/X for several of our regions from Marquetti (2002) hover around unity, a value that is improbably low.

causality in the identity (1) is assumed to run from right to left ($\hat{X}$ is determined by the variables on the right-hand side), then slower labor force growth will reduce the rate of output growth by less than the associated rate of population growth, leading per capita income to rise. Leaving aside the Kaldor-Verdoorn feedback for simplicity, slower population (and labor force) growth $\hat{L}$ can be seen to reduce output growth by a factor a_t in (1). Hence it *increases* the growth rate of output per capita by a factor $1 - a_t$. This effect will be especially strong when the wage share is low (typically at lower levels of per capita income).[14] Also note that by specifying $\hat{L}$ as well as $\hat{K}$ we are in practice assuming that some component(s) of national saving vary freely to permit "full employment" combined with an independent investment function. In the jargon of computable general equilibrium models, we thereby adopt a Johansen (1960) macroeconomic "closure."

8. **The retardation effect (Γ_t):** In honor of Gerschenkron (1962) and the poor country/rich country income gap, the term Γ stands for productivity effects of "backwardness." As discussed above, it is used to shift their overall productivity trends as poor countries catch up with richer ones. A positive value of the parameter *E* in (11) means that productivity growth *decelerates* as a poor region's income ratio l increases toward unity from below. This "retardation effect" turns out to be important in several of the regional simulations described in sections 3 and 4. In practice, we assumed that in technological terms, the Tigers, Latin America, Eastern Europe, and Russia are pursuing the OECD, while the Middle East, China, East Asia, and South Asia are trying to catch up with the Tigers. Sub-Saharan Africa is assumed to trail South Asia.

[14] In the simulations, regional labor force and population growth rates are allowed to differ. However, they are close enough for the result described in the text to carry through.

9. **Other factors influencing growth:** All this algebra omits many factors that affect economic growth. For example, UNCTAD (2002) emphasizes how “resource constraints” (basically, sources of saving) hold down accumulation in the Least Developed Economies. Trade, debt, and financial linkages between rich and poor countries (notably adverse trends in the terms of trade) all contribute to such external strangulation. More optimistically, do the successful growth performances Spain and Greece after the joined the European Union augur well for the future prospects of Eastern Europe? Such issues of insertion of regional economies into the global system cannot easily be captured in formal terms, but as discussed below we did try to take them into account in specifying parameters for the regional simulations.

3. Simulations for Latin America and Eastern Europe

Tables 1 and 2 summarize the data that feed into the regional simulations, from sources described in Appendix B. Taking Latin America as an example[15], reading across the top two rows of Table 1 we see that:

Population for the region grew at 1.7% per year on average in the 1990s. It is projected to drop steadily to 0.7% in 2030.

Employment growth ($\hat{L}$) averaged 1.8% prior to 1998. We assume that the growth rate decreases by an amount 0.05% yearly until it reaches 0.6% in 2022 and stabilizes thereafter.

Capital stock growth ($\hat{K}$) is initially assumed to be 4.3% per year and to slow to 3.8% in 2030, with both rates being higher than the 2% growth observed in the 1990s.

Labor productivity growth (x_L) averaged 1% per year in the 1990s. After purging the effects of human capital accumulation as discussed in Section 2.1, it decreases at -0.38%. Its growth picks up in the simulation period for several reasons to be discussed below.

Capital productivity growth (x_K) is assumed to rise from negative values in the late 1990s (a period of deep regional recession) to 0.5% per year in 2030.

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[15] The numbers for Latin America are based on appropriate weighted averages of data from Argentina, Brazil, Chile, Columbia, Mexico and Venezuela.

The tradable share (q^T) in total output is set to 0.31 in the base year, 1998, and is assumed to be increasing by an amount 0.004 per year, reaching 0.44 by 2030.

Tradable goods productivity enhancement (*Z*) is set to zero in the base year, and rises to a value of 0.019 by 2030

The Verdoorn parameter (g) starts at zero in 1998 and increases by a factor of 0.045 until it reaches 0.45 in 2008, after which we keep it constant.

The labor share (a), starts at 0.40 in 1998 and increases by an increment of 0.005 per year, reaching 0.56 by 2030.

Growth rate of average years of schooling ($\hat{H}$) is 1.37% and is kept constant throughout the whole period, raising the education level from 5.95 in 1998 to 9 mean years of schooling in 2030 (a rise of 50% in 32 years). As discussed above, this increase passes through into output growth with a coefficient of a because we set the elasticity h equal to one.

The reallocation effect (R) is set to .0011, equal to the shift in the productivity growth due to labor reallocation across sectors for the region during 1994-1998.

The retardation parameter (*E*) was set to 0.06. With the region's *income ratio* (l) taking a value of 0.3 in 1997, the intercept term (*D*) in (11) takes a value of 0.018.

The average growth rate of GDP per capita in OECD countries for 1980-1998 was 1.8% with higher rates for the end of 1990s and 1980s and lower or negative rates for the early 1990s. Throughout all the simulations we maintained a fixed rich country growth rate of GDP per capita of 1.8%.

TABLE 1: Incoming growth rates and values for variables which enter the simulation:

Regions	Population growth	GDP growth	$\hat{L}$	$\hat{K}$	x_L purged	x_K	q_T	z	g	a	$\hat{H}$	R	S	D, E
Latin America	.014 (1998) ↓ .007 (2030)	.03	.0182 (1998) ↓ .006 (2022-'30)	.043 ↓ .038 (2030)	.-.0038	-.019 ↓ .005 (1998-'30)	.31 (1998) ↓ .44 (2030)	0 (1998) ↓ .019 (2030)	0 (1998) ↓ .45 (2030)	.40 (1998) ↓ .56 (2030)	.0137 (1998-2030)	.0011	.0087	.018 .06
Notes	Avrg. 1990s .017	Avrg. 1990s	Avrg. 1994-1998: .0182 Decreases at .0005	Avrg. 1990-1998 .02 decreses at .00015	Avrg. 1994-1998 .01	Avrg. 1990-1998 .018 Increases at. 002	Avrg. 1994-1998: .30 Increases at .004	Increases at .0006	Increases at .045	Increases at .005	5.95 (1998) 9 (2030)	1994-1998	1994-1998	l ('97) =.30
Tigers	.011 (1998) ↓ .0045 (2030)	.055	.013 (1998) ↓ .0 (2027-'30)	.08 (1998) ↓ .03 (2030)	.009	-.03 ↓ .0 (2030)	.32 (1998) ↓ .45 (2030)	0 (1998) ↓ .019 (2030)	.5 (1998) ↓ .61 (2030)	.40 (1998) ↓ .50 (2030)	.012 (1998) ↓ .01 (2012-'30)	.0	.043	.029 .06
Notes	Avrg. 1990s .012	Avrg. 1990s	Avrg. 1990-1998: .0177 Decreases at .0006	Avrg. 90-1998 .095 Decreases at .0018	Avrg. 90-98 .033 adjusted by g .021	Avrg. 1990-1998 -.048	Avrg. 1994-1998: .32 Increases at .004	Increases at .0006	Increases at .0034	Increases at .0032	8.12 (1998) 11.28 (2030)	1990-1998	1990-1998	l ('97) =.47
Eastern Europe	.-0015 (1998) ↓ -.0051(2030)	.011	-.005 (1990s) ↓ .0015 (2030)	.048 ↓ .023 (2030)	.021	.006 ↓ .001 (2030)	.33 (1998) ↓ .49 (2030)	0 (1998) ↓ .019 (2030)	.0 (1998) ↓ .48 (2030)	.45 (1998) ↓ .58 (2030)	.0025 (1998) ↓ .01 (2030)	.0044	.019	.023 .09
Notes	Avrg. 1990s -.0013	Avrg. 1990s	Avrg. 1990-1998: -.005 Increases at .0002	Avrg. 1995-1998 .030 Decreases at .0008	Avrg. 1992-1998 .023	Avrg. 1996-1998 .005 decreases at .00015	Avrg. 1992-1998: .33 Increases at .005	Increases at .0006	Increases at .015	Increases at .004	9.53 (1998) 11.80 (2030)	1992-1998	1992-1998	l ('97) =.25
Russia	.-0037 (1998) ↓ -.006(2030)	.029	.004 (1990s) ↓ -.0148 (2030)	.001 (1999) ↓ .03 (2030)	.044	.009 (1998) ↓ .002 (13-30)	.39 (1998) ↓ .46 (2030)	0 (1998) ↓ .019 (2030)	0 (1998) ↓ .42 (2030)	.45 ↓ .51 (2030)	.018 (94-01) ↓ .001 (2030)	0	.062	.02 .09
Notes	Avrg. 1998-01 -.0037 WB forecasts	Avrg. 1998-00	Avrg. 1998-01 .0062 E/P= .43 to .46	Avrg. 1995-1998 increases at .00045	Avrg. 1998-01 .063	Avrg. 1995-98 NA	Avrg. 1998-01: .39	Increases at .005	Increases at .045	Increases at .002	12 (2001) 13.43 (2030)	1998-01	1998-01	l ('97) =.15

TABLE 2: Incoming growth rates and values for variables, which enter the simulation:

Regions	Population growth	GDP growth	$\hat{L}$	$\hat{K}$	x_L purged	x_K	q_T	Z	g	a	$\hat{H}$	R	S	D, E
East Asia (Tigers)	.015 (1998) ↓ .007 (2030)	.05	.019 (1998) ↓ .001 (2021-'30)	.069 (1998) ↓ .05 (1998-'30)	.007	-.024 (1998) ↓ 008	.49 (1998) ↓ .56 (2030)	0 (1998) ↓ .03 (2030)	0 (1998) ↓ .45 (2030)	.33 (1998) ↓ .40 (2030)	.017 (1998) ↓ .015 ('12-30)	-.003	.027	.018 .06
Notes	Avrg. 1990s .017	Avrg. 1990s	Avrg. 1990-1998: .0216 E/P= .42 (98) to .40 ('30)	Avrg. 1990-1994 .069	Avrg. 1990-1998 .024	Avrg. 1990-1998 -.024	Avrg. 1990-1998: .58 Ag=T	Increases at .001	Increases at .05	Increases at .0021	Avrg 1990-00 .017 5.69 (2000) 9 (2030)	1990-1998	1990-1998	l ('9 =.29
China (Tigers)	.01 (1998) ↓ .0015 (2030)	.079	.01 (1998) ↓ .005 ('30)	.09 (1998) ↓ .031 (2015-'30)	.083	-.024 (1998) .0 (2030)	.46 (1998) ↓ .52 (2030)	0 (1998) ↓ .01 (2030)	0 (1998) ↓ .40 (2030)	.33 (1998) ↓ .40 (2030)	.008 (1998) ↓ .016 ('30)	-.0048 (1998) ↓ -.02	.108	.037 .12
Notes	Avrg. 1990s .0114	Avrg. 1990s	Avrg. 1990-1998: .0067 E/P=.54 to .50	Avrg. 1990-1998 .069	Avrg. 1990-1998 .091	Avrg. 1990-1998 -.013	Avrg. 1990-1998: .50 Ag=NT	Increases at .0003	Increases at 016	Increases at .0025	6.4 (2000) 9.32 (2030)	Avrg 1990-98 =.0048	1990-1998	l ('9 =.297
South Asia (Tigers)	.02 (1998) ↓ .0095(2030)	.06	.0246 (1990s) ↓ .013 (2030)	.067 (1998) ↓ .05	.012	.01 (1990s) ↓ .0 (2030)	.265 (1998) ↓ .43 (2030)	0 (1998) ↓ .03 (2030)	0 (1998) ↓ .40 (2008-30)	.30 (1998) ↓ .40 (2030)	.0189 (1998) ↓ .0136 (2030)	-.0006	.031	.01 .06
Notes	Avrg. 1990s .02	Avrg. 1990s	Avrg. 1990-1998:.0246 E/P=.32 to .34	Avrg. 1990-1998 .057	Avrg. 1990-1998 .03	Avrg. 1990-1998 .01	Avrg. 1990-1998: .265 Ag=NT	Increases at .001	Increases at .04	Increases at .00325	4.96 (2000) 8 (2030)	1992-1998	1990-1998	l ('9 =.17
Africa (South Asia)	.027 (1998) ↓ .019(2030)	.033	.027 (1990s) ↓ .017 (2030)	.01 (1998) ↓ .061 (2030)	-.000005	.016 (1990s) ↓ .004 (2030)	.19 (1998) ↓ .36 (2030)	0 (1998) ↓ .04 (2030)	0 (1998) ↓ .38 (2008-30)	.18 (1998) ↓ .38 (2030)	.0066 (1998) ↓ .039 (2030)	.0057	.00086	.032 .06
Notes	Avrg. 1990s .027	Avrg. 1990s	Avrg. 1990-1996:.027 E/P=.50	Avrg. 1990-1998 -.012	Avrg. 1990-1998 .006	Avrg. 1990-1998 .016	Avrg. 1990-1998: .19 Ag=NT	Increases at .0015	Increases at .012	Increases at .008	3.17 (2000) 6.57 (2030)	1992-1998	1990-1998	l ('9 =.52
Middle East (Tigers)	.017 (1998) ↓ .01 (2030)	.037	.022 (1998) ↓ .009 (2030)	.016 (1998) ↓ .048 (2030)	-.005	.009 (1998) ↓ 01	.33 (1998) ↓ .46 (2030)	0 (1998) ↓ .026 (2030)	0 (1998) ↓ .44 (2030)	.30 (1998) ↓ .40 (2030)	.0246 (1998) ↓ .0054 ('12-30)	.001 (1998) .008 (2030)	.019	.021 .06
Notes	Avrg. 1990s .021	Avrg. 1990s	Avrg. 1990-1996:.028 E/P=.29	Avrg. 1990-1998 .012	Avrg. 1990-1998 .021	Avrg. 1990-1998 .033	Avrg. 1990-1998: .33 Ag=NT	Increases at .0008	Increases at .04	Increases at .0032	5.5 (2000) 8.75 (2030)		1990-1998	l ('9 =.34

See Legend at the end of the text

Figure 5 shows the key impacts of these parameter shifts. The lowest curve represents a "base run" simulation in which traded goods productivity growth, human capital, and Verdoorn effects on $\hat{X}$ are suppressed. Population growth is assumed to decline as discussed above, and the labor share to increase. The share of traded goods in output is held constant, and the growth rates of capital and capital productivity follow the trends mentioned above. Only the purged labor growth productivity term is included in equation (6).

As can be seen, the baseline result is that Latin America's per capita income ratio declines by five points from its initial level of 0.3. The level of l also falls when Verdoorn (an increase in g) and enhanced traded goods productivity growth (Z) effects are included in the

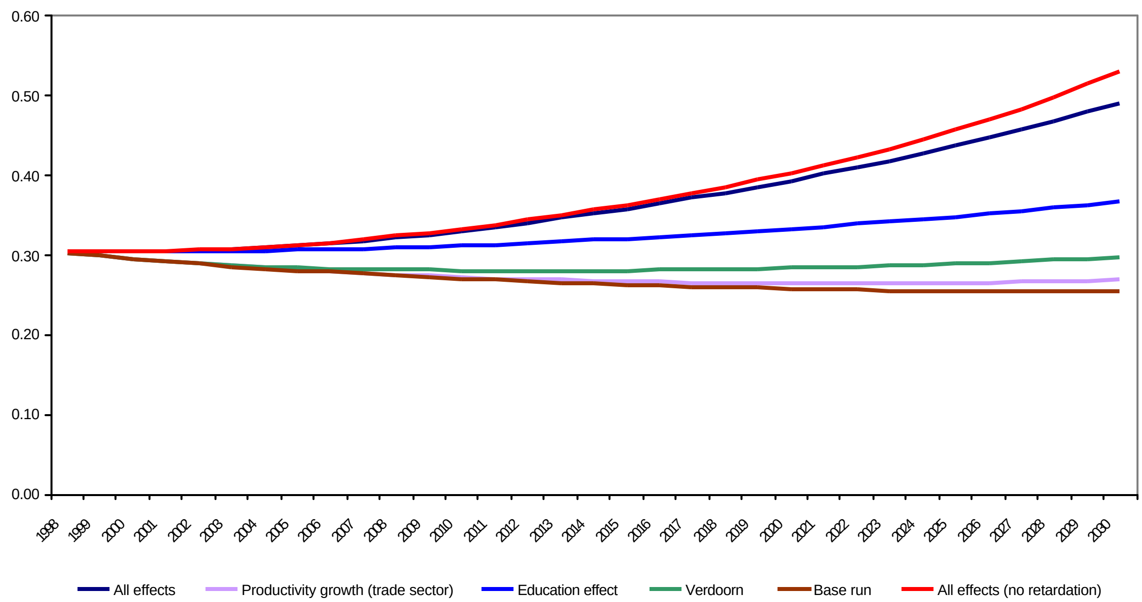

Figure 5: Latin America vs OECD (1998-2030)

simulation. The curve for the simulation with the education ($\hat{H}$) factor shows a minimal increase in the income per capita of Latin America relative to OECD. The curve for "All effects" shows an increase in l of 0.19, which exceeds the (approximate) sum relative to the base run of 0.177 of the three effects taken separately. In other words, there appears to be positive feedback among all sources of productivity increase. If the retardation factor Γ is omitted, l rises by another three points. Finally, the absolute income gap between Latin America and OECD countries increases from 14,900 Geary-Khamis 1990 dollars in 1998 to about 22,700 in 2030.

To illustrate feedback mechanisms, we ran simulations in which the traded goods productivity, education, and Verdoorn effects entered pairwise. As can be seen in Figure 6, combining faster traded goods productivity growth with either human capital accumulation or with a Verdoorn effect raises l in 2030 by about 0.07 above the base run to a value of 0.02. Faster human capital accumulation and Verdoorn taken together will add about .07 to l by the end of the simulation period. Also note that in both diagrams, the curves representing the various effects tend to become slightly steeper over time (that is, $d^2 l / dt^2 > 0$ or the curves are convex functions of time). Recall from section 2.1 that retardation by itself would make the curves concave. The positive "pushes" to growth built into the parameterization offset the retardation effects of catching-up.

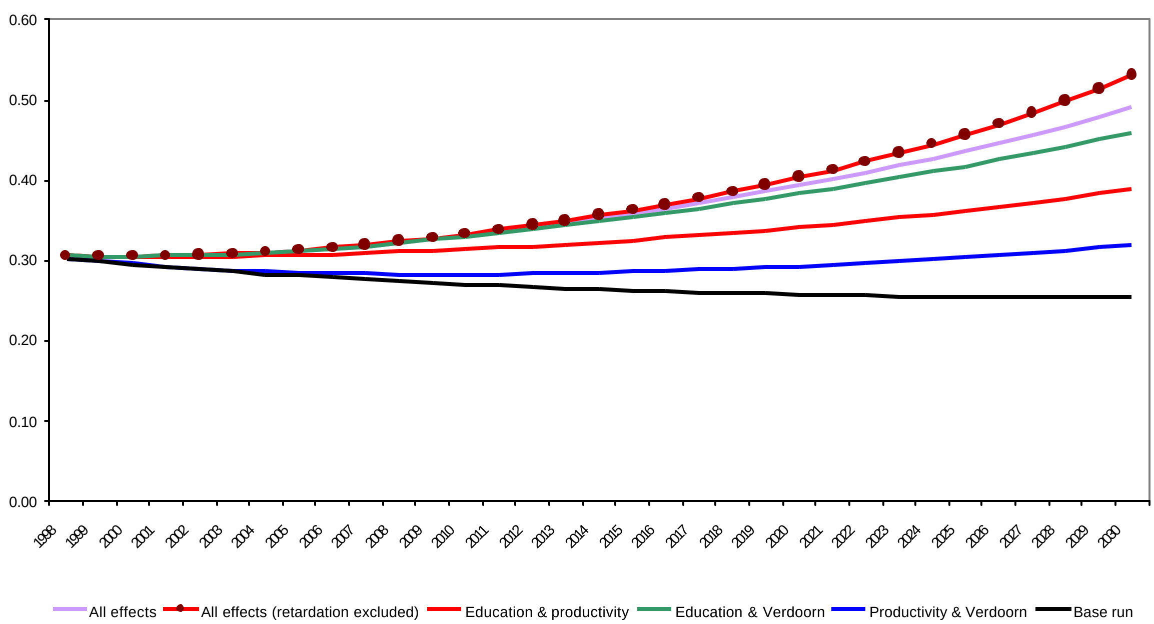

Figure 6: Combined effects of enhancement factors on catch-up scenario: LA vs OECD

Over the entire period, the simulation for "All effects" gives a growth rate of l of 1.6% per year, or less than half Japan's rate during its miracle. Per capita income growth is in the range of

3.4%. Such a performance is not to be sniffed at, especially in comparison to the last quarter of the 20th century. However, as already noted it depends on strong assumptions of full employment, no adverse economic shocks that could push the regional economy below its simulated trajectory for a significant amount of time, and optimistic specifications regarding the Verdoorn effect, traded goods productivity growth, and growth of physical and human capital. All these sources of growth would have to be present because they act synergistically. Designing a package that would force them all to be in action together for an extended period time is a non-trivial policy task.

Initial conditions in Eastern Europe are not strikingly different from Latin America's, except in four regards. First, Table 1 shows that both population and labor force growth in the region were negative in the 1990s. For the simulations, we assumed that the employment will decrease from 35.44 million in 1998 to 33.42 million in 2022 and then increase to 33.63 million so that its growth becomes slightly positive by 2030 while the growth rate of population remains negative, reaching about -0.5% per year.[16]

Secondly, an aging population implies a growing "dependency burden" (or ratio of retired to employed portions of the population). Cornia et.al, (1997) argue that associated pension and healthcare expenditures may cut into saving and slow accumulation. Thus we assume that $\hat{K}$ declines from 4.8% to 2.3% per year, with the implied ratio of PPP non-residential investment to GDP falling from 0.17 to 0.13.[17] Capital productivity growth is assumed to remain positive but small, varying between 0.6% and 0.3% per year.

The third contrast is that in 1998 Eastern Europe had an average 9.53 mean years of schooling, or 3.5 years more than Latin America. We assumed the region would attain 11.8 years by 2030, on a declining trend.

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[16] Forecasts of population growth are from the United Nations, *World Population Prospects.*

[17] We ran a separate simulation for Eastern Europe where the capital growth rate was decelerated further to 1.7% annually by 2030. The observed change in overall performance is not dramatic, with the increase in l being reduced by three percentage points relative to the case presented in the text.

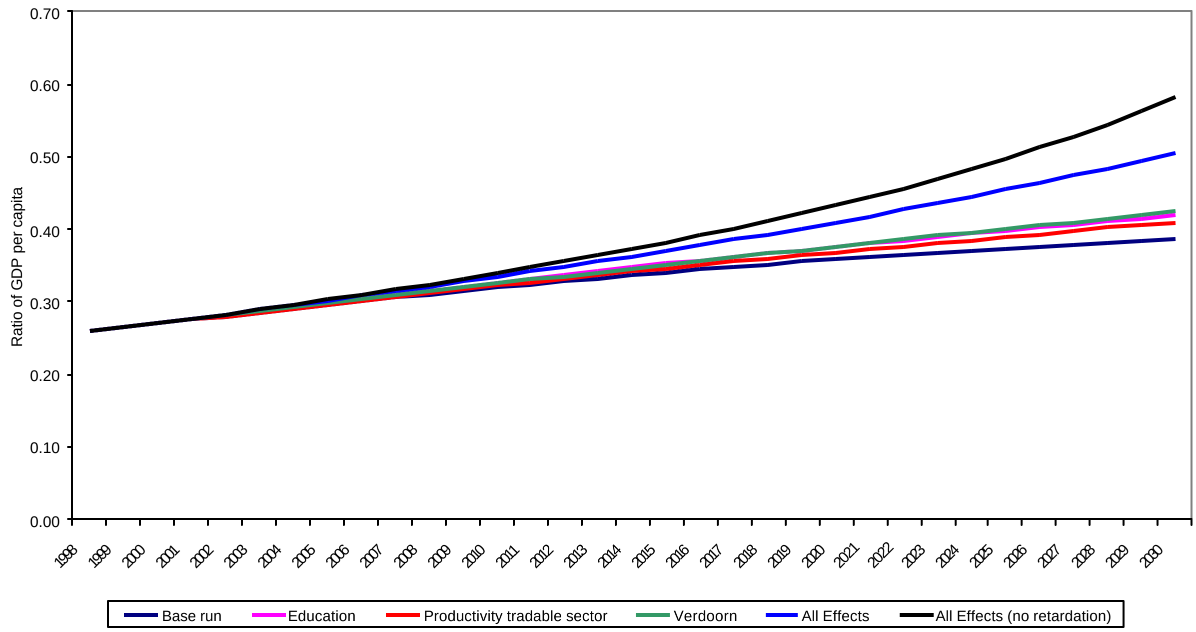

Figure 7: Eastern Europe vs OECD (1998-2030)

Finally, to offset improbably rapid growth in the region when there is no technical retardation, we set the parameter E to a value of 0.09. With an initial l of 0.25 we get $D = 0.023$.

The base run for Eastern Europe resembles Latin America's in that conditions in the 1990s were broadly projected to continue forward through time. In comparison to Figure 5, however, Figure 7 shows that the outcomes are visibly different. By 2030, there is an increase of 0.13 in base run l, in contrast to a decreasing level for Latin America. This distinction arises almost solely from different rates of population and labor force growth - positive rates in the vicinity of 1% per year in Latin America and negative or zero rates (especially for population) in Eastern Europe. The resulting projection of per capita income growth of 3.2% per year for the latter region is built into the core of mainstream full employment growth theory.

For the reason mentioned above, Figure 7 shows modest contributions (of about 0.03 beyond the base run) of more education, faster traded goods productivity or a higher Verdoorn parameter, to the level of l in 2030. The three factors taken together generate an overall increase in l of 0.25 by 2030 (or in other words they add 0.12 to the base run's increment of

0.13). If technological retardation were not present, the gain would be 0.32, which is more than a 100 % increase in l . Even an increment of 0.25 implies a growth rate of per capita output of 4.1% per year. Nevertheless, the absolute income gap increases by 20% from 1998 to 2030, reaching approximately 19,000 Geary-Khamis 1990 dollars by 2030.

Whether it makes sense to think that a declining, aging population will support three decades of such rapid growth is a question that the standard projection methodology cannot adequately address. Nor, on the other hand, can it adequately capture potential productive complementarity and technological spillovers between Western and Eastern Europe. Maddison (2002) emphasizes the latter factors in projecting 3% per capita income growth for Eastern Europe, 2001-2015.

4. Simulations for Russia, the Tigers, East Asia, China, the Middle East, South Asia, and sub-Saharan Africa

In summary fashion, Table 3 presents changes in the 2030 levels of l for all regions due to the effects discussed above. As discussed above, the OECD is taken as the growth target for Latin America, Eastern Europe, Russia and the Tigers; the Tigers for East Asia, China, and South Asia; and South Asia for sub-Saharan Africa.

	Tigers	LA	EE	Russia	East Asia	China	South Asia	Middle East	Africa
	vs OECD				vs Tigers				vs South Asia
Lambda 97	0.48	0.31	0.25	0.15	0.28	0.30	0.17	0.35	0.52
Increase in lambda 2030 vs 1998									
All Effects	0.23	0.19	0.25	0.21	0.04	0.31	0.18	0.09	-0.06
All Effects (no retardation)	0.44	0.22	0.32	0.29	0.04	0.49	0.20	0.09	-0.07
Productivity growth (trade sector)	0.09	-0.03	0.15	0.16	-0.07	0.18	0.06	-0.05	-0.20
Education effect	0.12	0.062	0.16	0.16	-0.06	0.23	0.09	-0.02	-0.16
Verdoorn	0.03	-0.005	0.16	0.17	-0.05	0.23	0.10	-0.01	-0.19
Base run	0.02	-0.05	0.13	0.14	-0.09	0.17	0.05	-0.07	-0.22
Education & productivity	0.21	0.02	0.19	0.18	-0.03	0.24	0.11	0.00	-0.13
Education & Verdoorn	0.14	0.07	0.18	0.19	0.00	0.30	0.14	0.06	-0.11
Productivity & Verdoorn	0.11	0.02	0.20	0.20	-0.03	0.24	0.12	0.02	-0.16

Table 3: Differences in l between 1998 and 2030

Russia's projections are comparable to those for Eastern Europe. Table 3 shows that the initial value of l is 0.15, well less than in the neighboring region and Latin America. Negative population and labor force growth rates are projected, and there is not much room for extending mean years of schooling beyond the level of 12 already attained in 2001. As with Eastern Europe, we set the retardation parameter E to 0.09.

The Russian base run alone adds 0.14 to l by 2030. Further direct increments are similar to the Eastern Europe: a 0.03 increase from the Verdoorn effect (with the parameter g going from zero in the base period to 0.45 during 2008-2030 in recognition of Russia's latent technological expertise), 0.02 from traded goods productivity growth (potential industrial expansion, again), and from human capital accumulation (12 years of schooling to 13.43). Taking into account retardation, the overall increment in l is 0.21 which translates into growth of per capita output at 4.7% per year. The growth rate implicit in the base run is already 4% per year, subject to the doubts already raised for Eastern Europe.

The Tigers follow an altogether different dynamic.[18] Table 1 shows projections of slowing population and labor force growth. But more strikingly, capital stock growth was 9.5% per year in the 1990s, which we assume slows to 3% by 2030 (with non-residential I / X decreasing by about five points). At the same time, capital productivity fell at -4.8% annually in the 1990s, demonstrating a strong Marx bias with labor productivity growing at 3.3% (or 0.9% when purged). In the projections we assume that the capital productivity growth rate increases to 0.2% per year by 2030. The region had a Verdoorn parameter of around 0.5 in the 1990s – we assume it rises to 0.61. Relatively small increases are projected for the labor share, traded goods share, and the productivity enhancement effect Z. Average years of schooling are assumed to increase from 8.1 to 11.3. The retardation parameter is set to 0.06

There is an increase of 0.02 in l in the base run solely as a consequence of a positive and high Verdoorn coefficient of 0.5 coming from the base year.[19] Relative to the base run,

[18] Our "Tigers" are Malaysia, Thailand, South Korea, and Taiwan, with the first two replacing Hong Kong and Singapore in the usual list.

[19] For the base run exercise for the Tigers we keep Verdoorn coefficient set to 0.5. Population growth decreases from 1.1% in 1998 to 0.5% in 2030 and employment growth goes to zero from a 1998 value of 1.3%. Capital stock grows at a decreasing rate throughout the simulation period going from 8% in 1998 to

increments in l due to faster productivity growth in traded goods and more education are 0.07 and 0.1 respectively. Starting from a high initial level, a larger Verdoorn parameter g adds a modest additional 0.01 to l in 2030. The overall change in l is 0.23 (or 0.44 without retardation, which is bound to be an important factor for the region since it starts at a relatively high per capita income ratio to the OECD of 0.48). The implied per capita growth rate is 3.1% per year, respectable but well below levels attained prior to the Asian crisis. Still, even with the good start the Tigers have relative to the other regions, the absolute gap between them and the "old" OECD does not narrow but remains constant around the value of 11,000 Geary-Khamis 1990 dollars.

Scaled to the Tigers, East Asia's base year l is 0.28.[20] The region resembles the Tigers in demonstrating rapid capital accumulation and a Marx bias in the 1990s – both assumed to decrease in the projections. There was no discernable Verdoorn effect in historical data and the initial educational level of 5.7 years of schooling is relatively low. The labor share is also low, reflecting a preponderance of non-wage transactions in the labor market (for example, in agriculture). From (1) a low a means that capital accumulation and productivity growth have a greater impact on output growth than in the regions considered heretofore.

The base run shows a steadily decreasing l, which falls by -0.09 over the simulation period. Baseline East Asian per capita income growth works out to be about 1.8% per year. Given the region's low level of a, the base run growth rate is driven mostly by capital accumulation as well as a reduction in Marx bias. Individual increments to final year l from the Verdoorn effect, faster traded goods sector productivity growth, and human capital accumulation add little to the base run projection of l. However, when taken pairwise, their contributions are stronger. Figure 8 shows that each pair contributes 0.06 to 0.09 to l beyond the base run. The final increment is

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3% in 2030 while capital productivity growth becomes slightly positive in 2030 from a previously negative value of –0.35% in 1998.

[20] The East Asian countries are Indonesia, Philippines, Sri Lanka, and Vietnam.

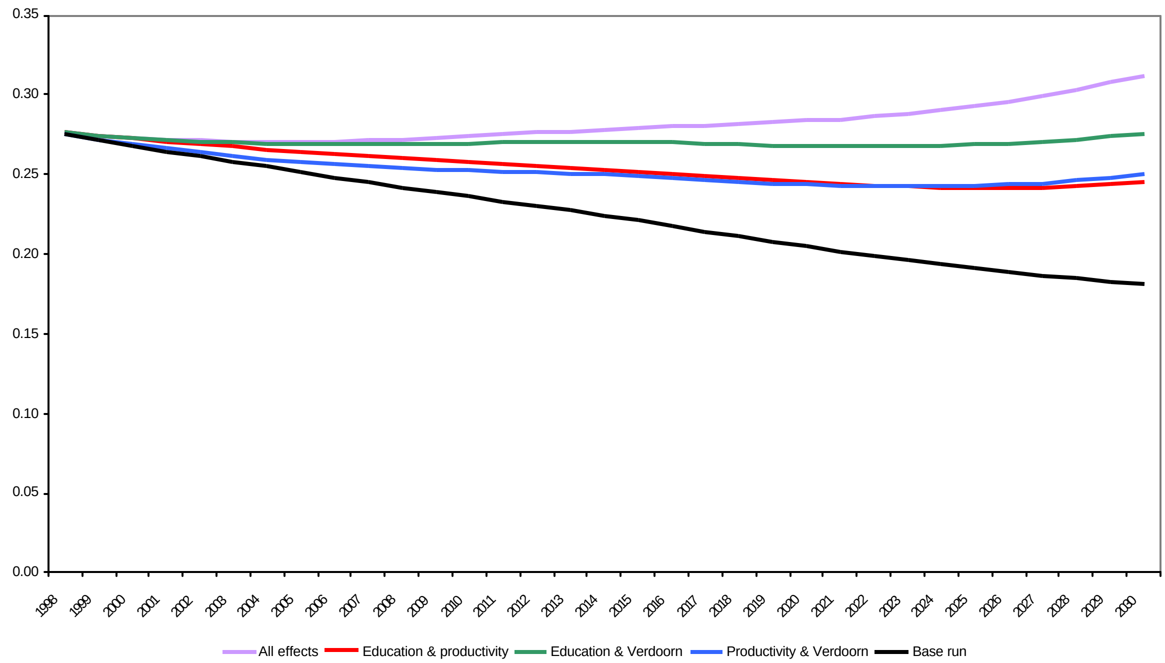


Figure 8: Combined effects of enhancement factors on catch-up scenario: East Asia vs Tigers

to the base run is 0.13 (or 0.04 to the initial level of l), with or without retardation. The corresponding growth rate of per capita output is 3.5% per year.

Our South Asian region comprises India and Pakistan. Its l compared to the Tigers is 0.17. Population and labor force growth rates exceed East Asia's and the rate of capital accumulation is comparable. There is no strong history of Marx bias. Initial traded goods and wage shares are low and the schooling level is a bit less than five years. The base run shows an increment in l of 0.05, or per capita income growth of 4% per year. Taken singly, Verdoorn (0.05), human capital (0.04) and traded goods (0.01) effects all add to the base run. Taken together, they generate an increment of 0.18 in l , for a per capita output growth rate of 5.5% per year. Even so, the absolute income differential between the rich countries and South rises by more than 28,000 from an initial level of 19,622 Geary-Khamis 1990 dollars.

The story for China, insofar as its official statistics are credible, is a more extreme version of those for the rest of Asia. Its initial l in comparison to the Tigers is 0.3. Population and labor force growth rates were in the range of one percent per year in the 1990s, and are projected to decline. The capital stock growth rate in the late 1990s was around 9% and is projected to drop to

3% by 2030. Meanwhile, negative growth of capital productivity in the 2% annual range is projected to move toward zero.

Reported labor productivity growth in the 1990s was on the order of 10% per year, a phenomenally high value. After purging, we get a value of 8.3% which remains at the very high end of realistic levels. Carried through into the simulation model (even with a relatively low a, rising from 0.33 to 0.4), initially high productivity growth feeds into a baseline projection that l would increase by 0.17. The implied growth rate of per capita output is 4.6%. When Verdoorn, traded goods productivity, and human capital contributions are factored in, the increment in l (incorporating a strong retardation effect with $E = 0.12$) is 0.31, for a per capita growth rate of 5.4% per year.

Only two decades ago Middle East[21] had the same GDP per capita as the Tiger countries. By 1997, the ratio was about one-third. For the next thirty years we simulate how successful the Middle East may be in retaking its old position. During the 1990s population and labor growth rates were around 2%. According to UN data, growth during the 1990s was sluggish. To be optimistic, we give the region a large injection of capital stock throughout the simulation period, having it increase at a rate of almost 5% annually by 2030. The labor productivity growth rate[22] averaged 2.1% during 1990s, making the purged growth rate equal to -0.5% due to the high incoming growth rate for education. To compensate for this drop in the base year labor productivity growth rate we allow the reallocation effect, *R*, to kick in at an increasing value throughout the simulation period. In the base run simulation the Middle East is not able to keep up with the fast growing Tigers and so l decreases by 0.07. When all the growth enhancement factors are present, the Middle East records an average GDP per capita growth rate of 3.6% which leads to an absolute increase in l of 0.09. Relative to OECD the absolute gap for Middle East follows the same upwards trend as most of the regions, reaching almost 27,000 Geary-Khamis 1990 dollars by 2030.

[21] The Middle East countries are Egypt, Iran, Jordan and Syria.
[22] Due to the lack of data we were able to calculate labor productivity growth rate only for Egypt and Iran, which together make up 87% of Middle East population.

Finally, we could find data on five countries (Ghana, Kenya, Senegal, Uganda, and Tanzania) to represent sub-Saharan Africa. The region's l relative to South Asia was 0.52 in 1998. It comes into the simulation period with several disadvantages that are to be blamed for the troubling results about convergence that follow. The main culprits are a high population growth rate of 2.7% annually in 1990s, low incoming labor productivity growth (0.66% per year, or essentially zero after purging), a low trade share of 0.19, and an incoming capital stock growth rate of 1%.

For the simulations, we assumed substantial increases in the traded goods output share (0.19 to 0.36), the labor share (0.18 to 0.38), the capital stock growth rate (1% to 6.1%), faster productivity growth in the traded goods sector (zero to 4% per year), the Verdoorn parameter (zero to 0.38), and years of schooling (3.17 to 6.57) along with decreases of about 1% per year in labor force and population growth rates by the end of the simulation period. Nevertheless, in none of the simulations is sub-Saharan Africa able to reduce its relative income gap with South Asia. In the base run lambda decreases by 0.22. When all the enhancement factors are present (without retardation), l still goes down by 0.06.

The saving grace, perhaps, is that the implied growth rate of regional per capita income is 5.1% per year over the simulation period.[23] This would be a very substantial improvement over Africa's recent performance, but would still leave it in 2030 with a huge absolute income gap of almost 34,000 Geary-Khamis 1990 dollars in comparison to the OECD.

5. Summary and Conclusions

Figures 9 and 10 summarize our results, showing changes in l for all regions in comparison to the OECD. Clearly, there is room for poorer regions to close their incomes gaps with respect to the developed countries. It is also clear that Doctor Pangloss smiles on the results. Here are some reasons why:

It is unlikely that any poor country or region will be able to sustain rapid and steady per capita income growth for a period of three decades. There are very few cases on record, e.g.

[23] Maddison (2002), in contrast, projects 1% annual per capita income growth for Africa, 2001-2015.

Brazil between the 1950s and the 1980s, Malaysia and South Korea between the 1960s and 1990s, and not many others.

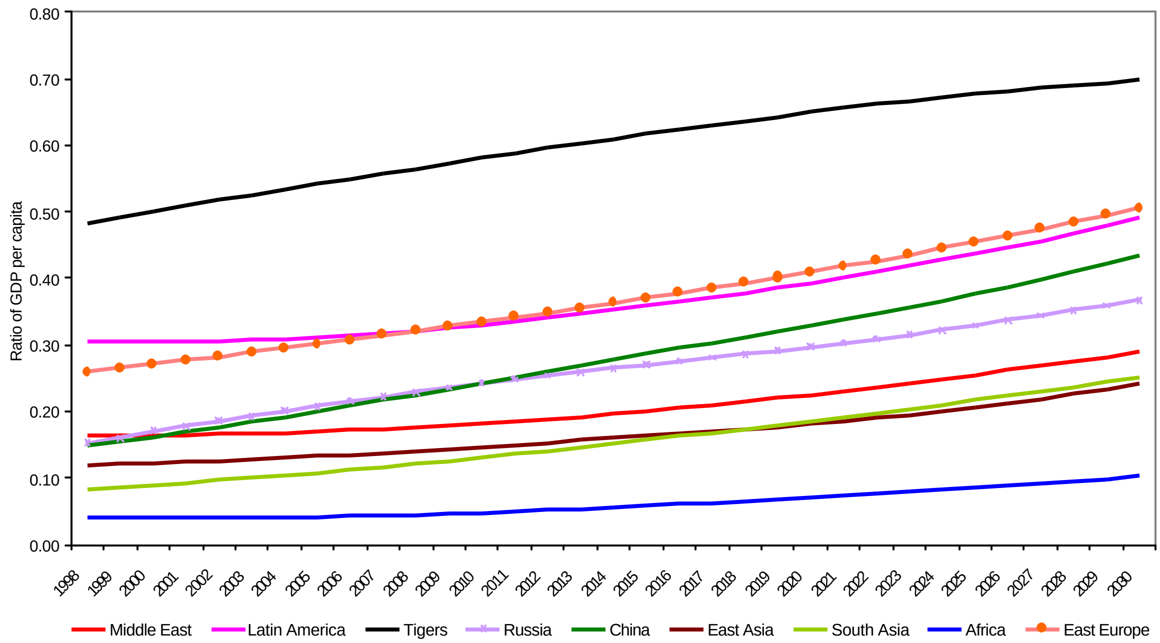
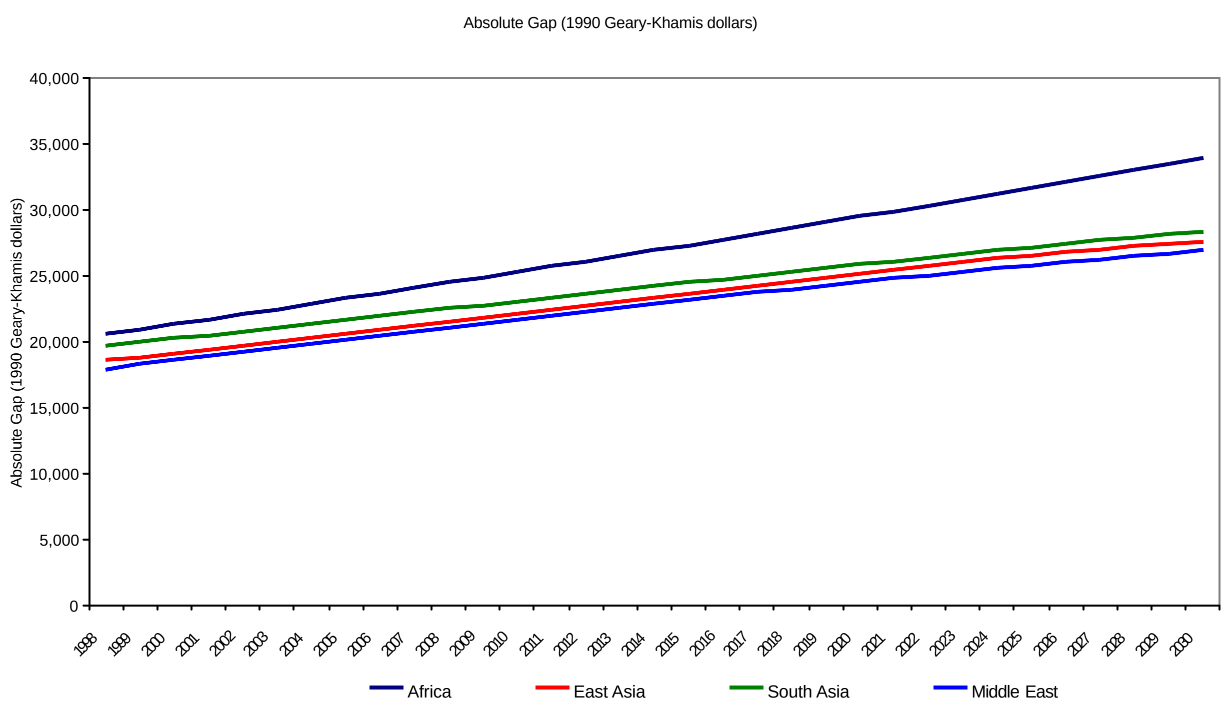


Figure 9: Relative per capita income ratios: developing regions vs. the OECD (1998-2030).



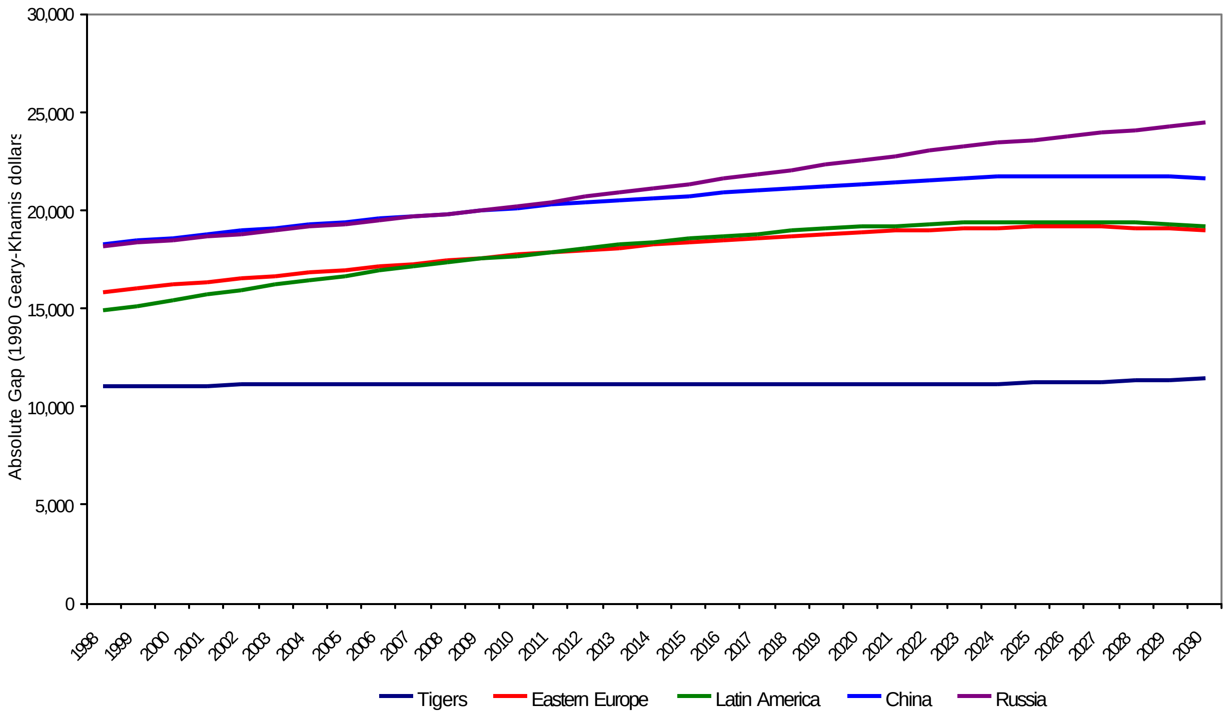


Figure 10: Absolute gaps to OECD (1998-2030)

The assumptions we have made with regard to the effects on growth of Verdoorn-Kaldor linkages, labor productivity increases in the traded goods sector, human capital accumulation, and the reduction of Marx bias are all at the optimistic ends of the plausible parameter ranges.

The most rapidly ascending curves include those for Eastern Europe, Russia, and China. The first two are undoubtedly biased toward speed by the supply-driven projection model's unrealistic assumptions about the effects on per capita income growth of negative population growth. China's reported rates of labor productivity growth during the 1990s are best taken with a measure of salt, as are their extrapolations toward the future in the model simulations.

Growth in the Tiger region is more than respectable, which in turn may bias upward the projections for its technological followers China, East Asia, and South Asia.

Finally, even if poor regions converge relatively as in Figure 9, Figure 10 shows that their absolute income gaps (the Tigers excepted) will rise. At least in the medium term, Lucas's (2000) prophecy about all countries being "equally rich and growing" looks well off the mark. As just discussed, in some cases we are projecting historically unprecedented per capita regional growth rates (and in all cases the model errs toward optimism). Unfortunately, they would not be high enough to substantially reduce absolute and even relative income gaps.

Appendix A: Growth Accounting

The accounting that underlies the simulations described in the text is presented in this appendix. Because the data are available for discrete periods of time (typically years), the analysis is set up with variables at the beginning of period *t* denoted by that subscript. For simplicity, equations are often written just with subscripts 0 and 1 standing for the beginning and end of a period respectively.

Although it is unrealistic for developing countries in which much economic activity is undertaken by independent proprietors (peasants, vendors, small manufacturers) who receive a mixture of capital and labor incomes, we follow convention in assuming that wage payments and profits can be cleanly separated in the determination of costs of production,

$$P_t X_t = w_t L_t + r_t P_t K_t \tag{A1}$$

in which X_t is real output at time t, P_t is a corresponding price index (such as a GDP deflator), w_t is an index of nominal wages, L_t is employment (measured in the text as numbers of workers in lieu of person-hours), r_t the overall rate of profit, and K_t the real capital stock (constructed by the perpetual inventory method, for example). For simplicity, a separate price index for capital goods is *not* used in (A1).

Subtracting terms in equation (A1) at time zero from those at time one and some manipulation give

$$\hat{P} + \hat{X} = a_0(\hat{w} + \hat{L}) + (1 - a_0)(\hat{r} + \hat{P} + \hat{K}) + a_0(\hat{w}\hat{L} - \hat{P}\hat{X}) + (1 - a_0)(\hat{r}\hat{P} + \hat{r}\hat{K} + \hat{P}\hat{K} - \hat{P}\hat{X})$$

where $a_0 = w_0 L_0 / P_0 X_0$ is the share of wages in output at time zero (and $1 - a_0$ the share of profits), and the last two terms on the right gather products of growth rates or "interaction effects."

Interactions become important when some variable grows very rapidly (for example the price index under conditions of high inflation) or else the span between times 0 and 1 is long so that the difference between final and initial values of a variable is more than a few percentage points of the latter. When these conditions don't apply, it is usually safe to ignore the interaction terms and write

$$\hat{P} + \hat{X} = a_0(\hat{w} + \hat{L}) + (1 - a_0)(\hat{r} + \hat{P} + \hat{K})$$

to a good approximation. The equation can be rearranged to give a decomposition of quantity and price log-changes in "Divisia indexes" with weights a_0 and $1 - a_0$ that will typically vary over time:

$$0 = a_0[(\hat{w} - \hat{P}) - (\hat{X} - \hat{L})] + (1 - a_0)[\hat{r} - (\hat{X} - \hat{K})] \quad . \qquad \text{(A2)}$$

The terms $(\hat{X} - \hat{L})$ and $(\hat{X} - \hat{K})$ respectively measure shifts in the output/labor and output/capital ratios, or average "productivity" levels of the two inputs.

If we let $w_t = w_t / P_t$ be the real wage at time *t*, then one can show that

$$\hat{w} = (1 + \hat{P})^{-1}(\hat{w} - \hat{P}) \approx \hat{w} - \hat{P}$$

in which the term $(1 + \hat{P})^{-1}$ represents interactions.

A "stylized fact" that is often not falsified by the data and built into many growth models is that real wage growth $\hat{w} \approx \hat{w} - \hat{P}$ tends to run at about the same rate as labor productivity growth $(\hat{X} - \hat{L})$, when both variables are averaged over time. If this relationship is observed, then persistently negative trend growth $(\hat{X} - \hat{K})$ in capital productivity has to be associated with a falling rate of profit ($\hat{r} < 0$) in (A2) because the bracketed term multiplied by a_0 will be close to zero. Marx-biased productivity changes as discussed in the text go together with the traditional Marxist distributive theme that a falling rate of profit is to be expected under modern capitalism.

A further step taken by the mainstream throws in another identity,

$$\hat{X} = a_0[\hat{L} + (\hat{X} - \hat{L})] + (1 - a_0)[\hat{K} + (\hat{X} - \hat{K})] \quad , \qquad \text{(A3)}$$

which basically states that $\hat{X} = \hat{X}$ for any value of a_0. If rates of labor and capital productivity growth are defined as $x_L = \hat{X} - \hat{L}$ and $x_K = \hat{X} - \hat{K}$ (thereby ignoring interactions) then this expression becomes

$$\hat{X} = a_0(\hat{L} + x_L) + (1 - a_0)(\hat{K} + x_K) = a_0\hat{L} + (1 - a_0)\hat{K} + x \qquad \text{(A4)}$$

which is restated as equation (1) in the text with a_0 set equal to the labor share.

Finally, suppose that one has data on employment and output for several sectors over time. As in the text, let $q_0^i = X_0^i / X_0$ be the share of sector *i* in real output in period zero, with $\sum_i X_0^i = X_0$. Similarly for employment: $e_0^i = L_0^i / L_0$ with $\sum_i L_0^i = L_0$. The level of labor productivity in sector *i* is X_0^i / L_0^i with an exact growth rate $x_L^i = (1 + \hat{L}^i)^{-1}(\hat{X}^i - \hat{L}^i) \approx \hat{X}^i - \hat{L}^i$.

After a bit of manipulation, an exact expression for the rate of growth of economy-wide labor productivity emerges as

$$x_L = (1 + \hat{L})^{-1} \sum_i [q_0^i(\hat{X}^i - \hat{L}^i) + (q_0^i - e_0^i)\hat{L}^i] \quad . \qquad \text{(A5)}$$

Aside from the interaction term $(1 + \hat{L})^{-1}$, x_L decomposes into two parts. One is a weighted average $\sum_i q_0^i(\hat{X}^i - \hat{L}^i)$ of sectoral rates of productivity growth as conventionally measured. The weights are the output shares q_0^i. The other term, $\sum_i (q_0^i - e_0^i)\hat{L}^i$, captures "reallocation effects."

For the record, another expression for x_L emerges after some manipulation of (A5),

$$x_L = (1 + \hat{L})^{-1} \sum_i [l_0^i(\hat{X}^i - \hat{L}^i) + (q_0^i - e_0^i)\hat{X}^i] \quad . \qquad \text{(A6)}$$

In (A6), sectoral productivity growth rates are weighted by employment shares, and the reallocation effect is stated in terms of output growth rates. The message is basically the same as in (A5).

Equations (2) through (4) in the text follow from (A5) when we set

$$S = \sum_i q_t^i(\hat{X}^i - \hat{L}^i) \quad .$$

as an average of sector-level rates of productivity growth weighted by output shares, and

$$R = \sum_i (q_t^i - e_t^i)\hat{L}^i$$

representing shifts in productivity growth do to reallocation of labor across sectors. Historical data coming into the model's base year will satisfy the decomposition $x_L = (1+\hat{L})^{-1}(S+R)$.

Appendix B: Sources of Data

Population

Population forecasts were obtained from UN Population Database which provides population estimates for every fifth year starting 2000. Based on these data and on the incoming growth rates we were able to obtain annual population growth rates throughout the simulation period.

Capital Stock and Capital Productivity

Data for capital stock for East Asia were available only for Sri Lanka, Philippines and Indonesia. Data for capital stock for Bulgaria and the Czech Republic were not available. For the Tigers, capital stock figures were available for Malaysia, South Korea and Thailand.

Capital productivity growth is calculated as the difference between the growth of output and the growth of capital stock. A special note should be made in the case of Russia and Eastern Europe where capital stock data experience large fluctuations during most of the 1990s due to problems such as strong underestimation of fixed assets during previous regimes. Therefore we decided to take as representative numbers for capital growth and capital productivity only the period post-1998 for Russia and post-1995 for Eastern Europe.

Productivity decomposition

In the case of Eastern Europe special data manipulation had to be undertaken, due to the nature of data we were able to collect, in order to obtain the productivity decomposition as it is described in Appendix A.

We used data on employment and output for the tradable and nontradable sectors. The main source was a database provided by Vienna Institute for international Economic Studies (WIIW). In the tradable sector for all of the five countries we include agriculture, mining and quarrying and manufacturing while the nontradable sector is comprised of electricity, gas and water, construction, wholesale and retail trade, restaurants and hotels, transport, storage and communications, finance, insurance, business services, dwellings and community and government services. The figures are in current values given in each country's domestic currency, as well as the growth rates of each sector's output measured in constant prices. Since there are noticeable differences between the increase in prices of nontradable and tradable goods in Eastern and Central Europe, one has to deflate the sectoral output serie by the price deflators pertaining to it i.e. CPI for nontradables and PPI or WPI for tradable sector. However, the data provided by WIIW contains the growth rates of sectors' output in constant prices. To be able to aggregate the data we had to obtain estimates of growth rates of real output by sectors denominated in the same currency for each country. This process was divided in several operations (details are available from the authors).

For all the other regions data were available in absolute terms and therefore we were able to obtain the productivity decomposition without using indirect methods. However a few observations need to be made. The tradable sector includes only manufactures and mining in the case of the Tigers, China, South, East Asian and African countries. The decision to include only these two sectors into the tradable sector was made based on the fact that the share of agricultural goods exports into the total agriculture output was too small. For the other regions, agriculture is part of the tradable sector.

Also, For Argentina and Mexico, because of lack of data for employment for several subsectors, we were forced to use the following sectorial composition. For Argentina, the tradable sector includes only manufactures, and nontradable includes everything but electricity, gas and transportation. For Mexico we assume that tradable contains manufacturing and mining and nontradables is transportation, storage and communications, finance, insurance, business services, dwellings and community and government services.

Education

For most of the countries data on mean years of schooling are taken from the UNDP *Human Development Report 2001*. Exceptions are Taiwan where data was obtained from http://www1.moe.edu.sg/speeches/1998/13oct98.htm and Russia where data were provided by

Stanislav Zhukov based on information from Goskomstat (The Russian State Statistical Agency). In most of the cases we had estimates for 1990 and 2000 for our countries exceptions are Taiwan (1985 and 1995) and Russia (1994 and 2001). For our simulation we need to calculate an average rate of growth of mean years of schooling. We assume that the growth in mean years of schooling is the same for every year. Using each country's population weight in total population of the region we obtain an estimate for the region's mean years of schooling and growth rate of years of schooling.

Table B1 provides a compact summary of all the data sources that we used.

Table B1: Data Source

<table>
<tr><th>Regions</th><th>Population 1990s</th><th>Population Forecasts 2000-2030</th><th>GDP</th><th>GDP Sectors</th><th>Employment</th><th>Capital Stock</th><th>Education</th></tr>
<tr><td>Africa</td><td>Angus Maddison (2000)
The World Economy:
A Millennial Perspective</td><td rowspan="8">United Nations World Population Prospects (http://esa.un.org/unpp/)</td><td>Maddison (2000) (1990 Geary-Khamis $)</td><td>World Bank
World Development Indicators 2000</td><td>African Development Bank
http://www.afdb.org/</td><td rowspan="5">Extended World Penn Tables

by Adalmir Marquetti

http://homepage.newschool.edu/~foleyd/epwt/</td><td rowspan="5">Human Development Report 2001

http://www.undp.org/ hdr2001</td></tr>
<tr><td>China</td><td rowspan="2">Maddison (2000)</td><td rowspan="2">Maddison (2000)</td><td>World Bank
World Development Indicators 2000</td><td>World Bank
World Development Indicators 2000 &
UN database</td></tr>
<tr><td>East Asia</td><td>World Bank
World Development Indicators 2000</td><td>ILO
World Bank
Iwan j. Azis
(http://www.worldbank.org.vn)</td></tr>
<tr><td>Eastern Europe</td><td>World Bank
World Development Indicators 2000 (WBDI)</td><td>World Bank World Development Indicators 2000 (1995 $)</td><td>The Vienna Institute for International Economic Studies</td><td>The Vienna Institute for International Economic Studies</td></tr>
<tr><td>Latin America</td><td>Maddison (2000)</td><td>Maddison (2000)</td><td>ECLAC
http://www.eclac.cl/</td><td>WBDI
ILO
GGDC at (http://www.eco.rug.nl/)
ECLA</td></tr>
<tr><td>Russia</td><td>World Bank
http://www.worldbank.org/research/growth/GDNdata.htm</td><td>World Bank World Development Indicators 2000 (1995 $)</td><td>Stanislav Zhukov based on Goskomstat
www.gks.ru/</td><td>The Vienna Institute for International Economic Studies
Slava Zhukov
Goskomstat</td><td>Stanislav Zhukov
Goskomstat
De Broeck and Koen</td><td>Stanislav Zhukov</td></tr>
<tr><td>South Asia</td><td rowspan="2">Maddison (2000)</td><td rowspan="2">Maddison (2000)</td><td>WBDI</td><td>ILO
WBDI
Adalmir Marquetti
Sundaram K./Mohan Rao/Dutt A.</td><td rowspan="2">Extended World Penn Tables

by Adalmir Marquetti

http://homepage.newschool.edu/~foleyd/epwt/</td><td rowspan="2">Human Development Report 2001

http://www.undp.org/ hdr2001</td></tr>
<tr><td>Tigers</td><td>Statistical Yearbooks of countries</td><td>ILO
Statistical Yearbooks of countries</td></tr>
</table>

Legend Table 1&2:

$\hat{L}$ - employment growth

$\hat{K}$ - capital growth

x_L - labor productivity growth

x_K - capital productivity growth

q_T - traded goods share

Z – traded goods labor productivity growth

g - Verdoorn parameter

a - labor share

$\hat{H}$ – mean years of schooling growth rate

R – reallocation effect

S – sectoral productivity shift

D, E – retardation parameters

References

Cornia, Giovanni Andrea, Juha Honkkila, Renato Paniccia, and Vladimir Popov, "Long-Term Growth and Welfare in Transitional Economies: The Impact of Demographic, Investment, and Social Policy Changes" (mimeo), Helsinki: World Institute for Development Economics Research

Foley, Duncan K., and Thomas R. Michl (1999) *Growth and Distribution*, Cambridge MA: Harvard University Press

Gerschenkron, Alexander (1962) *Economic Backwardness in Historical Perspective*, Cambridge MA: Harvard University Press

Johansen, Leif (1960) *A Multi-Sectoral Study of Economic Growth*, Amsterdam: North-Holland

Kaldor, Nicholas (1957) "A Model of Economic Growth," *Economic Journal*, *67*: 591-624

Maddison, Angus (1995) *Monitoring the World Economy 1820-1992*, Paris: Organisation for Economic Co-operation and Development

Maddison, Angus (2001) *The World Economy: A Millennial Perspective*, Paris: Organisation for Economic Co-operation and Development

Maddison, Angus (2002) "The West and the Rest in the International Economic Order" in Jorge Braga de Macedo, Colm Foy, and Charles P. Oman (eds.), *Development in Back,* Paris: Organisation for Economic Co-operation and Development

Marquetti, Adalmir (2002) *Extended Penn World Tables: Economic Growth Data on 118 Countries*, http://homepage.newschool.edu/~foleyd/epwt/.

Ocampo, Jose Antonio (2001) "Structural Dynamics and Economic Development" (mimeo), Santiago: Economic Commission for Latin America and the Caribbean

Ros, Jaime (2000) *Development Theory and the Economics of Growth*, Ann Arbor MI: University of Michigan Press

Syrquin, Moshe (1986) "Productivity Growth and Factor Reallocation," in Hollis B. Chenery, Sherman Robinson, and Moshe Syrquin, *Industrialization and Growth*, New York: Oxford University Press

Taylor, Lance (1994) "Gap Models," *Journal of Development Economics, 45*: 17-34

Taylor, Lance (ed., 2001) *External Liberalization, Economic Performance, and Social Policy*, New York: Oxford University Press

Taylor, Lance (2003) *Reconstructing Macroeconomics: Structuralist Proposals and Critiques of the Mainstream*, Cambridge MA: Harvard University Press

United Nations Conference on Trade and Development (2002), *The Least Developed Countries Report.*

Verdoorn, P. J. (1949) "Fattori che Regolano lo Sviluppo della Produttivita del Lavoro," *L'Industria*, *1*: 3-10

Weisbrot, Mark, Dean Baker, Egor Kraev, and Judy Chen, “The Scorecard on Globalization 1980-2000: Twenty Years of Diminished Progress,” Washington DC: Center for Economic and Policy Research