Economic Growth in East Asia:
Accumulation Versus Assimilation
by

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The impressive economic performance of many Asian economies over the past three decades is by now an old story. The growth of per capita GDP averaged over 4 percent in China and the major East Asian economies between 1960 and 1994, compared with less than 2 percent in other developing economies and 2.7 percent among the industrial countries. East Asia stands out as the only region where living standards are catching up with those in industrial countries, while other parts of the develping world seem to be struggling either to tread water or to fall further and further behind (table 1).[2]

The exemplary performance of many East Asian economies has been the basis for a large and varied literature, much of which explores reasons for the persistently high growth, and draws lessons for other countries that would like to follow suit. A surprising aspect of this literature is its lack of agreement on fundamental aspects of the performance record which analysts seek to explain. Is the basis for East Asian growth the maintenance of high rates of physical and human capital accumulation over a number of decades -- a willingness to make the sacrifices of current consumption necessary to invest for the future? Or has the key been the less-costly approach of adopting existing technologies of more advanced econmies, perhaps associated with increased capital accumulation along the way?

[2]Our grouping of East Asian economies is somewhat unconventional becuase it is based on the availability of data to construct the growth accounts. It includes all but one (Hong Kong) of the seven economies that were the focus of the 1993 World Bank study, The East Asian Miracle, plus the Phillipines. We also exclude Japan, placing it with the other industrial economies.

Establishing which of these characterizations is correct is a crucial first step in extracting appropriate lessons from East Asian growth experiences, and is a primary motivation for this paper. If the accumulation view is correct, East Asian experiences reinforce the lesson that improving living standards requires investment, paid for in large part through foregone current consumption. The alternative assessment, which Paul Romer has referred to as narrowing the "idea gap," implies a much more optimistic message.[3] No opportunity cost need be incurred to create the requisite ideas. Instead, they could be transmitted to the mutual benefit of both suppliers and recipients. Deciphering East Asia's rapid growth would hold forth the promise of a much less steep road to prosperity.

A long list of authors implicitly or explicitly highlight productivity growth as the key to Asian success. One strand of literature has engaged in a debate over the role of (particularly microeconomic) government policies in achieving productivity increases. In its early incarnation, one side of this debate pointed to high growth Asian economies as proof of the pay-offs from "market friendly" approaches, including the maintenance of an open trading regime, in promoting increased efficiency.[4] Others characterized government strategies in the region as targeted intervention, not laissez-faire, arguing that the experiences showed how "getting prices wrong" and picking winners were the road to catching up with industrialized nations.[5] Thus, the same group of countries became poster children for conflicting policy advice. Views in this debate have moved somewhat closer over time. In particular, there is now broad recognition that the high growth Asian economies exhibit a range of government strategies, from extreme laissez-faire to extensive intervention in some sectors. A growing number of analysts also conclude that some interventions were beneficial.[6] However, considerable disagreement remains over the importance and

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[3]Romer (1993).

[4]World Bank (1993a), and more recently, Krueger (1995b).

[5] Amsden (1989, 1991, and 1994),Wade (1990), and Fishlow and others (1994).

[6] See for example, the World Bank (1993), and Krugman (1992)

transferability of active intervention.[7] This debate still centers on the role of the public versus the private sector in generating productivity growth.

A second strand of literature stems from dissatisfaction with the ability of traditional growth models to explain observed features of economic growth.[8] The result has been an exploration of alternative frameworks, known collectively as models of endogenous growth. Some of the ideas underlying this work can be found in the development literature of the 1950s and 1960s, but the associated explosion of attention to how rapid economic growth may be spurred by increases in efficiency is certainly new. While productivity gains may induce capital accumulation in these models so that the two are observed to grow hand in hand, it is productivity gains, not capital formation per se that is the fundamental cause of growth.[9]

The quotes below imply an acceptance of the view that rapid economic growth, such as that in East Asia, can largely be explained by successful technological catch-up:

"The optimistic view of the potential for development suggested by idea gaps is consistent with the experience of a few very rapidly growing economies. In fact, a rapidly closing idea gap offers the best way to explain these cases of dramatic success."[10]

"The source of growth in a few Asian economies was their ability to extract relevant technological knowledge from industrial countries and utilize it productively within the domestic economy."[11]

This literature has also looked for policy lessons, with many authors concluding that openness to

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[7]See , in particular, the debate that followed the publication of The East Asian Miracle. For example, Singh (1994), Page (1994) and Ito (1994).

[8]For example, Lucas (1988) and Romer(1986).

[9]Barro and Sala-I-Martin (1992), Romer(1990), King and Levine (1994.)

[10]Romer, (1993, p. 547).

[11]Pack, (1992, p. 299)

trade, capital goods imports, direct foreign investment, financial development and macroeconomic stability can help countries to grow by closing technology gaps. These claims are based on a combination of cross-country growth regressions and evidence from industry and firm level studies.[12]

Not so fast, argue a growing number of empirical studies which find little or no evidence that East Asia's rapid growth has been associated with rapid productivity growth or closing the knowledge/technology gap. The best known of these studies are Alwyn Young's growth accounting papers that examined the composition of growth in Korea, Taiwan, Hong Kong and Singapore.[13] Using regression analysis to estimate underlying production functions, Kim and Lau are unable to reject the hypothesis of no technical progress in the same four economies.[14] If these studies are correct, and efficiency gains are not lead actors in the Asian success stories, then debates over the roles of government and the private sector in raising productivity, while of interest in their own right, can not hope to uncover the lessons from Asian experience.

This paper revisits the issue of the sources of East Asia's rapid output growth. The empirical framework is provided by a set of growth accounts that partition the growth in output per worker from 1960 to 1994 into the contributions from accumulation of physical and human capital and a residual measure of the change in total factor productivity (TFP). Our methodology is simpler and therefore more transparent than many of the other growth accounting studies in the literature. Furthermore, we apply a common methodology to 88 developing and industrial countries, including a broad group of eight East Asian economies, as well as a range of countries from other regions at all levels of development.

Growth accounting has been subject to recent criticism, because it can not identify the underlying fundamental causes of growth. However, this is not its objective. It provides a consistent decomposition of growth among its proximate sources which we believe is very informative. The approach also avoids some of

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[12] See, for example, Bell and Pavitt (1992), Pack (1992), Romer (1993), and Fagerberg (1994).

[13] Young (1991, 1994a, 1994b).

[14] Kim and Lau (1994).

the problems associated with cross-country regression analyses. In particular, it has been widely recognized

that, because these studies suffer from simultaneity, multi-co-linearity and limited degrees of freedom, their

results should be interpreted with caution.[15] Note also that growth accounting does not require us to take a

stand on the appropriate underlying model of growth. We do not need to choose among a neoclassical

framework in which technology is identical across countries and technical progress is exogenously determined

and the many alternative frameworks in which technology may differ across countries and the accumulation

of knowledge is an endogenous process.

To put the punch line from our empirical analysis up front, the central result is to reinforce those of

studies which have concluded that TFP growth played a surprisingly small role in East Asia's success.   The

main lessons come not from identifying which policies best promote TFP growth, but how countries can

achieve and sustain high rates of saving and investment.

Of course, simply finding little TFP growth among these countries is not new. Indeed, our results are

similar to those of Alwyn Young in this regard. The main contributions of our work fall into three areas. The

first is its extensive coverage -- particularly of other East Asian economies, enabling us to make comparisons

across countries and time periods in which different experiences cannot be attributed to methodological

inconsistencies. We are able to study the robustness of Young's conclusions which, because they are based

on a very detailed decomposition, can not be contrasted directly with those for other countries.   We also

examine the relationship between factor accumulation and productivity growth in these economies.

Second, our analysis clarifies why some previous studies have under-emphasized the importance of

capital accumulation in East Asia. We show that using investment to proxy physical or human capital

accumulation can be very misleading. These proxies are surprisingly uncorrelated with changes in capital

stocks. Furthermore, they lead to severe underestimates of the role of physical capital in explaining high

Asian growth. We also examine ways to measure human capital accumulation. We argue that direct usage of

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[15]See Mankiw (1995) for one exposition of the difficulties with the empirical analysis.

years of schooling is problematic because of how it treats those with no formal education. It therefore

overstates growth in human capital for countries with low initial levels of education relative to our alternative

labor quality index which weights labor based on returns to schooling. This alternative implies a larger,

though still modest, growth contribution from increased schooling in East Asia.

Third, we use our decomposition of growth between factor accumulation and productivity gains to

explore the channels through which variations in initial conditions, the external environment, and some

aspects of government policy have affected the growth process. In some cases the roles of various policies

can be evaluated by examining the extent to which they are correlated with changes in factor accumulation

versus gains in the efficiency with which the factors are used.

In the sections that follow, we explain the construction on the accounts and discuss the results as they

bear upon the East Asian experience. We then use the resulting data to explore the context in which East

Asian economic growth has been different. Is there, as emphasized by the new growth literature, a positive

correlation between capital accumulation and factor prductivity gains, and was it important for East Asia?

Given our emphasis on the dominant role of capital accumulation, we go on to examine a further issue raised

by Krugman, based on Young's analysis, of whether or not East Asian growth must inevitably slow down.[16]

We suggest that there is some evidence that these economies are evolving toward a greater emphasis on TFP

gains, and that future growth can be sustained.

Construction of the Accounts

Growth accounts make it possible to decompose the change in output into the contributions of factor

accumulation and a residual measure of gains in the efficiency with which the factors are used.   Most

previous studies have been restricted to a select few countries where the researcher was able to obtain the

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[16]Krugman (1994).

required information from national sources.[17] In recent years that situation has changed because of the

development of several large international data sets. We have used those data sets to construct growth

accounts that, while simpler than those available from other sources, cover a large number of economies over

an extended period. Thus, they augment the other studies by employing a standardized and transparent

methodology to the growth experience of a large number of countries. Comparisons can be made between the

East Asian growth experience and those of the industrial countries and developing economies in other

regions, without concern for differences in methodology.

We have constructed indexes of real output, the capital stock, and a measure of the education-

adjusted workforce for 88 countries over the period of 1960 to 1994. The choice of countries was limited

primarily by the availability of national accounts data and measures of educational attainment; but the result

provides very good coverage of the major regions: East Asia (8 countries), South Asia (5), Sub-Sahara Africa

(21), the Middle East and North Africa (9), Latin America (22), and the OECD countries (23).[18] In addition,

we have used an updated version of the Penn World Tables (version 5.6) to obtain relative levels of output

and capital per worker in common international prices.

The neoclassical analysis of economic growth starts with the assumption of a stable underlying

relationship between output (Q), the inputs of capital (K) and labor (L), and technology (A):

$$(1) \quad Q_t = F(K_t, \acute{L}, A_t).$$

The notation of $\acute{L}$ is used to denote a skill adjusted measure of the labor input:

$$(2) \quad \acute{L} = H \bullet L, \text{ where}$$

H is an index of labor quality. In concept, the growth accounts can be constructed to yield estimates of total

factor productivity that are independent of the parameters or functional form of the above production process.

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[17]Three of the most detailed recent examples are the studies of: Elias (1990) covering seven Latin American countries; Hoffman(1993), who compared six Latin American countries with three in Asia: and Young(1994b) for four newly industrializing economies of Asia.

[18]A complete list is given in the appendix.

It is only necessary to assume a degree of competition sufficient to ensure that the earnings of the factors are proportionate to their factor productivities. The shares of income paid to the factors can then be used to measure their relative importance in the production process. That is, an index of growth in total factor productivity, denoted by a(t), can be defined as the growth rate of output, $q(t)$, less the share-weighted growth of the factor inputs, $k(t)$ and $\acute{l}(t)$:

$$(3) \quad a(t) = q(t) - s_k k(t) - s_l \acute{l}(t).$$

As discussed later, we are compelled to use fixed weights -- an assumption that is only consistent with a more limited set of production functions -- in the construction of the indexes. Furthermore, any deviation from constant returns to scale is allocated to the residual of total factor productivity.

Output Growth.

  The basic output measure is Gross Domestic Product in national prices of 1987 as published by the World Bank. Because of data revisions and some reporting errors, we substituted measures from the IMF and the OECD in a few cases. An alternative measure of GDP in international prices with a base year of 1985 is available in the Penn World Table (PWT). While the PWT measure begins with the same national accounts data of the World Bank, it is converted to standard international prices by constructing indexes at the level of the three main components of real GDP in national prices -- private consumption, government consumption, and investment -- and forming a new aggregate using international price weights.

        The composition of output, measured in international prices, can deviate from that shown by the standard national accounts which are measured in national prices. Most of these differences can be traced to wide variations across countries in the price of labor used to produce non-traded products, but they also reflect the influence of various restrictions on external trade that prevent an equalization of the domestic and foreign prices of tradables. In general, the conversion to international prices raises the share of output devoted to investment (capital and skill intensive) in the high-income countries and lowers the share of

government consumption (labor intensive). The opposite is true for poor countries.

The measurement of output in common international prices is of great value for comparing levels of income across countries. However, the two concepts produce very similar measures of output change.[19] Over the period of 1960 to 1990, the correlation coefficient between the two measures exceeds 0.95. The difference in the average annual growth rate exceeds one percentage point in only six countries; and, in one case, China, the disparity reflects a special methodology of the Penn World Tables in which the authors' revised the national source data.[20] In this paper, we report output growth in terms of national prices because we have it on a more up-to-date basis, extending through 1994, that captures some important data revisions.

Physical Capital

The measure of the capital stock, which was obtained from the World Bank, is based on a perpetual inventory estimation with a common geometric depreciation rate of 0.04.[21] Estimates of the capital stock are normally viewed as unreliable because of lack of information about the initial capital stock and the rate of depreciation. However, the researchers who developed the World Bank data set devoted substantial effort to incorporate the results of previous studies of individual or small groups of countries, and they obtained investment data extending as far back as 1950. The use of a long time series on investment is significant because it reduces the importance of the assumption about the initial stock. For the East Asian economies in particular, where subsequent investment rates have been very high, any error in the estimate of the capital stock for the 1950s would be a very small portion of the stock available in the 1980s and 1990s.

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[19]The differences in weights will have large effects on the growth in the aggregate only if the growth rates of the components are widely divergent.

[20]The six countries with large differences are: China, Jordan, Mali, Myanmar, Nigeria, and Rwanda. In the case of China, the Penn-World Table reflects a special adjustment to the underlying national accounts that reduced the growth rate of investment by 40 percent over the 1980-93 period, and that of consumption by 30 percent. In the other cases, it appears that the World Bank measures of GDP had been revised since the data was gathered for the Penn World Table.

[21]Nehru and Dhareshwar (1993). We extended the estimates through 1994 using data from the 1995 World Tables.

An alternative approach, reflecting skepticism about any estimate of the capital stock, uses the gross investment rate as a proxy for the change in the capital stock. Indeed, that is the route taken by many past studies. The change in the capital stock is given by

(4) $\Delta K = I - dK$,

where d is a measure of the geometric rate of depreciation. Dividing through by K and assuming a steady-state constant value (γ) for the inverse of the capital-output ratio allows the rate of change of capital (k) to be measured by the investment rate ($i = I/Y$):

(5) $k = i\gamma - d$.

Most cross-national growth studies have relied upon the investment rate to measure capital accumulation.[22]

The choice between a direct estimate of the capital stock or its steady-state investment equivalent is critical to deciphering the differences among the various studies that have sought to explain East Asian growth. Many developing countries have had a growth experience over the past three decades that was very far from the conditions of a steady-state, and the capital-output ratio has been far from constant. As a result, the investment rate is a very poor proxy for the rate of capital accumulation. In fact, in our sample of 88 countries, there is no significant correlation between rate of change in the capital stock and the mean investment rate, even over a period as long as 34 years (See figure 1).

The newly-industrializing economies of Asia all stand out with an extraordinarily high rate of growth of the capital stock, but they are less unique in terms of the share of output devoted to investment. The combination of an elevated investment share and a rapid growth of output has yielded a very high rate of capital accumulation for the East Asian economies, whereas other countries with high investment shares have had less output growth.

It is also possible to use the data from the Penn-World Table to construct estimates of the capital stock in international prices. However, because there is no disaggregation below the level of total investment,

[22]See Mankiw and others (1992) and the studies referenced in Levine and Renelt (1992).

its growth is the same in national and international prices. Thus, the choice between the two measures affects only the level of the capital input.[23]

Labor Inputs

The measure of the quantity of labor is actual employment for the industrial countries and estimates from the International Labor Organization of the economically-active (labor force) population for the others. For many countries, data on the economically-active population are available only every five or ten years from population surveys or censuses. The ILO has used the information on age-specific labor force participation rates and more-frequent population estimates to develop consistent estimates of the labor force at five-year intervals extending over the period of 1960 to 1990. Those participation rates are then interpolated and applied to annual estimates of the total population.

The use of a labor force measure instead of the total population, as is more common in other studies, makes little difference in the aggregate: over the 1960-94 period, the two series have nearly identical growth rates at the level of the total sample (2.1 versus 2.0 percent), and the cross-country correlation of the change is 0.82. It does makes a difference, however, at the level of individual countries; and it is important for evaluating the sources of growth in some of the East Asian economies (see columns 5 and 6 of table 1). The growth of the labor force exceeds that of the population in China and East Asia -- with particularly large differences in Korea, Singapore, and Taiwan . A similar phenomenon of rising labor force participation is evident in the industrial countries, but the opposite is true for the low-income, high-population-growth economies of South Asia and Sub-Sahara Africa. Thus, the use of the labor force to measure growth in the labor input lowers the the residual growth in TFP in the faster-growing economies and reduces its variance across countries.

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[23]To construct an estimate of the capital stock in international prices, we adjusted the initial capital-output ratio in line with the ratio of the investment rate in national prices and international prices in the 1960s.

Education

Measures of the labor force effectively treat all workers as if they were identical, but worker characteristics clearly influence marginal productivity. Some previous growth-accounting studies of individual countries have incorporated detailed adjustments by labor force groupings, including education, age, and gender.[24] We follow a simpler approach, adjusting only for the characteristic that has been found to be most important -- education. The benefits of education are assumed to be embodied in workers as explained below.[25]

Our analysis is based on the educational attainment data constructed by Barro and Lee (1993). As explained in their paper, they use a combination of data sources to infer the percentage of each country's population (age 25 or older) which had obtained a particular level of education for each year from 1960 to 1990.[26] Census data provide direct measures of a country's stock of education in a particular year. However, census data are only available for selected years, particularly in developing countries. Thus, enrollment data are used to interpolate between census years, and, along with data on literacy rates, to fill in missing cells. The result is an allocation of each country's population among seven schooling levels, ranging from no schooling/illiterate to completed post-secondary schooling, and an estimate of average years of schooling of the total population constructed from the categorical data. Following their interpolation procedures, we extended the data to 1994. Seven of the countries in our sample were not in the Barro-Lee data set.[27] In these cases, we constructed estimates using years of schooling data from an alternative source and the

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[24]For example, Denison (1967) and Young (1994).

[25]Other formulations of the production function that treat the benfits of education separately from the workers, such as that of Mankiw and others (1992), are reported in Bosworth, Collins, and Chen (1996).

[26] Thus, we assume that the educational distribution of the population is representative of the educational distribution of the labor force.

[27] The seven countries are China, Cote d'Ivoire, Egypt, Ethiopia, Madagascar, Morocco and Nigeria.

relationship between the two data sets for countries at comparable stages of development.[28] Although the resulting education indicators represent what we believe to be the best available comprehensive educational data, there are a number of potentially serious measurement problems, and those problems may vary systematically with the level of development.[29]

Table 2 summarizes the average educational attainment for East Asian countries and major regions. The first two columns show the proportion of adults with no education in 1960 and 1994. Column 3 reports average years of schooling in 1960. Countries in Sub-Saharan Africa had the least educated population, followed by those in South Asia and the Middle East. On average, East Asian countries had slightly less human capital (per person) than those in Latin America, but educational attainment in both regions remained well below the industrial country average. By 1994, average educational levels in East Asia were second only to those in industrial countries, and well above levels in all other non-industrial regions. The third column shows the change in years of schooling between 1960 and 1994. East Asia stands out as the region with the greatest increase. However, as shown in the fourth column, East Asia (excluding China) is not the region with the most rapid percentage increase in schooling. This distinction goes to the Middle East, where educational levels nearly tripled, but from an initially low base.

Prior empirical studies have frequently relied on enrollment rates as a proxy for changes in education. But the enrollment rate encounters a problem similar to that discussed earlier with regard to investment rate as a measure of physical capital accumulation: it only works in the steady state.[30] The same enrollment rate that would be necessary to maintain constant average years of schooling in a country with an initially high

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[28] Nehru and others. (1994). This alternative data set is based primarily on information about school enrollments. Surprisingly, although there is a very high cross-country correlation between the two measures of the average level of schooling (1960-85), the correlation vanishes in a comparison of changes over the period of 1965-85. There are also significant discrepancies between the two data sets for some industrial countries. As discussed further in Bosworth, Collins and Chen (1996) we find the Barro-Lee data preferable.

[29] See Behrman and Rosenzweig (1994) and Barro and Lee (1994a) for a discussion of the problems with education and labor force data from developing countries.

[30]This assumption and its steady-state justification became very popular following the paper by Mankiw, Romer and Weil (1992).

stock would imply increasing years of schooling in a country with an initially low stock.[31] Indeed, enrollment

in 1965 and growth in years of schooling (1965-85) are uncorrelated in the both the Barro-Lee and the Nehru

et. al data sets.

More recently, many studies have used years-of-schooling in level form as an explanatory variable.

But, as Barro and Lee are careful to point out, the beginning of period level should be interpreted as an initial

condition and not a proxy for human capital accumulation. Indeed, the initial years-of-schooling has been

found to be negatively correlated with the growth in years-of-schooling. Other studies have used the average

years-of-schooling over the growth period.[32]

Many studies have found it difficult to detect a significant relationship between the change in years-

of- schooling and economic growth.[33]   A variety of explanations have been offered. Some emphasize the

measurement problems in cross-country data on educational attainment; but it is also evident that years-of-

schooling alone is a poor index of labor quality because it assigns workers with zero education a weight of

zero and it implies disproportionate changes in labor quality for countries with low initial levels of schooling.

We have tried to follow Denison and others in using estimates of the relative wage structure for

workers with different years of schooling to construct weights for aggregating workers across educational

levels:[34]

$$(6) \quad H = \sum W_j \bullet P_j$$

Our labor quality index weights the percentage of the population that has attained different levels of

educational attainment (P_j, j=1=no schooling, ...,7=complete higher level) by estimates of the returns to

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[31] This point is also made in Benhabib and Spiegal (1994).

[32] Benhabib and Spiegal (1994) justify use of the average level of schooling with an endogenous growth model in which productivity growth depends on the accumulated stock of human capital.

[33] Benhabib and Spiegal (1994), Pritchett (1995), Harrison (1996), and Judson (1996).

[34]Denison (1967).

schooling, based on the relative earnings of different educational groups. In constructing the weights (W_j, j=1,...,7), we have assumed that the returns to schooling are constant across levels of schooling and countries.

A recent article by Psacharopoulos provides a comprehensive survey of the empirical literature.[35] The most frequently used method for estimating the return to education involves a regression of log earnings on years of schooling, potential years of experience, potential experience squared, and a constant. The estimated coefficient on years of schooling can be interpreted as the average marginal return to an additional year of schooling. The assumption that the returns to schooling are constant across different schooling levels is consistent with Card and Krueger's (1996) findings for the U.S. However, Psachropolous reports that the estimates for other countries frequently find returns that are larger for primary than for secondary or higher levels of education.[36]

The estimated average returns to schooling by region, drawn from data reported by Psacharopolous, are summarized in appendix table 2.[37] Based on the range of regional estimates, we constructed two indices of labor quality, one using weights implied by a 7% return to schooling -- a relatively low estimate -- and the other using weights implied by a 12% return to schooling -- a relatively high estimate. While both growth accounting decompositions will be presented and compared, we treat the 7% return weights as our base.[38] Both sets of weights assign 100 to individuals with no formal schooling. The weights implied by the 7 and 12 percent rate of return at different levels of schooling are shown in appendix table 2. The table also shows

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[35] Psacharopolous (1994).

[36] The earnings regression approach may overstate returns to schooling because of the omission of variables such as ability, and family background.

[37] Estimates are available for 53 of the countries in our sample (60%), including all of our East Asian countries and 18 of the 22 Latin American countries. The average return to an additional year of school in East Asia is 10.7%, slightly higher that the overall world average of 10.2%.

[38] There are two reasons for focusing on the 7% return decomposition. First, we believe that the likely biases due to omitted variables imply overestimates of returns to schooling among developing countries. Second, as discussed below, assuming a higher rate of return to schooling will result in a smaller residual, or estimate of factor productivity, in East Asia. Since one of our main messages is that there is surprisingly little productivity growth for these countries, we wanted to ensure that this conclusion was not attributable to extreme underlying assumptions.

the percentage distribution across each of the seven educational levels in 1960 and 1994 by country and region.

The change in the labor quality indexes, assuming a 7 percent return, is reported in column (4) of table 2. In contrast to the raw years-of-schooling measure (column 3), East Asia experienced the greatest increase in labor quality over the period 1960 to 1994: a 0.9 percent annual growth. The quality index, however, sharply changes the picture of the distribution of education gains with in the region. China and Indonesia, which began with very low average years of schooling decline sharply, and Korea jumps to the top of the ranking. A similar phenomena is evident in the regional data. The improvement in labor quality for Africa is much smaller than implied by the increase from an average of one to three years of schooling -- a rise in labor quality of only 0.3 percent per year. Latin America and the industrial countries enjoyed moderate increases in average labor quality over the period.

Measures of Factor Shares

The final step in the estimation of the indexes of TFP growth involves the choice of weights for aggregating the factor inputs. As mentioned previously, in a competitive economy, those weights could be represented by the shares of income earned by capital and labor respectively; and, to be truly independent of the underlying production function, the weights would need to vary freely across countries and time (Divisia-Tornquist indexes). However, reliable measures of factor income shares are not available for most developing countries; and even for the industrial countries there are difficulties of dividing the income of the self-employed between the returns to capital and labor.

We have employed fixed weights in aggregating the factor inputs. That procedure is consistent with a much more limited set of production functions; but, in the existing studies, there is surprisingly little evidence of major changes in factor shares over time. Instead, most of the debate has been about the absolute level of the capital share. Within the industrial countries, the disagreements are largely reconcilable if we

relate them to differences among the studies in the breadth of the definition of capital and the specific sectors

of the economy that are included.[39] For definitions of capital and output close to ours, Maddison found that

capital's share of income in the major industrial economies was closely clustered around 0.3[40] Englander and

Gurney calculated factor-share ratios, adjusted for the self-employed, for the business sector of the OECD

countries and found that capital's share varied between 0.30 and 0.35, and was largely free of trend.[41]

For the developing economies, there has typically been a much broader range of variation. In those

situations where national accounts data exist, the reported capital shares are usually well above those of the

industrial countries, but the difference is heavily influenced by the large role of the self-employed, whose

income is included with that of capital.[42] Furthermore, it could be a mistake to attribute the higher share to

the greater importance of capital in the developing economies. For example, capital's contribution could be

overstated if developing countries systematically suffer from weaker competition and a greater role for

monopoly profits.

Parametric estimates, however, also have generally found that the capital elasticity is higher in

developing economies. For example, Kim and Lau obtained capital elasticities in excess of 0.4 for the Asian

NICs, compared to values near 0.3 for the industrial countries; and Harrison obtained coefficients in excess of

0.4 for a larger set of developing economies.[43] There are good reasons, however, for believing that the

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[39]Denison, for example, typically assigned a low weight to capital because he focused on output net of depreciation and excluded some of the most capital intensive sectors, such as housing. The studies by Jorgenson and his various co-authors, in contrast, used gross output and often included consumer durables in capital.

[40]Maddison (1987), p. 659.

[41]Englander and Gurney (1994). They used the average factor share in each country to construct their TFP indexes.

[42]In his estimates for four Asian economies (1994), Young estimated the factor shares with detailed adjustments for the self-employed. For the period of 1960-90, he obtained a capital share of 0.32 for Korea, 0.29 for Taiwan, 0.53 for Singapore, and 0.37 for Hong Kong. The share appeared to be constant over time for Taiwan and Singapore, falling slightly for Korea, and rising for Hong Kong.

[43]Kim and Lau(1994) and Harrison (1996). See as well Page (1994).

parametric estimates will be biased upward.[44]

We believe that the existing literature supports a plausible range for the capital share of 0.3 to 0.4; and there is also considerable evidence for the argument that the capital elasticity is higher in the developing economies. However, to minimize concern about methodological differences in our comparison of East Asian growth with that of other regions we opted to use a uniform capital share of 0.35 for the entire sample. We have also treated the benefits of education (H) as being embodied in workers, so that the basic production relationship is of the form:

$$(7) \quad Q = AK^{\alpha}(HL)^{(1-\alpha)}, \text{ where } \alpha = 0.35.$$

Thus, we report our results in a form that decomposes the growth in output per worker (q/l) into the contribution of increased capital per worker (k/l), education (h), and total factor productivity (a):

$$(8) \quad q/l = \alpha(k/l) + (1-\alpha)\,h + a,$$

Sources of East Asian Growth

The growth in output per worker, separated among the contributions of increases in physical capital per worker, education, and total factor productivity, is reported in table 3 for the eight East Asian economies over various sub-periods. For comparison purposes, regional aggregates are reported in table 4. We separated China from the rest of Asia both because of its size and questions about the accuracy of the underlying national accounts data. The United States is also reported separately because of the interest in the comparison of East Asia today with the non-U.S. industrial countries during their period of rapid catchup with the productivity standards of the United States. An alternative perspective is provided in the graphical summary of the regional indexes on an annual basis in figure 2 -- again, with a division of growth in output per worker between the contribution of increased capital per worker and TFP.[45]

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[44]Some evidence is provided in Benhabib and Spiegel (1994), pp. 169-173.

[45]Capital-labor subustitution is defined to include education as part of capital.

The results are interesting in several respects. First, as stressed by Alwyn Young, it is quite surprising to note the extent to which the extraordinary growth of East Asia has been driven by factor accumulation, with rather ordinary gains in TFP.[46] In fact, the division between factor accumulation and TFP growth is actually tilted more toward the former by the extension of the analysis to cover a larger number of East Asian countries. While it might be tempting to argue that developing economies can make rapid strides forward by simply accelerating the pace at which they adopt the more efficient technologies of the industrial countries, this does not appear to be an important aspect of the Asian success story. The estimated growth of TFP for the region, 1.1 percent per year over the full 34-year period, is about the same as that of the non-U.S. OECD, and only marginally above that of South Asia. Gains in TFP account for only one-fourth of the region's growth in output per worker over the last three decades. The situation may be changing as there is some evidence of more extensive gains in TFP in the 1984-94 period. There are also some important differences among the individual countries -- TFP growth is higher for Taiwan, and the poor performance of the Philippines does pull down the average.

However, there is a qualification in that, while the rate of TFP growth in East Asia may seem low in an absolute sense, it is far better than that achieved by the other regions. It has been negative in Africa and the Middle East, and nearly zero in Latin America. The real surprise is that TFP growth is low in all of the developing countries. We would have expected that the ability to borrow existing technology and management knowhow from the advanced industrial nations would make the process easier for those who come after. That does not appear to be true.

Second, the contribution of educational advances, if adequately measured by wage differentials, is larger in East Asia than in other regions, but still a relatively minor part of the story. Its contribution is largest for Korea and Taiwan; but the intra-regional variation is small. If there were large spillover effects,

[46]Our results for Korea, Singapore and Taiwan are very similar to those of Young once allowance is made for our inclusion of the agricultural sector.

taking account of education raises additional questions about the modest growth of TFP because the

spillovers would be reflicted in larger TFP gains for countries, such as East Asia, with major improvements in

education.

Furthermore, East Asia does stand out in the extent to which the countries of the region have

avoided the large reversals of TFP growth that are common elsewhere, such as Latin America in the 1980s

and the Middle East since the mid-1970s. This is particularly evident in the late 1970s and early 1980s,

when the global oil and financial shocks and war were so costly to other regions. The major East Asian

countries righted their economies and resumed growth more quickly that elsewhere. This aspect is most

evident in Figure 2.

In addition, there does seem to be some basis for questioning the magnitude of growth reported for

China in the 1980s because the size of the gain in TFP is so large and out of line with that experienced by the

other East Asian economies at similar stages of their development. Only in China do we find a contribution

of TFP growth that exceeds that of capital per worker. In their latest update of the Penn World Table,

Summers and Heston have argued that the official estimates of China's GDP understate the level of output

and overstate it growth.[47] Some support for their basic point that inflation is underestimated, and thus growth

overestimated, is provided in a recent article that concludes that output growth in the industrial sector has

been overstated.[48] In addition, it is consistent with the puzzling decline in the reported Chinese real exchange

rate, which is today about one-third of its 1980 value. Real depreciation might be expected as part of the

process of economic liberalization; but the magnitude and sustained nature of the decline is a surprise.

Generally, real exchange rates rise with development. In China's case, the decline in the exchange rate has

been large enough to eliminate any evidence of real growth in the dollar-denominated measure of GDP. One

explanation for such a result would be an underestimate of the inflation rate in the official statisitics,

[47]Summers and Heston (1994).

[48] Jefferson, Rawski, and Zheng (1995)

overstating real growth. The growth of the Chinese real GDP in the Penn World Tables is about the same as that of the official data for the 1960-80 period, but for 1980-92 the growth rate drops to an annual rate of 5 percent compared to the 9 percent rate that we have used.

Among the other regions, South Asia seems to have enjoyed considerably better productivity performance in the 1980s after a decade of very weak performance. A larger portion of the growth of these economies has been the result of improvements in TFP than is true for East Asia. Africa stands out as a very sad case in which output/worker has increased by an average of only 0.5 percent over the past three decades, and TFP growth has been highly negative. Finally, the 1980s may have been a lost decade for Latin America from the perspective of growth in output per worker, but there is an even longer history of low rates of growth in the TFP component. In fact, it is interesting that all of the regions of the world, except East Asia, experienced a sharp slowing of growth after the 1973 oil crisis from which they have yet to recover.

We recomputed the accounts using alternative values for the capital elasticity of 0.3 and 0.4. Those results, together with the alternative 12 percent return to education, are summarized in appendix table 4. As a region, East Asia stands out with the greatest sensitivity to the choice of the parameter values because it has the highest rates of both physical capital accumulation and educational attainment. An increase in the weight attached to physical capital accumulation increases its contibution, and reduces the residual contribution of TFP, by 0.6 percent per year over the 1960-94 period. An increase in the assumed return to education from 7 to 12 percent would further reduce the contribution of TFP by 0.4 percent. Overall, the contribution of TFP could range from a high of 1.4 percent per year to a low of 0.4. We interprete this result as implying that even more extreme values would be required to fundamentally change the conclusion that growth in East Asia is dominated by factor accumulation.

Productivity Growth Versus Capital Accumulation

By now, it is clear that the Asian economies are different in terms of their overall output growth, but there is considerably less agreement about why. Their success has generated a vast empirical literature directed toward explaining the source of their growth; but that research has not eliminated the controversy. In part, the continued controversy results from the difficulties of using cross-national analysis to identify key correlations between aggregate output growth and various policy measures. The regression analysis, in particular, has been frustrated by the instability of results in the face of seemingly minor changes in specification.[49] In addition, growth and its proximate determinants are all endogenous elements, making it hard to infer causality.

Similar questions could be raised about our decomposition of growth in output per worker between capital accumulation and TFP growth. Distinguishing between the two could be difficult for at least two reasons. First technical advances might be embodied in new capital. Second, by raising the returns to capital , increased TFP might induce greater capital accumulation. Thus, as a point of departure, it is worth asking whether the growth-accounting exercise has actually yielded a meaningful division among the components, and whether it allows us to say anything more definite about the dimension in which East Asia differs from other countries.

As one approach to these issues, we use regression analysis to relate economic growth to some basic measures of initial conditions and the external environment. We then attempt to determine the extent to which, conditional on these basic determinants, the East Asian growth experience differs from that of other economic regions. The same exercise is then performed on the two components, factor accumulation and TFP growth.

In developing the measures of initial conditions we have borrowed heavily from prior work by Barro

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[49]Levine and Renelt (1992).

and Lee.[50] We were able to replicate the essential features of their statistical results for our different sample of countries and somewhat different measure of output per worker.[51] The basic measures are listed in table 5. The initial level of income per capita, in international prices, is included to capture the phenomena of catchup; and life expectancy and years of schooling are included as measures of health and education. Variations in the external environment are represented by the mean and standard deviation of the annual change in each country's terms of trade -- defined as the ratio of the price index of exports over the price index of imports, both measured in dollars.

As shown in column (1) of table 6, these conditioning variables account for nearly half of the cross-national variation in per capita GDP growth for the 1960-94 period. Except for the convergence measure, however, they do relatively little to explain why the East Asian economies has grown faster than the average -- the East Asian means of the conditional variables, shown in table 5 do not differ significantly from those of the total sample. They do, however, highlight some important regional differences. Comparing East Asia and Latin America, about one-fourth of the gap in growth rates can be attributed to differing magnitudes of terms-of. trade shocks. In contrast, differing external conditions explain little of East Asia's rapid growth relative to South Asia. Higher East Asian education and life expectancy, however, are worth about one percent per year of higher growth.

The consequences of adding fixed regional effects are reported in column (2). Relative to the base region, East Asia, the others have considerably lower growth rates. The difference is small for the industrial countries; but it is very large, three percent per year, for Latin America and Sub-Sahara Africa. The regional effects also reduce the significance of education and the terms of trade, while raising the overall adjusted R^2

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[50]Barro and Lee (1994b).

[51]We did not find any role in our data set for Barro-Lee measure of revolutions and political instability and it is excluded from the following analysis. We also do not attempt to differentiate between the role of male and female education levels. The most important difference in the dependent variable is that we use adjust for changes in labor force participation by using GDP per worker as the dependent variable. Barro and Lee used per capita GDP. In addition, the initial income level is measured as a percent of per capita income of the United States.

to 0.66.

The contribution of capital accumulation is included as a right-hand side variable in column (3).
Recognizing that it is likely to be highly endogenous, the regression can be interpreted as indicative of
whether the growth accounting has resulted in a meaningful measure of the contribution of capital
accumulation. It is reassuring to note that the coefficient on the capital accumulation term is not significantly
different from unity and that it raises the R^2 to 0.74.[52] Column (4) reports the result of substituting the
investment rate for the capital accumulation term. The use of the investment share as a proxy for capital
accumulation results in a much lower overall adjusted of 0.52, leaving a much larger residual estimate of the
contribution of productivity gains to economic growth.[53]

The remaining columns of table 6 report the results from parallel regressions for the contributions of
capital accumulation and TFP growth. Here it is interesting to note that, while the set of conditioning
variables expalains a significant portion of the variation in both capital accumulation and TFP growth, the
regional are very large and significant for capital accumulation, but marginal for TFP growth. The addition
of the regional variables raises the R^2 by 0.33 for capital accumulation, but by only 0.04 for TFP growth.
Because the regional effects are measured relative to East Asia, the interpretation is that East Asia stands out
from the other regions in the magnitude of its capital accumulation, but not for TFP growth. Furthermore, as
shown in equation(9), the measure of capital accumulation is essentially orthogonal to the estimate of TFP
growth.

These same issues of the relative importance of TFP and capital formation also come up in a slightly
different context as part of the new endogenous growth theory literature. In many of these models, TFP and
capital per worker are expected to be highly correlated, both across countries and over time. The conclusion

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[52]Combining the capital accumulation term with fixed regional effects results in a coefficient of 0.95, and only the regional
measure for Latin America retains statistical significance.

[53]The regression is based on using the investment share in international prices. The national price measure results in an even
lower R^2 of 0.47.

from the regression analysis that, controlling for differences in initial conditions and the external

enviornment, growth in TFP is largely orthogonal to that of capital per worker is surprising.

It is important to note that the correlation between TFP growth and factor accumulation is sensitive

to the choice of the capital elasticity. Assuming a higher capital share tends to reduce the residual measure of

TFP growth and consequently to lower the correlation between productivity and accumulation. Our

assumption of 0.35 is a relatively low estimate for the non-industrial economies, however. Thus, if anything

we would expect the correlation to be overstated in our data.

The issue of correlation is explored more fully in the individual panels of figure 3. First we look at

the industrial countries and distinguish between the experience of 1960-73, when many of these countries had

high rates of investment and were actively engaged in catching-up with the technological leader -- the United

States., and the post-1973 period of a common growth slowdown. We expect to find a positive correlation

between TFP growth and capital accumulation. Previous studies have reported high correlations, both over

long time periods and in recent decades.[54] And, indeed that is exactly what emerges in our data for the pre-

1973 period. However, the correlation is modest -- an R^2 of 0.28. In contrast, panel b shows no evidence of a

relationship after 1973. Some reduction of the correlation might be expected as marginal returns on

investments are equalized, and the gap between the leader and the followers is reduced. Those projects with

the largest advance in technology presumably have high relative returns and would be among the first ones

undertaken everywhere. Thus, TFP growth would not be reflected in variations of investment at the margin.

Still, the disappearance of the relationship is quite surprising.

The story for the non-industrial economies is essentially the opposite of that for the OECD. Before

1973, we find no correlation between TFP growth and capital accumulation (panel c). Again, it is evident

that, while the East Asian economies exhibit relatively high capital accumulation, they are not unusual in

terms of productivity. After 1973, a modest correlation emerges, but it is largely the result of developments

[54]Baumol and others (1989), Wolfe (1992) and Grossman and Helpman(1994).

outside of East Asia: capital accumulation declined and TFP collapsed. Meanwhile, East Asia continued to accumulate capital rapidly and to maintain moderate rates of productivity growth.

These results are strikingly supportive of Alwyn Young's argument, discussed in the introduction. The East Asian economies are unusual primarily in the dimension of their capital accumulation, not TFP growth. The regional coefficients are highly negative and significant for overall growth and capital accumulation; but they are small and largely insignificant for TFP growth. This outcome is not very encouraging for either the argument that the East Asian experience reflects the benefits of open, liberalized markets, or that it illustrates the efficiency gains of an activist government industrial policy. Most of these policies are expected to operate through affecting the level and growth of TFP; but there is little about the behavior of East Asian TFP to be explained. Instead, it appears that the East Asian economies do well because they are willing to make the sacrifices necessary to accumulate capital at very high rates.

The Role of Government

The role of government has emerged as the most controversial aspect ot the East Asian growth experience. The debate is not about whether policy mattered, but over which measures paid off and their relative importance. We cannot hope to resolve these issues; but we do believe that there has been inadequate attention to assesing the channels through which policy operated, and that the growth accounts provide a basis for distinguishing between the effect of policies on factor accumulation versus improvements in the efficiency with which they were used. Indeed, the prior analysis suggests that any claims that the policies "worked" by generated large gains in productivity should be viewed with suspicion.

Government is often cited as playing a major role in the turnaround of a region whose economic prospects seemed dismal in the early 1960s. Growth was slow. Most had very low rates of saving and investment. Some were heavily dependent on foreign aid. At the time, external assessments of East Asia's prospects were typically very pessimistic relative to those for Latin America and Africa. Indeed, one World

Bank study considered the Philippines the most likely to "succeed.".[55] Subsequently, each of the high-performing East Asian countries has initiated significant policy changes since the early 1960s -- although there has been considerable cross-country variation in both the timing and in many features of the policies implemented, as discussed further below. In the following decades these economies all took off. While many experienced difficulties along the way, the rapidity and persistence of their growth has been phenomenal.

The policy measures that have been suggested as contributing to East Asia's success can be divided into two groups. The first comprises policies which are now generally agreed to have played a positive role. These include stable macroeconomic policy (albeit, defined in somewhat different ways) as well as the promotion of education. These policies are generally viewed as contributing to growth through positive effects on both capital accumulation and productivity gains. The second group includes policies which have been more controversial. Trade policy (more specifically, openness or outward orientation) is often cited as a central element in the region's success; however, definitions of openness vary widely, and there are a range of views on its importance. Most controversial are different types of selective intervention pursued to varying degrees among countries in the region and over time. Since export promotion was often one of the objectives of intervention, there is some overlap between intervention and outward orientation.[56]

It is striking that the controversy focuses on the role of policies which are presumed to operate through the channel of promoting growth in TFP. As one analyst phrases it "Central to the debate ... is industrial policy, defined as government efforts to alter industrial structures to promote productivity-based growth."[57] However, a clear implication of our decomposition is that this debate is misplaced. The search

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[55] World Bank (1993b, p.14).

[56] There is a very large literature assessing the role of policy in rapid East Asian growth. Additional references are provided in the works cited below. Recent studies that emphasize the importance of "market friendly" policies include World Bank (1993) and Krueger (1995). Studies that stress the effects of selective intervention include Amsden (1994) and the papers in Fishlow and others (1994). Views about the importance of outward orientation range from Sachs and Warner (1995) who argue that it is the most important element of government policy, to Rodrik (1994, 1995) who argues that export orientation could not have played a significant role.

[57] Kwon (1994).

for lessons from high Asian growth should focus on explaining the magnitude and persistence of capital accumulation, not on productivity gains.

It is also striking that the same group of successful economies has been used to illustrate the purported benefits from extremely different -- and conflicting -- policy strategies. Those Western economists who tend to stress the benefits of free markets frequently cite East Asia as evidence that a relatively laissez-faire approach pays off. According to this view, the economies prospered due to the establishment of relatively open trading regimes and other "market-friendly" policy reforms. In contrast, Asian economists and policy makers are more likely to describe their underlying policy strategy as one of sequential industrial targeting, based on the Japanese model initiated in the 1950s.[58] Yet, neither they nor most Western economists would classify Japanese policy during 1950-70 as an example of a "market-friendly" approach.

For a variety of reasons, it is difficult to draw definitive conclusions about precisely which policies worked and why. Groups of policies are often implemented together, confounding efforts to tease out the separate effects of individual policies. Cross-country (or panel) regression studies require simple indicators of policy that may do a poor job of capturing actual differences and suffer from measurement error. Arguably, the available measures of trade regime and industrial targeting -- the areas of most controversy -- are even more suspect than measures of fiscal, monetary and exchange rates policy. The fact that most policy variables should be considered endogenous makes causal interpretations of these regressions suspect. On the other hand, while case study approaches can provide much clearer pictures of what happened in individual (or small groups of) countries, they typically provide inadequate "checks" on the conclusions, since they provide limited comparison with performance in other countries that pursued similar policies. However, it is interesting to note that the detailed studies highlight disparities among policies followed by the high growth

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[58] Ito (1992, 1994), Singh (1994)

East Asian countries. We focus below on the roles of macroeconomic policies and trade policies.[59] The

remainder of this section, first provides some background information about the initial situation, policy and

performance in East Asia. It then turns to an empirical analysis of the links between policy and economic

growth.

East Asian Policy: An Overview

As a starting point, it is important to recognize that East Asia is composed of a very diverse set of

countries. Only a Westerner would lump them together as homogeneous! The population data in Table 1

show the considerable range in size from a tiny city state (Singapore) to small countries (Malaysia and

Taiwan), moderate sized countries (Korea, Thailand and the Philippines) and the relatively populous

Indonesia. While countries such as Korea are relatively resource poor, others such as Indonesia are richly

endowed with natural resources, facing the special problems of commodity booms and busts. The fact that

Indonesia comprises thousands of islands raises another unique set of issues. Korea is ethnically quite

homogeneous, but the same cannot be said of Malaysia.

Prior to the onset of rapid growth, there was considerable regional variation in terms of economic and

social conditions. The seven countries were at very different developmental stages. Per capita incomes in

Singapore and Malaysia were substantially higher than in Korea, Thailand or especially Indonesia. (Table 1)

Indonesia and Thailand began with very high percentages of their labor force in agriculture (62% and 75%

respectively). Korea and Taiwan had relatively high initial levels of education, but in 1965, average years of

schooling were only 1.6 and 2.8 in Indonesia and Malaysia. (Table 5) The region's income distribution is

typically characterized as relatively equitable.[60] But on average, income inequality in East Asia is similar to

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[59] Analysts have considered a variety of additional policies, including financial market policy, infrastructure development, and exchange rate regime.

[60] Deininger and Squire (1996) report data for income shares of the top relative to the bottom quintile in a variety of countries. According to this indicator, the most equitable East Asian countries are Taiwan, China, Indonesia, and Thailand, with ratios of 4.5-5.5. Korea and Singapore are somewhat less equitable, with ratios of 6.3-6.7 Least equitable are the Philippines (12.0)

that in South Asia and in the Middle East. Malaysia, like the Philippines, has quite high income inequality, comparable to that in Latin America. Only Korea and Taiwan began with highly equitable income distributions -- the others enjoyed rising equality along with rapid growth.

The seven countries are now frequently cited for high rates of investment and saving. However, most began with low to moderate investment and saving rates. Dramatic increases in, particularly saving rates, are a hallmark of their successful development. Similarly, exports were initially modest shares of GDP, and very rapid export growth is another striking feature that they have in common.

There are also both similarities and differences in the policies pursued in the region.[61] Overall, East Asian countries have tended to follow prudent macroeconomic policies. (Table 7) Average fiscal deficits have been low, limiting the need for inflationary finance. Public saving rates have been relatively high. Inflation rates have tended to be moderate (though not exceptionally low); real interest rates have been quite stable; and black market exchange rate premia have been very low.

The broad averages mask considerable cross-country diversity. Budget deficits have not always been small, nor have inflation rates consistently been in single digits. In Thailand, the central government deficit ranged from 3.5 to 6.5 percent of GDP during the nine years from 1978 to 1986. Malaysia's budget deficit reached 15.5 percent of GDP during 1981-82, and averaged 6.9 percent over 1960-92. CPI inflation averaged 20 percent per year during 1974-81 in Korea, and reached as high as 40 percent per year in Indonesia. However, a key feature of these experiences is that surges in budget deficits or inflation were reversed relatively quickly -- governments adjusted policies promptly when indicators got far out of line. Consequently, economic crises in the high performing East Asian countries appear to have been shorter and less severe than many of the crises experienced elsewhere. These countries do not show that moderate but

and Malaysia (14.2). The regional average is 7.2 in East Asia, comparable with 5.6 in South Asia, 6.7 in the Middle East, 9.8 in Africa, 14.3 in Latin America and 6.3 among industrial economies.

[61] For summaries of the range of policies pursued in each of the high growth Asian countries, see World Bank (1993) and its extensive references.

persistent inflation or budget deficits are inconsistent with long periods of rapid growth, or that there is any need for pre-occupation with doctrinaire targets, such as zero inflation, or budget surpluses; but, for the most part, they have avoided the extremes. Overall, our reading of the East Asian experience in terms of macroeconomic policy and performance is similar to that of Fischer.[62]

The governments in the region promoted broad-based educational increases, through the allocation if not the level of public spending.[63] Government expenditures tended to be concentrated on the lower grades, particularly while literacy rates were still low. Spending at the post-secondary level was limited, and focused on strengthening technical skills. As we have seen, East Asian countries did achieve impressive increases in the educational attainment of their populations. At the same time, our accounting decomposition implies that the direct effect of increased schooling for growth was modest, contributing perhaps 0.2% and 0.4% to annual growth in East Asia, relative to growth in Latin America and Africa respectively. However, these figures do not factor in the potentially significant positive implications for per capita growth rates from the effect of increased education on lowering population growth rates.

In the early 1960s, trade policies in all of the East Asian economies (except Hong Kong) could be characterized as promoting import substitution, with strong biases against exports. Following Japan's example, each shifted away from this inward-looking development strategy towards an outward-oriented strategy based on promoting especially manufactured exports. Korea, Singapore and Taiwan made the switch during the mid to late 1960s. However, like Japan, Korea and Taiwan initially maintained significant protection of their domestic markets, and promoted exports through a variety of selective measures, such as export credits and tax incentives. The move away from extensive usage of selective measures is quite recent. Korea's " big push" to develop heavy and chemical industries during the 1970s stands out as an example of very intensive intervention. While Korean development has been associated with very large, conglomerates,

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[62] Fischer (1993).

[63] Compared with other countries, government spending on education is moderate in Taiwan, Singapore and Korea.

Taiwanese exporters are primarily small and medium sized firms. Indonesia, Malaysia and Thailand shifted

to export promotion strategies in the early 1980s. Their approaches tended to employ less targeted

intervention, but in all cases, some selective measures were used to promote targeted industries. Finally, all

of the countries encouraged capital goods imports, licensing arrangements and training abroad as means to

transfer more efficient technologies from the industrial countries. However, foreign direct investment was

welcomed in Malaysia, Singapore and more recently in Indonesia and Thailand, but heavily restricted in

Taiwan and especially Korea.

Regression Analysis

The association between policies and growth is explored more formally with regression analysis. A

new feature is our usage of the components of growth -- capital accumulation and TFP changes -- as

dependent variables, enabling us to study the channels through which the various policies are presumed to

operate. Following the existing literature, we concentrate on macroeconomic policy and on outward oriented

trade policy.

Our choice of indicators of macroeconomic policy is heavily influenced by prior studies of Barro and

Lee and Fischer.[64] In particular, we focus on the average budget balance as a share of GDP (1960-92) as a

broad measure of fiscal discipline, and on the variability of the real exchange rate (1960-92) as a measure of

the stability of macroeconomic policy.[65]   While fiscal data were available for all but one country in our

sample (Sudan), these data come from different sources, raising issues of comparability and data quality. The

measures of fiscal balance for industrial countries come from OECD statistical files, and tend to be close to a

standard national accounts concept of the general government sector. In most cases, data for developing

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[64] Barro (1991), Barro and Lee (1994b), and Fischer (1993).

[65] In previous work, we considered other macroeconomic policy indicators such as the average level and change in the real exchange rate, the average level and standard deviation of inflation, and the share of government consumption in GDP. See Bosworth et. al. (1996).

economies come from the International Financial Statistics or previous World Bank Studies, and are based on the concept of the consolidated general government budget. In a few cases, data are based on the broader concept of the public sector budget.

The real exchange rate measure is based on the international price of consumption goods from the Penn World Tables; and as such, it provides an indicator of under- or over-valuation relative to purchasing power parity. There is, however, a general tendency for the relative price of consumption goods to increase with income. Thus, we followed the procedure developed by Dollar[66] to adjust our series for this systematic bias. The international price of consumption, converted to U.S. dollars using the standard exchange rate, was regressed on the ratio of each country's per capita GDP relative to that of the U.S. Residuals from this regression were used as adjusted prices. Each country's real exchange rate is then its adjusted price level relative to a sample average, which is constructed using trade weights. We also included various measures of the level and stability of inflation. However, these were consistently insignificant in the regressions.

Alternative trade policy measures can be divided among three types.[67] The first are direct measures of tariff and non-tariff (NTB) barriers.[68] The second type of measures are those based on trade flows. Actual imports and exports will differ across countries because of country size, factor endowments and other features that have nothing to do with policy stance. Thus, it has become common to estimate a "gravity" or a structural model of trade flows, and to assume that the regression residuals reflect the underlying policy stance.[69] Finally, a number of authors have constructed qualitative indices of trade policy, based on a variety of underlying indicators. These tend to enter growth regressions with large and very significant coefficients

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[66] Dollar (1992).

[67] See Bosworth et. al. (1996) and the references therein for further discussion.

[68] NTBs, arguably more important than tariff barriers in terms of industrial targeting, are notoriously difficult to measure. Further, comparable, comprehensive figures (from UNCTAD) are for the mid 1980s, not the period at the beginning of East Asia's economic take-off.

[69] This procedure can be applied to total imports, or to categories such as imports of consumer versus capital goods. However, adjusted trade flow measures tend to have low correlations with direct trade policy measures, and are likely to be endogenous. In any case, the association between adjusted trade shares and output growth does not appear to be robust.

compared with direct and trade flow measures. Sachs and Warner[70] have recently developed one such

measure. They define a country as closed if any of five conditions applied during 1970-89, and open

otherwise. The conditions are: (1) NTBs covering at least 40% of trade, (2) average tariff rates of at least

40%, (3) an average black market premium of at least 20% during the 1970s or the 1980s, (4) a socialist

economic system, or (5) a state monopoly on major exports.

While our previous work has employed all three types of trade policy measures, our discussion below

focuses on the results based on the Sachs and Warner measure of openness for two reasons.[71] First, it is

available for 83 of our countries,[72] while alternative indicators necessitated much greater reductions in sample

size. Second, we wished to further explore the significance of trade policy measures that previous analyses

have found to be especially important. At the same time, we recognize difficulties with categorical measures.

They force stark distinctions among countries, and it is unclear whether these really reflect underlying

differences in trade policy per se.[73] They do not capture underlying differences in the nature and extent of

selective government interventions at the industry level. Finally, the problem of endogeneity may be

especially acute for indicators such as Sachs and Warner that place a heavy weight on the premium (or

discount) in the foreign exchange black market. This variable is likely to be very reflective of a country's

general economic condition.

Table 7 provides means of the macroeconomic and trade policy indicators for individual East Asian

countries and for our regional groupings. As shown, real exchange rates were relatively stable in East Asia.

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[70] Sachs and Warner (1995).

[71] Our own analysis finds that neither the tariff nor the NTB measures were significantly associated with growth or its components. We find some evidence that an adjusted measure of capital goods imports as a share of GDP is associated with more rapid capital accumulation, but no evidence of any link with productivity growth. Finally, an alternative qualitative indicator constructed by the World Bank (1987) produces similar results to those using the Sachs and Warner indicator. All of the results reported above are based on sub-samples of our data. (See Bosworth et. al, 1996.)

[72] The 83 country sample excludes Iceland, Malta, Panama, South Africa and the Sudan.

[73] The Sachs and Warner openness indicator is as strongly correlated with our macroeconomic policy indicators (budget surplus and real exchange rate stability) as with the direct trade policy measures (tariff and non-tariff barriers).

The region was characterized by low average budget deficits, comparable to those among industrial countries, and less than half of the level in Latin America, and elsewhere. Finally, East Asia stands out as extremely open, based on the Sachs-Warner indicator. Focusing on the variable OPENP, defined as the percentage of country years classified as open during 1970-89, East Asia (74%) is second to the industrial economies (90%), and considerably more open than the Middle East (37%), the third most open region. Few if any countries in the other regions are classified as open over the entire period.   While subject to the problems mentioned above, this indicator is very successful in singling out the East Asian economies.

Regression results are reported in Table 8.[74] The role of macroeconomic policy is considered first. As shown, countries with smaller budget deficits and more stable real exchange rates tended to grow more rapidly. However, the two elements of policy work through very different channels. Budget surpluses are strongly associated with more rapid accumulation of capital per worker, while real exchange rate stability is associated with productivity growth.

Like Sachs and Warner, we also find that openness during the 1970s and 1980s was strongly associated with growth. Their interpretation is that an open trade policy is the most important element of overall economic policy. If and only if poorer countries are open will they tend to grow more rapidly than richer countries, and to catch up. Further, they argue that the main reason to expect convergence of open economies is that poorer countries can import capital and modern technology from wealthier ones, reaping "the advantages of backwardness."[75] Our results create some difficulty for this interpretation, because the openness variable adds nothing to the explanation of differences in productivity growth. (Column 8) All of its influence comes through a positive effect on accumulation of capital per worker. (Column 5) To the extent that the openness indicator is assumed to capture outward orientation, the lack of evidence that this

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[74] These regressions are all based on a sample size of 83. For comparison purposes, the regressions with initial and external conditions were redone for the 83 country sub-sample, with only minor changes in the results.

[75] Sachs and Warner (1995), pp. 2-3.

policy stance is linked to the transfer of more efficient production techniques is striking.

Overall, the macroeconomic policy and openness measures account for about one third of the difference in growth performance between East Asia and other developing regions. That is, the size of the regional dummy variables in column 3 are about one-third smaller than the regional effects in column (2) of Table 6. Further, the reduction is evenly divided between capital accumulation and TFP growth.

Concluding Thoughts

Our examination of the data for East Asia leaves us with several major questions. The first two follow from the finding that East Asia differs in the magnitude of it capital accumulation but that the gains in productivity have been quite ordinary. First, why has TFP growth been so moderate given the obvious opportunities to simply copy the technologies of the industrial economies; and, second, what enabled the East Asian economies to achieve and maintain such high rates of capital accumulation? The third question is that raised by Paul Krugman: if past growth has been the result of capital accumulation, does not the law of diminishing returns suggest a sharp slowing of growth in the future. Finally, a finding of a limited role for TFP growth, raises questions about the relevance of much of the new growth theory, with its suggestion that the transfer of ideas provides a less costly means of economic catchup than the past emphasis on capital accumulation. In the remaining sections we briefly examine each of these issues.

Why Was TFP Growth So Modest?

Previous growth accounting studies have found large contributions from TFP for industrial countries that enjoyed periods of rapid output growth.[76] We find similar TFP contributions for industrial countries in the earliest period of our sample. Table 4 shows that the average contribution of TFP to growth of output per worker during 1960-73 was 2.1 percent among all non-U.S. industrial countries -- more than twice its contribution (0.9 percent) in the U.S.   Six of the seven highest growth industrial countries had annual contribution of TFP to output growth of at least 2.6 percent.[77] A common explanation for these large TFP contributions has been that other industrial countries were "catching up" with the technical know-how in the U.S. Why did East Asia not have a similar experience. Much of the East Asian growth occurred after 1973, when TFP gains were smaller throughout the industrial economies; but, given the magnitude of the technology gap, it is difficult to see why developments at the frontier were of relevance to East Asia. To varying degrees, the East Asian economies followed Japan in pursuing a development strategy which involved sequenced promotion of low, then middle, then high-tech industries. But unlike Japan in the 1960s, their productivity increases have been modest.

One possible explanation is that the potential to adopt knowledge and technology from abroad depends on a country's stage of development.[78] Growth in the early stages may be primarily associated with physical and human capital accumulation, and significant potential for growth through catch-up may only

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[76] For example, Denison (1976) finds that TFP growth contributed from 1.9% to 4.9% per year to growth for nine industrial countries (with at least 3% annual average growth) over various periods between 1948 and 1971. Christenson, Cummings and Jorgenson (1980) find that the contribution of TFP ranged from 1.7% to 4.2% per year to growth for seven industrial countries over the period 1947-73. These TFP estimates are not strictly comparable to the ones we have constructed for a variety of reasons, which helps to explain their magnitudes. In particular, Denison's estimates apply to industrial not aggregate output.

[77] The six countries, with contributions from productivity growth during 1960-73 given in parentheses, are Greece (3.6%), Italy (2.6%), Japan (3.3%), Portugal (3.8%), Spain (3.3%) and Turkey (2.6%). The contribution of TFP growth in Austria was 1.9% All of these countries had growth rates of output per worker of at least 4.8%.

[78] The idea that countries pass through different stages of development and that entering a stage in which growth is characterized by significant technological improvements might require pre-conditions was widely studied in the early economic development literature. For example, see Rostow (1960).   Recent analyses have used modern analytic tools to revisit the potential importance of developmental stages.   For example, Azariadis and Drazen (1990) develop a model of economic growth in which returns to scale rise rapidly once economic characteristics, such as labor quality, reach a critical range.

emerge once a country had crossed a development "threshold". Grossman and Helpman may be correct that, even if "technological progress provides the engine of long-run growth, accumulation will play an independent role during a (perhaps prolonged) transitional phase."[79]

To explore this stages-of-growth explanation, we compared development indicators in 1975 for the East Asian countries with indicators in 1965 for the six industrial countries with the highest TFP growth rates during 1960-73. The Asian countries were indeed less developed than their high-growth industrial counterparts. On average, the industrial countries had more than a year of additional schooling, as well more than three times the amount of capital per worker. Less than a third of their labor force was employed in agriculture, compared with nearly half for the Asian countries. While these comparisons do not provide a formal test, they are consistent with the view that the low TFP growth in East Asia during 1960-94 (or 1973-94) relative to that in high growth industrial economies during the 1960s is due in part to the Asian economies' earlier stage of development. Also consistent with the stages of development hypothesis is that TFP growth accelerated sharply after 1984 in many of the countries.

High Capital Accumulation

The East Asian economies are most remarkable for the magnitude of their capital accumulation. In figure 4 we show the historical pattern of saving and investment as a percent of GDP. While there are obvious differences among the countries, they also share some common features. First, rising rates of national saving occurred throughout the period of accelerating growth, providing a strong example of a virtuous circle in which rising rates of capital formation and growth fed upon one another. Indonesia, Korea, and Singapore began with relatively low rates of saving; and the same would be apparent for Taiwan if the chart were extended back into the 1950s. Certainly, the data do not support a view of a special cultural predisposition toward saving. The large expansion of the saving rate in Singapore was the result of a

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[79] Grossman and Helpman (1994, p. 26).

program of mandated saving and in Thailand the late-1980s surge was concentrated in the public sector; but

for the others, the pattern of rising saving does not seem directly related to any specific government policy.

Most governments have followed very conservative financial market policies, emphasizing the avoidance of

crises and maintaining generally positive real interest rates. Furthermore, open bond and equity markets have

played a relatively minor role in the financing of investment relative to institutional lending.

Second, several of the countries were very dependent upon foreign capital inflows to finance the

initial surge of investment. For Korea, the capital inflow averaged 6 percent of GDP throughout the 1960s

and 1970s. Singapore had an even greater reliance on capital inflows until the mid-1980s. More recently,

both Singapore and Taiwan have experienced a significant falloff in domestic investment and they are

generating large capital outflows.

The Outlook for Future Growth

Paul Krugman, among others, has suggested that East Asia's growth must slow in the future because

of what he saw as an excessive reliance on capital formation. Over time, a high rate of growth of the capital

stock, well in excess of that of output, should result in a falling return to capital, and ultimately lead to the

diversion of investment to other regions. And it is true in figure 4 that we can observe a falling-off of the

investment rate in Singapore and Taiwan. Yet, the other countries continue to be highly popular destinations

for foreign capital, and recent experience does not seem to support any notion of a major slowing of growth.

Some aspects of the outlook are summarized in table 9 where the international price data are used to

construct measures of income and capital per worker on a comparable basis.[80] First, it is notable that, despite

the rapidity of the past growth, most of these countries have a considerable distance to go before they reach

levels of output per worker comparable to the United States. Second, stocks of physical capital per worker

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[80]The data are drawn from the latest version of the Penn World Table, but the estimates of output using comparable
international prices are subject to substantial uncertainty.

are still quite low, generally less than half those of the United States and Japan.

However, Krugman is certainly right that these countries cannot continue to rely on an expansion of the amount of capital per worker in excess of the growth in labor-augmenting technical change, without significant reductions in capital's return. However, the effective labor force will continue to expand as a consequence of improvements in average education levels. Even though young age cohorts in these countries have levels of education comparable to their counterparts in the United States and Japan; the simple passage of time will raise the average educational skill level as older, less-educated workers leave the labor force. On the basis of our simple index, labor quality in these countries is still 20-30 percent below that of the United States. A further basis for optimism is provided by the earlier discussion of an apparent improvement in TFP growth over the last decade. These data do not suggest that these countries have exhausted the potential for 'catch-up.'

As shown in columns (7) and (8) of table 9, all of these countries have experienced a major rise in the capital-output ratio; and the increase would be expected to have driven down the return to capital. Korea and Singapore, for example, now have capital-output ratios comparable to the United States, suggesting that they may face significant limits on future capital accumulation without commensurate increases in TFP; but both are still well short of Japan. Most of the other countries have capital-output ratios, however, that imply a considerable capacity for further capital deepening.

REFERENCES

Amsden, Alice H. 1989. <u>Asia's Next Giant: South Korea and Late Industrialization</u> (New York: Oxford University Press).

___. 1991. "Diffusion of Development: The late-industrialization Model and Greater Asia," <u>American Economic Review</u> 81, No. 2 (May),.282-86.

___. 1994. "Why Isn't the Whole World Experimenting with the East Asian Model to Develop?: Review of the *East Asian Miracle,*" <u>World Development</u>, 22, No. 4, 627-33.

Azariadis, Costas and Allan Drazen. 1990. "Threshold Externalities in Economic Development," <u>Quarterly Journal of Economics</u> (May) 501-26.

Barro, Robert J. 1991. "Economic Growth in A Cross Section of Countries," <u>Quarterly Journal of Economics</u> 106:407-443.

___ and Jong-Wha Lee. 1994a. "International Comparisons of Educational Attainment," <u>Journal of Monetary Economics</u> 32: 363-394.

___. 1994b. "Sources of Economic Growth," <u>Carnegie-Rochester Conference Series on Public Policy</u> 40, 1-46.

Barro Robert and Xavier Sala-i-Martin. 1992. "Convergence," <u>Journal of Political Economy</u> 100, 223-51.

___. 1995. <u>Economic Growth</u> (New York: McGraw-Hill, Inc.).

Baumol, William J., Richard R. Nelson and Edward N. Wolfe. 1994. Editors. <u>Convergence of Productivity</u> (Oxford: Oxford University Press).

Bell, Martin, and Keith Pavitt .1992. "Accumulating Technological Capability in Developing Countries," <u>Proceedings of the World Bank Annual Conference on Development Economics</u> (Washington D.C: The World Bank), pp. 257-82.

Behrman, Jere R. and Mark Rosenzweig. 1994. "Caveat Emptor: Cross-Country Data on Education and the Labor Force," <u>Journal of Development Economics</u> 44:147-71.

Benhabib, Jess`and Mark M. Spiegel. 1994. "The Role of Human Capital in Economic development - Evidence from Aggregate Cross-Country Data," <u>Jouirnal of Monetary Economics</u> 34: 143-73.

Bosworth, Bary, Susan M. Collins, and Yu-chin Chen, "Accounting for Differences in Economic Growth," in Akira Kohsaka and Koichi Ohno (editors) <u>Structural Adjustment and Economic Growth</u>, Tokyo: Institute of Developing Economies.

Card, David and Alan B. Krueger. 1996. "Labor Market Effects of School Quality: Theory and Evidence," in

Does Money Matter? Edited by Gary Burtless (Washington: The Brookings Institution).

Deininger, Klaus and Lyn Squire. 1996. "Measuring Income Inequality: A New Data Base," Harvard Institute for International Development, Working Paper No. 537 (May).

Denison, Edward F. 1967. Why Growth Rates Differ: Postwar Experiences in Nine Western Countries (Washington: The Brookings Institution).

_____ and William K. Chung. 1976. How Japan's Economy Grew So Fast (Washington: The Brookings Institution).

Dollar, David. 1992.

Easterly, William. 1995. "Explaining Miracles: Growth Regressions Meet the Gang of Four,"in Growth Theories in Light of the East Asian Experience edited by Takatoshe Ito and Anne O. Krueger, pp. 267-301. (Chicago: University of Chicago Press and NBER).

Easterly, William, and others. 1993. "Good Policy or Good Luck: Country Growth Performance and Temporary Shocks," Journal of Monetary Economics 32:459-484.

Edwards, Sebastian. 1993a. "Openness, Trade Liberalization, and Growth in Developing Countries." Journal of Economic Literature, XXXI (September):1358-93.

Elias, Victor J. 1990. Sources of Growth: a Study of Seven Latin American Economies. San Francisco: Institute for Contemporary Studies Press.

Englander and Gurney . 1994. "OECD Productivity Growth: Medium-Term Trends,' OECD Economic Studies No. 22 (Spring). 111-130

Fagerberg, Jan .1994. "Technology and International Differences in Growth Rates," Journal of Economic Literature XXXII, No. 3 (September), 1147-75.

Fischer, Stanley. 1993. "The Role of Macroeconomic Factors in Growth," Journal of Monetary Economics 32:485-512.

Fishlow, Albert, Catherine Gwin, Stephan Haggard, Dani Rodrik, and Robert Wade. 1994. Miracle or Design? Lessons from the East Asian Experience. Policy Essay, No. 11. Washington: Overseas Development Council.

Grossman, Gene M. and Elhanan Helpman. 1991a. "Endogenous Growth: Trade, Knowledge Spillovers, and Growth." European Economic Review, 35:517-26. North-Holland.

_____. 1991b. Innovation and Growth: Technical Competition in the World Economy (Boston: MIT Press).

_____. 1994. "Endogenous Innovation in the Theory of Growth," Journal of Economic Perspectives 8, No. 1, 23-44.

Harrison, Ann. 1996. "Openness and Growth: A Time Series, Cross-Country Analysis for Developing Countries," Journal of Developing Economics 48: 419-47.

Hoffman, André. 1993. "Economic Development in Latin America in the 20th Century: A Comparative Perspective." In Explaining Economic Growth, edited by A. Szirmai, B. van Ark, and D. Pilat,241-66. New York: North Holland.

Ito, Takahashi. 1992. The Japanese Economy (Cambridge: The MIT Press).

____. 1994. "Comment" in NBER Macroeconomics Annual Vol. 9 (Cambridge: MIT Press).

___ and Anne O. Krueger. 1995. Growth Theories in Light of the East Asian Experience (Chicago: University of Chicago Press and NBER).

Jefferson, Gary H., Thomas G Rawski, and Yuxin Zheng. 1995. "Chinese Industrial Productivity: Trends, Measurement and Recent Developments," mimeo, Department of Economics, University of Pittsburgh.

Judson, Ruth A. 1996. "Measuring Human Capital Like Physical Capital: What Does It Tell Us?" Federal Reserve Board, Mimeo.

Kim, Jong-Il, and Lawrence J. Lau. 1994. The Sources of Economic Growth of the East Asian Newly Industrialized Countries," Journal of the Japanese and International Economies 8, 235-71.

King, Robert and Ross Levine. 1994. "Capital Fundamentalism, Economic Development, and Economic Growth," Carnegie-Rochester Conference Series on Public Policy 40: 259-292.

Krueger, Anne O. 1978. Foreign Trade Regimes and Economic Development: Liberalization Attempts and Consequences. Cambridge Mass: Ballinger Publishing Company for the National Bureau of Economic Research.

____. 1995a. Trade Policies and Developing Nations. Washington: Brookings Institution.

____. 1995b. "East Asian Experience and Endogenous Growth Theory" in Growth Theories in Light of the East Asian Experience edited by Takatoshe Ito and Anne O. Krueger, pp. 9-36. (Chicago: University of Chicago Press and NBER).

Krugman, Paul. 1994. "The Myth of Asia's Miracle," Foreign Affairs 73 (November/December) 62-78.

Kwon, Jene. 1994. "The East Asian Challenge to Neoclassical Orthodoxy," World Development 22, No. 4, 635-44.

Levine, Ross and David Renelt. 1992. "A Sensitivity Analysis of Cross-Country Growth Regressions." American Economic Review 82 (September):942-63.

Levine, Ross, and S. Zervos. 1992. "Looking at the Facts: What We Know About Policy and Growth From the Cross-country Analysis, mimeo (Washington D.C: The World Bank).

Lucas, Robert. 1988. "On the Mechanics of Economic Development." Journal of Monetary Economics

22:3-42.

Maddison, Angus. 1987. "Growth and Slowdown in Advanced Capitalist Economies: Techniques of Quantitative Assessment," Journal of Economic Literature, (June), 649:98.

___. 1989. The World Economy in the Twentieth Century (Paris: OECD Development Centre).

___. 1994. "Explaining the Economic Performance of Nations, 1820-1989," in Convergence of Productivity edited by William J. Baumol, Richard R. Nelson and Edward N. Wolfe, (Oxford: Oxford University Press).

Mankiw, N. Gregory, David Romer, and David N. Weil. 1992. "A Contribution to the Empirics of Growth," Quarterly Journal of Economics 107:407-438.

___. 1995. "The Growth of Nations," Brookings Papers on Economic Activity, 1995:1, 275-310.

Nehru, Vikram, and Ashok Dhareshwar. 1993. "A New Database on Physical Capital Stock: Sources, Methodology and Results," Revista de Análisísis Económico 8: 37-59.

___. 1994. "New Estimates of Total Factor Productivity Growth for Developing and Industrial Countries," Policy Research Working Paper No. 1313 (Washington D.C: the World Bank).

Nehru, Vikram, Eric Swanson, and Ashutosh Dubey. 1994. "A New Database on Human Capital Stock: Sources, Methodology, and Results," Journal of Development Economics, forthcoming.

Pack, Howard. 1992. "Technology Gaps Between Industrial and Developing Countries: Are There Dividends for Latecomers," Proceedings of the World Bank Annual Conference on Development Economics (Washington D.C: The World Bank), pp 283-302.

___. 1994. "Endogenous Growth Theory: Intellectual Appeal and Empirical Shortcoming," Journal of Economic Perspectives 8, No. 1, 55-72.

Page, John. 1994. "The East Asian Miracle: Four Lessons for Development Policy," in Stanley Fischer and Julio Rotemberg (editors) NBER Macroeconomics Annual, 1994. Cambridge Mass: the National Bureau of Economic Research. 219-69.

Pritchett, Lant. 1995. "Where Has All the Education Gone?" Mimeo (June).

Psacharopoulos, George. 1994. "Returns to Investment in Education: A Global Update," World Development 22, No. 9, 1325-43.

Rodrik, Dani. 1992a. "Closing the Technology Gap: Does Trade Liberalization Really Help?" In Trade Policy, Industrialization, and Development: New Perspectives, edited by G. Helleiner. New York: Clarendon Press.

___. 1994. "Getting Interventions Right: How South Korea and Taiwan Grew Rich," NBER Working Paper No. 4964.

___. 1995. "Trade Strategy, Investment and Exports: Another Look at East Asia," NBER Working Paper No.

5339.

Romer, Paul M. 1986. "Increasing Returns and Long-run Growth," Journal of Political Economy 94: 1002-1037.

____. 1990. "Endogenous Technical Change," Journal of Political Economy 98: S71-S102.

____. 1993."Idea Gaps and Object Gaps in Economic Development," Journal of Monetary Economics 32 (December) pp. 543-73.

____. 1994. "The Origins of Endogenous Growth," Journal of Economic Perspectives 8: 3-32.

Rostow, Walter. 1960. The Stages of Economic Growth (Cambridge: Cambridge University Press).

Sachs, Jeffrey D. and Andrew Warner. 1995. "Economic Reform and the Process of Global Integration." Brookings Papers on Economic Activity, 1:1994, pp. 1-118.

Singh, Ajit. 1994. "Openness and the market Friendly Approach to Development: Learning the Right Lessons from Development Experience," World Development 22, No. 12, 1811-23.

Solow, Robert. 1956. "A Contribution to the Theory of Economic Growth," Quarterly Journal of Economics 70: 65-94.

____. 1957. "Technical Change and the Aggregate Production Function," Review of Economics and Statistics 39: 312-20.

Summers, Robert, and Alan Heston. 1991. "The Penn World Table (Mark V): An Expanded Set of International Comparisons 1950-88," Quarterly Journal of Economics 106: 327-368.

Syrquin, Moshe and Hollis Chenery. 1989. "Three Decades of Industrialization." World Bank Economic Review 3 (2):145-81.

United Nations Conference on Trade and Development. 1987. Handbook of Trade Control Measures of Developing Countries. New York: United Nations.

Wade, Robert. 1990. Governing the Market (Princeton: Princeton University Press)

World Bank. 1987. World Development Report. Washington, D.C.: The World Bank.

____. 1991. World Development Report. Washington, D.C.: The World Bank.

____. 1993a. The East Asian Miracle: Economic Growth and Public Policy. Washington D.C: World Bank.

____. 1993b. Sustaining Rapid Development in East Asia and the Pacific. Washington D.C: World Bank.

____. 1993c. "National Policies and Economic Growth: A World Bank Conference," Journal of Monetary Economics 32: 363-573.

____. 1995. <u>World Development Report</u>. Washington, D.C.: The World Bank.

Young, Alwyn. 1991. "Learning by Doing and the Dynamic Effects of International Trade." <u>Quarterly Journal of Economics</u> 106 (May):369-405.

____. 1994a. "Lessons From the East Asian NICS: A Contrarian View," <u>European Economic Review</u> 38 (April): 964-73.

____. 1994b. "The Tyranny of Numbers: Confronting the Statistical Realities of the East Asian Growth Experience," Working Paper No. 4680. Cambridge Mass: National Bureau of Economic Research.

Table 1. Basic Indicators of Economic Growth in East Asia, 1960-94

Country/ Region	Population 1990 (millions)	Per Capita Income* 1960	1990 (Thousands of dollars)	Annual Growth Rates 1960 - 94 GDP	Population (Percentage change)	Labor Force
East Asia						
China	1,134	0.6	1.3	6.8	1.8	2.3
Indonesia	178	0.6	2.0	5.7	2.1	2.2
Korea	43	0.9	6.7	8.5	1.7	2.6
Malaysia	18	1.4	5.1	7.0	2.6	3.0
Philippines	61	1.1	1.8	3.8	2.7	2.5
Singapore	3	1.6	11.7	8.3	1.7	2.7
Thailand	56	0.9	3.6	7.7	2.4	2.5
Taiwan	20	1.3	8.1	8.7	2.1	2.7
Regional Averages						
East Asia		0.9	3.6	6.8	2.2	2.5
South Asia		0.8	1.1	4.2	2.3	1.9
Sub-Sahara		0.6	0.7	2.9	2.8	2.6
Middle East		1.9	3.0	4.5	2.9	2.9
Latin America		2.4	4.1	4.2	2.4	2.7
Industrial		6.4	14.9	3.5	0.9	1.1

* International Prices of 1985.
Sources: Computed by the authors from a sample of 88 countries (see appendix).
Regional averages are weighted by average GDP; and East Asia is defined
to exclude China and Japan.
Per Capita Income - Summers and Heston (1991).
GDP, Population - World Bank (1995).
Labor Force - Data obtained from International Labor Organization.

Table 2. Educational Attainment and Labor Quality,1960-94

Country/ Region	Average Years of Schooling		Annual Rates of Change	
	1960	1994	Years-of- Schooling	Quality Index
East Asia				
China	1.66	5.33	3.5	0.6
Indonesia	1.11	4.95	4.5	0.8
Korea	3.23	9.67	3.3	1.2
Malaysia	2.34	6.95	3.3	0.8
Philippines	3.78	7.35	2.0	0.8
Singapore	2.99	6.11	2.1	0.6
Thailand	3.45	7.47	2.3	0.7
Taiwan	3.24	8.17	2.8	1.0
Regional Averages				
East Asia	2.66	7.16	3.0	0.9
South Asia	1.32	3.42	2.8	0.5
Africa	1.60	3.52	2.4	0.3
Middle East	1.36	4.89	3.8	0.7
Latin America	2.97	5.53	1.8	0.5
Industrial Countries	7.26	9.82	0.9	0.5

Sources: Barro and Lee (1994) and authors' construction.
Note: Regional averages are weighted using the average value of GDP in internatior
prices of 1985.

Table 3. Sources of Growth in East Asia, 1960-94
annual percentage rate

		Contribution of:		
Region/Period	Output per Worker	Physical Capital	Education	Factor Productivity
CHINA				
1960-94	4.5	1.5	0.4	2.6
1960-73	2.2	0.4	0.4	1.4
1973-94	6.0	2.2	0.4	3.3
1973-84	4.3	1.7	0.4	2.2
1984-94	8.0	2.9	0.3	4.6
INDONESIA				
1960-94	3.4	2.1	0.5	0.8
1960-73	2.5	0.9	0.5	1.1
1973-94	4.0	2.8	0.5	0.7
1973-84	4.3	3.3	0.5	0.5
1984-94	3.7	2.3	0.5	0.9
KOREA				
1960-94	5.7	3.3	0.8	1.5
1960-73	5.6	3.2	0.9	1.4
1973-94	5.8	3.4	0.7	1.6
1973-84	5.3	3.4	0.8	1.1
1984-94	6.2	3.3	0.6	2.1
MALAYSIA				
1960-94	3.8	2.3	0.5	0.9
1960-73	4.0	2.4	0.5	1.0
1973-94	3.7	2.3	0.5	0.9
1973-84	3.6	2.7	0.5	0.4
1984-94	3.8	1.8	0.5	1.4
PHILIPPINES				
1960-94	1.3	1.2	0.5	-0.4
1960-73	2.5	1.3	0.6	0.7
1973-94	0.5	1.1	0.5	-1.1
1973-84	1.2	2.0	0.6	-1.3
1984-94	-0.3	0.2	0.4	-0.9
SINGAPORE				
1960-94	5.4	3.4	0.4	1.5
1960-73	5.9	4.6	0.4	0.9
1973-94	5.1	2.7	0.4	2.0
1973-84	4.3	3.1	0.2	1.0
1984-94	6.0	2.3	0.6	3.1
THAILAND				
1960-94	5.0	2.7	0.4	1.8
1960-73	4.8	3.2	0.1	1.4
1973-94	5.2	2.3	0.6	2.1
1973-84	3.6	2.0	0.5	1.1
1984-94	6.9	2.6	0.8	3.3
TAIWAN				
1960-94	5.8	3.1	0.6	2.0
1960-73	6.8	3.9	0.5	2.2
1973-94	5.2	2.7	0.7	1.8
1973-84	4.9	3.0	0.9	0.9
1984-94	5.6	2.3	0.5	2.8

Source: Authors' calculations as explained in text. Regional averages are weighted

Table 4. Sources of Growth by Region, 1960-94
annual percentage rate

Region/Period	Output per Worker	Contribution of:		
		Physical Capital	Education	Factor Productivity
China				
1960-94	4.5	1.5	0.4	2.6
1960-73	2.2	0.4	0.4	1.4
1973-94	6.0	2.2	0.4	3.3
1973-84	4.3	1.7	0.4	2.2
1984-94	8.0	2.9	0.3	4.6
East Asia (1)				
1960-94	4.2	2.5	0.6	1.1
1960-73	4.2	2.3	0.5	1.3
1973-94	4.2	2.5	0.6	1.0
1973-84	4.0	2.8	0.6	0.5
1984-94	4.4	2.2	0.6	1.6
South Asia				
1960-94	2.3	1.1	0.3	0.8
1960-73	1.8	1.4	0.3	0.1
1973-94	2.6	0.9	0.3	1.3
1973-84	2.5	0.9	0.4	1.2
1984-94	2.7	1.0	0.3	1.5
Africa				
1960-94	0.3	0.8	0.2	-0.6
1960-73	1.9	1.3	0.2	0.3
1973-94	-0.6	0.4	0.2	-1.3
1973-84	-0.6	1.2	0.2	-2.0
1984-94	-0.6	-0.4	0.3	-0.4
Middle East				
1960-94	1.6	1.5	0.5	-0.3
1960-73	4.7	2.0	0.4	2.3
1973-94	-0.3	1.1	0.5	-1.9
1973-84	0.5	2.2	0.6	-2.2
1984-94	-1.1	-0.0	0.5	-1.5
Latin America				
1960-94	1.5	0.9	0.4	0.2
1960-73	3.4	1.3	0.3	1.8
1973-94	0.3	0.6	0.4	-0.8
1973-84	0.4	1.1	0.4	-1.1
1984-94	0.1	0.1	0.4	-0.4
United States				
1960-94	1.1	0.4	0.4	0.3
1960-73	1.9	0.5	0.6	0.8
1973-94	0.6	0.3	0.2	0.1
1973-84	0.2	0.3	0.5	-0.5
1984-94	0.9	0.3	-0.0	0.7
Non-US Industrial Cs.				
1960-94	2.9	1.5	0.4	1.1
1960-73	4.8	2.3	0.4	2.2
1973-94	1.7	1.0	0.4	0.4
1973-84	1.8	1.1	0.6	0.2
1984-94	1.7	0.8	0.2	0.7

Source: Authors' calculations as explained in text. Regional averages are weighted
1. Excludes China.

Table 5. Initial Conditions and External Shocks, 88 Country Sample

Country/ Region	Income per Capita 1960 (% of USA)	Life Expectancy 1960	Years of Schooling 1965	Change in Terms of Trade	Standard Deviation of Terms of Trade	Investment Share (Int'l Prices)
East Asian Countries						
China	5.4	36.3	2.1	-0.4	5.0	20.5
Indonesia	5.8	41.5	1.6	5.4	25.6	17.1
Korea	8.7	54.2	4.4	-1.5	5.9	23.7
Malaysia	15.0	54.3	2.8	-1.2	9.9	23.5
Phillipines	11.5	53.1	4.2	-1.7	10.5	15.3
Singapore	16.6	63.7	3.2	1.6	5.7	31.2
Thailand	9.6	52.7	3.2	-2.5	8.1	18.1
Taiwan	12.3	65.4	3.8	0.0	12.8	22.0
Regions						
East Asia	11.4	55.0	3.3	-0.0	11.2	21.6
South Asia	7.8	47.7	1.7	-1.2	10.4	9.3
Sub-Sahara	9.2	42.1	1.2	-1.3	16.4	8.8
Middle East	15.7	54.5	2.6	1.7	14.3	17.2
Latin America	22.1	55.4	3.2	-0.9	15.4	15.6
Industrial Countries	55.6	69.3	6.4	-1.2	8.0	25.9
Total	25.3	55.1	3.4	-0.7	12.9	17.0

Source: Authors' calculations from World Bank (1995), Barro and Lee (1994), and
Summers and Heston (1991). The regional means are simple averages.

Table 6. Regression Results for Changes in Output per Worker and its Components, Initial Conditions, 1960-1994

Variable	Output per worker				Capital per worker		TFP		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Initial income	-0.05 (4.5)	-0.04 (4.0)	-0.02 (2.8)	-0.04 (3.9)	-0.02 (3.3)	-0.01 (2.3)	-0.03 (3.5)	-0.03 (3.2)	-0.02 (2.8)
Years of schooling	0.19 (1.6)	0.04 (0.4)	0.15 (1.7)	0.08 (0.6)	0.03 (0.5)	-0.07 (1.3)	0.15 (1.8)	0.12 (1.4)	0.15 (1.7)
Life expectancy	0.06 (3.0)	0.05 (2.8)	0.03 (1.7)	0.04 (1.8)	0.03 (2.4)	0.02 (2.1)	0.03 (2.2)	0.03 (1.9)	0.03 (1.7)
Change in tot	0.24 (3.8)	0.05 (0.8)	0.08 (1.7)	0.19 (2.9)	0.13 (3.5)	0.02 (0.6)	0.11 (2.4)	0.03 (0.6)	0.08 (1.7)
Standard dev. of tot	-0.11 (4.7)	-0.04 (1.9)	-0.06 (3.2)	-0.09 (4.3)	-0.04 (3.2)	-0.01 (0.5)	-0.06 (3.9)	-0.03 (1.9)	-0.05 (3.2)
Capital-labor substitution			1.21 (8.8)						0.20 (1.5)
Investment share				0.07 (2.8)					
Regional dummies	no	yes	no	no	no	yes	no	yes	no
South Asia		-1.7 (3.0)				-1.4 (4.6)		-0.2 (0.5)	
Africa		-2.2 (4.7)				-1.7 (6.2)		-0.5 (1.4)	
Middle East		-0.9 (2.0)				-1.0 (3.7)		0.1 (0.2)	
Latin America		-2.4 (5.5)				-1.5 (6.1)		-0.8 (2.3)	
Industrial cntry.		-0.4 (0.7)				-0.6 (2.0)		0.2 (0.5)	
Adj. R2	0.42	0.62	0.70	0.46	0.24	0.52	0.36	0.43	0.36

Numbers in parentheses are t-statistics. Capital per worker includes education. The investment rate is measured as a percent and is based on international prices.
The dependent variable is measured as an annual percent change, and the units of the other variables are shown in Table 5.

Table 7. Macroeconomic and Trade Policy Indicators, 83 Countries

Country/ Region	Macroeconomic Policy					Trade Policy			
	Budget Balance (% GDP)	Change in Real Exchange Rate	Standard Deviation of Real Exchange Rate	Inflation Rate	Black Market Exchange Rate Premium(%)	Open	OpenP (% Years)	Average Tariff (%)	Non-tariff Barriers (%)
East Asian Countries									
China	-2.0	-3.9	10.2	3.4	---	0.0	0.0	32.6	37.8
Indonesia	-2.0	-2.2	12.9	73.4	14.3	1.0	66.7	16.4	10.4
Korea	-1.0	-1.9	14.6	12.0	17.7	1.0	73.3	14.5	10.5
Malaysia	-6.9	-2.1	5.5	3.4	1.0	1.0	90.0	11.1	6.9
Philippines	-1.6	-2.6	14.5	11.7	12.4	0.0	12.8	25.9	53.3
Singapore	2.2	-2.5	5.9	3.5	0.8	1.0	83.3	2.0	1.1
Thailand	-1.8	-1.1	6.0	5.3	0.5	1.0	100.0	34.0	5.7
Taiwan	-1.3	0.0	6.5	5.8	6.6	1.0	90.0	10.6	45.7
Regions									
East Asia	-1.8	-1.7	9.4	16.4	7.6	0.9	73.7	16.4	19.1
South Asia	-6.0	-2.4	12.9	9.0	114.2	0.0	4.6	68.6	45.7
Sub-Sahara	-5.5	-1.8	15.4	26.9	76.7	0.1	6.3	30.6	31.5
Middle East	-5.4	-2.0	9.3	13.5	62.3	0.3	37.2	27.3	45.5
Latin America	-3.8	-1.1	15.8	121.0	36.2	0.0	17.5	28.8	31.2
	-1.6	0.2	5.4	7.9	1.8	0.9	90.4	6.9	19.4

Sources: Budget balance and real exchange rate measures - see text.
Inflation - calculated from consumer price indices, International Financial Statistics.
Black market exchange rate - Barro-Lee data set.
Open and OpenP - Sachs and Warner(1995).
Average tariff and Non-tariff barrier coverage ratio - UNCTAD, Sachs and Warner(1995) and authors' calculations. Data refers to various years in the late 1980s, and are available for 76 countries.

Table 8. Regression Results for Changes in Output per Worker and its Components, Initial Conditions, Macroeconomic Policy and Openness: 1960-1994
83 Countries

Variable	Output per worker			Capital per worker			TFP		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Initial income	-0.06	-0.05	-0.04	-0.03	-0.03	-0.02	-0.03	-0.03	-0.03
	(5.6)	(6.0)	(4.2)	(4.7)	(5.1)	(2.8)	(3.7)	(3.7)	(3.1)
Years of schooling	0.25	0.21	0.10	0.09	0.06	-0.03	0.16	0.14	0.13
	(2.3)	(2.1)	(1.0)	(1.3)	(1.0)	(0.6)	(2.1)	(1.9)	(1.6)
Life expectancy	0.04	0.02	0.03	0.03	0.01	0.01	0.02	0.01	0.02
	(2.3)	(1.4)	(1.7)	(2.2)	(1.2)	(1.3)	(1.3)	(0.8)	(1.1)
Change in tot	0.18	0.14	0.02	0.13	0.10	0.02	0.05	0.03	0.00
	(3.0)	(2.5)	(0.3)	(3.5)	(3.1)	(0.5)	(1.1)	(0.8)	(0.0)
Standard dev. of tot	-0.09	-0.07	-0.03	-0.05	-0.03	-0.01	-0.04	-0.03	-0.02
	(4.1)	(3.4)	(1.5)	(3.4)	(2.7)	(0.5)	(2.7)	(2.3)	(1.4)
Standard dev. of RER	-0.05	-0.04	-0.03	0.00	0.01	0.01	-0.05	-0.05	-0.04
	(3.2)	(2.7)	(2.4)	(0.2)	(0.7)	(0.7)	(4.5)	(4.1)	(3.5)
Budget surplus (% GDP)	0.10	0.07	0.07	0.07	0.06	0.04	0.02	0.02	0.03
	(2.9)	(2.3)	(2.1)	(3.4)	(2.9)	(2.1)	(1.0)	(0.6)	(1.0)
Open		1.32	0.64		0.86	0.47		0.44	0.17
		(4.3)	(1.6)		(4.6)	(2.0)		(1.9)	(0.6)
Regional dummies	no	no	yes	no	no	yes	no	no	yes
South Asia			-0.83			-0.92			0.10
			(1.4)			(2.6)			(0.2)
Africa			-1.49			-1.29			-0.18
			(2.8)			(4.1)			(0.4)
Middle East			-0.35			-0.49			0.15
			(0.7)			(1.6)			(0.4)
Latin America			-1.54			-1.07			-0.44
			(2.9)			(3.4)			(1.0)
Industrial cntry.			-0.35			-0.46			0.12
			(0.7)			(1.6)			(0.3)
Adj. R2	0.55	0.64	0.68	0.36	0.50	0.58	0.49	0.51	0.51

Numbers in parentheses are t-statistics. Capital per worker includes education.
The dependent variable is measured as an annual percent change, and the units of the other variables are shown in Table 7.

Table 9. Relative Rankings of Output and Capital per Worker, 1970-94
United States (1970) = 100

Country	Output/Worker		Capital/Worker		Education/Worker		Capital-Output Ratio	
	1970	1994	1970	1994	1970	1994	1970	1994
China	3.2	10.4	1.5	6.6	56.4	65.3	1.5	1.7
Indonesia	6.8	15.1	2.5	16.2	58.0	69.0	1.2	2.8
Korea	13.2	52.9	5.0	49.4	74.3	95.3	1.2	2.9
Malaysia	18.9	46.8	8.1	37.8	63.1	77.2	1.3	2.5
Philippines	10.9	13.4	4.1	8.5	73.3	88.3	1.2	2.0
Singapore	30.0	77.3	13.0	72.5	65.2	74.9	1.4	2.9
Thailand	8.4	26.7	3.0	15.2	61.4	76.4	1.1	1.8
Taiwan	18.5	67.7	7.2	47.6	68.9	87.9	1.2	2.2
Japan	44.0	85.5	30.9	124.9	79.8	92.7	2.2	4.6
United States	100.0	118.5	100.0	122.5	100.0	110.2	3.1	3.2

Source: Authors' calculations as explained in text.

**Figure 1. Comparison of Growth in the Capital Stock and the Average Investment Rate, 1960-94**
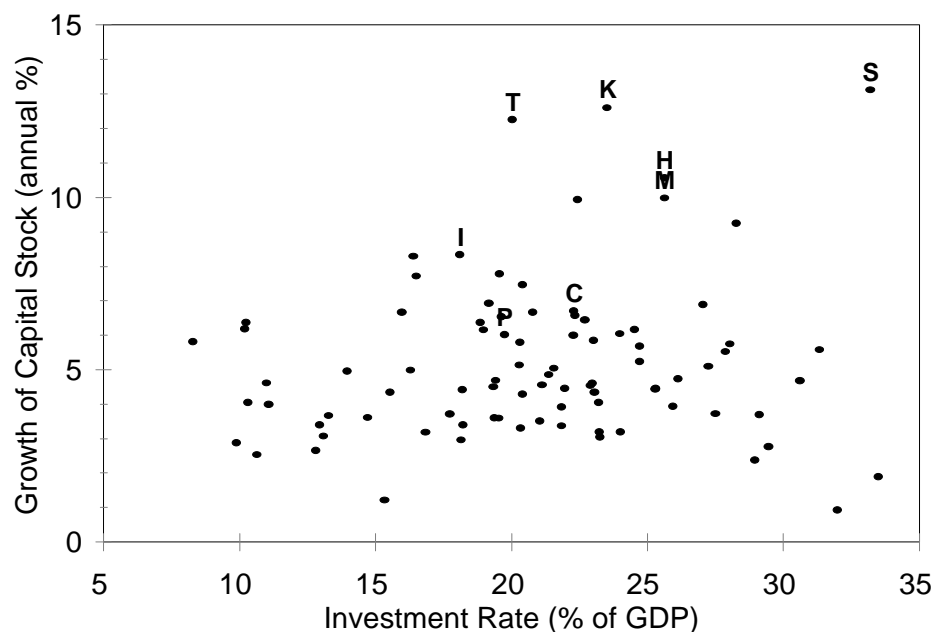
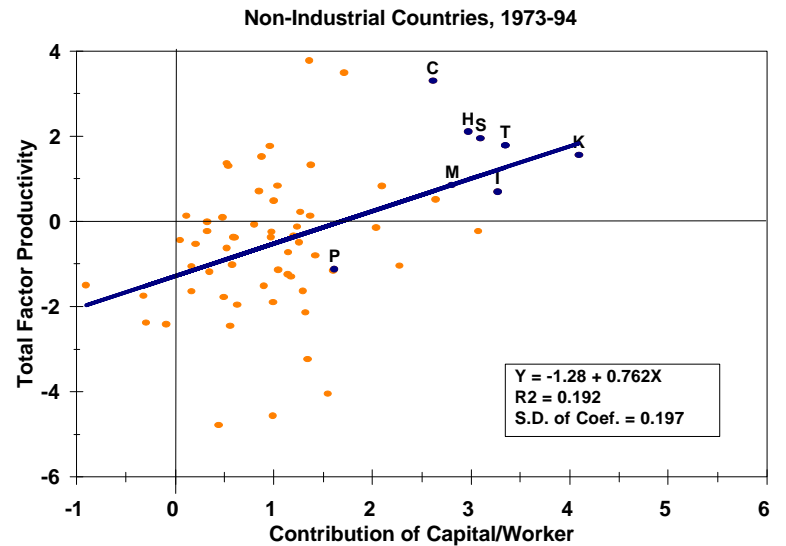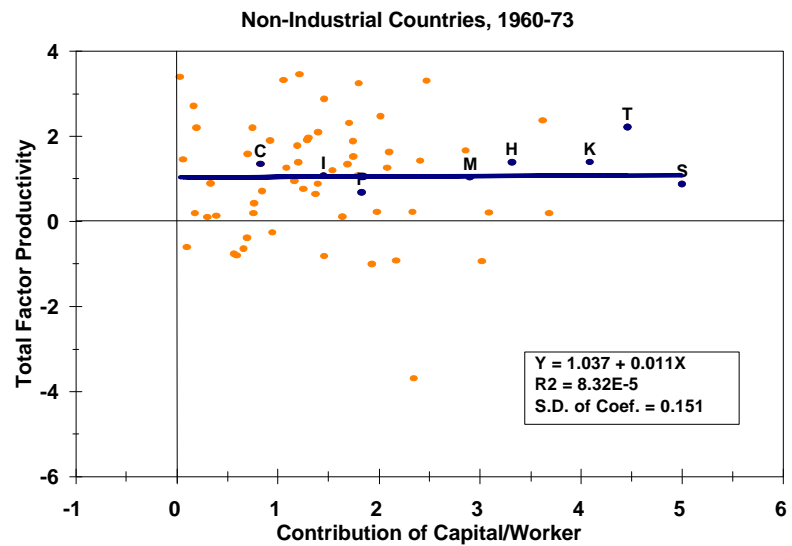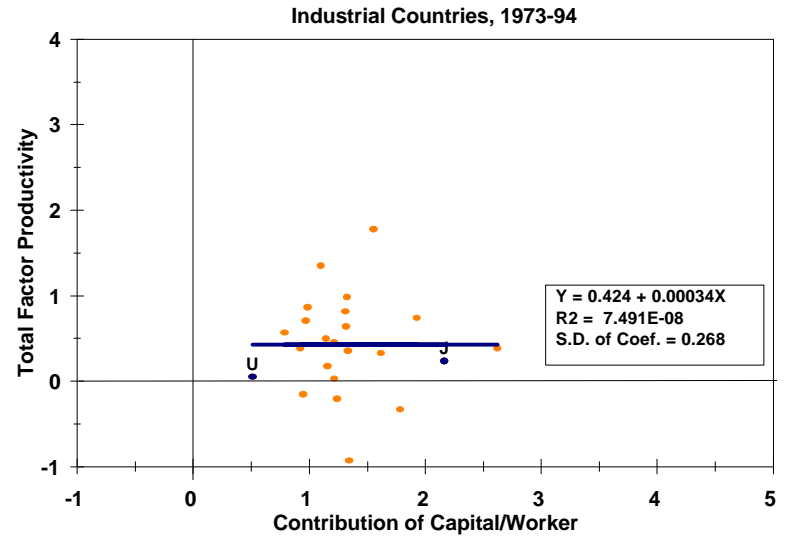| Country/ Region	Growth in Capital Stock	Investment Rate National Prices	Rate International Prices
East Asian Economies			
China (C)	6.7	22.3	20.5
Indonesia (I)	8.3	18.1	17.1
Korea (K)	12.6	23.5	23.7
Malaysia M)	10.0	25.6	23.5
Philippines (P)	6.0	19.8	15.3
Singapore (S)	13.1	33.2	31.2
Taiwan (T)	12.2	20.0	21.9
Thailand (H)	10.6	25.6	18.1
Regional Averages			
East Asia	9.9	21.1	18.6
South Asia	5.2	18.9	11.3
Sub-Sahara	4.8	19.0	9.5
Middle East	7.1	19.0	12.6
Latin America	5.4	21.4	16.9
Industrial	4.5	20.8	24.5

Source: authors' calculations as explained in text

Figure 2. Output per Worker and its Components, Regional Averages, 1960-92
Index, 1960=1
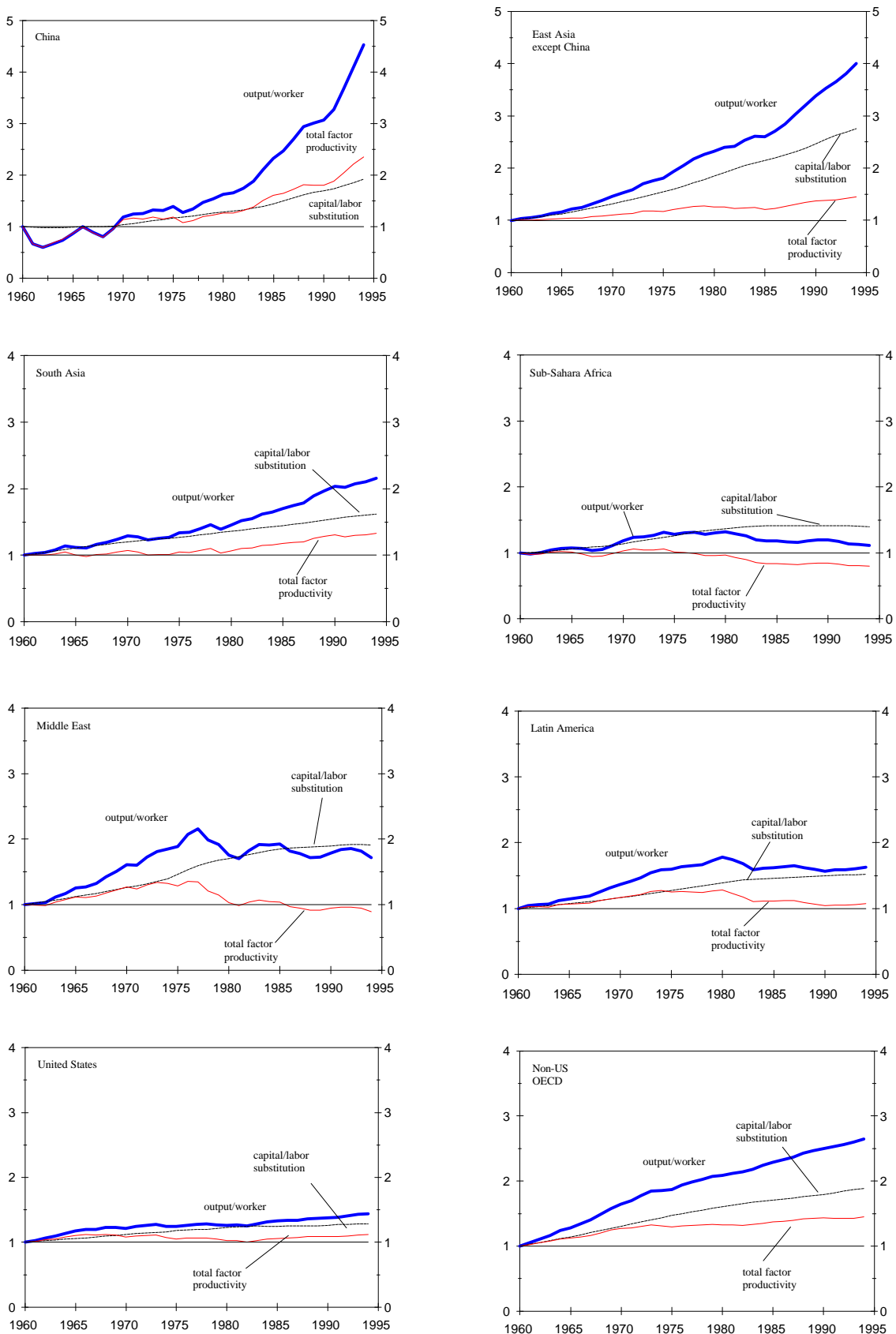
Figure 3. Comparisons of Sources of Growth

Average Annual Rates of Growth

Industrial Countries, 1960-73

Y = 0.387+.710X
R2 = 0.383
S.D. of Coef. = 0.196

Industrial Countries, 1973-94

Y = 0.424 + 0.00034X
R2 = 7.491E-08
S.D. of Coef. = 0.268

Non-Industrial Countries, 1960-73

Y = 1.037 + 0.011X
R2 = 8.32E-5
S.D. of Coef. = 0.151

Non-Industrial Countries, 1973-94

Y = -1.28 + 0.762X
R2 = 0.192
S.D. of Coef. = 0.197
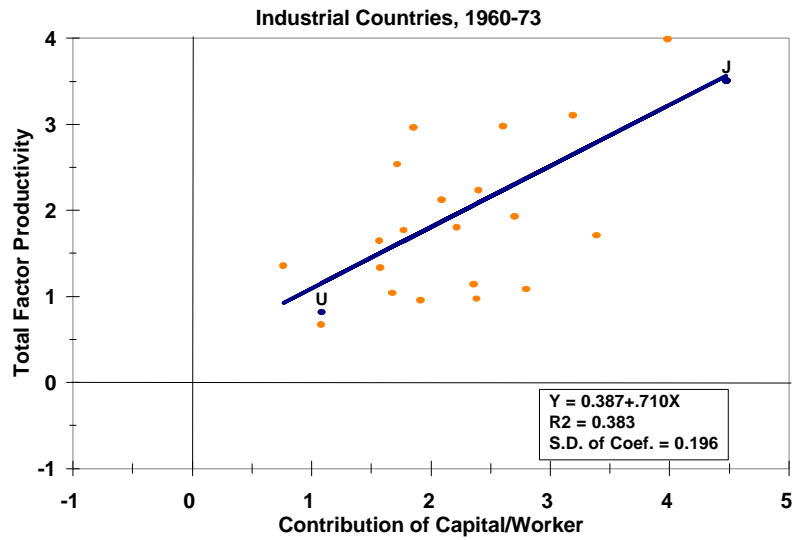
Figure 4. Saving - Investment Balance in East Asia
Percent of GDP
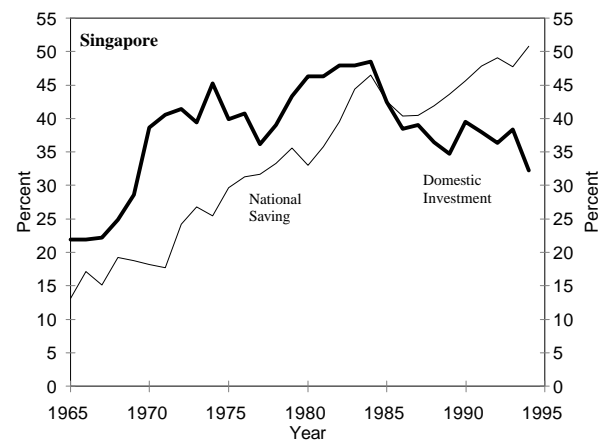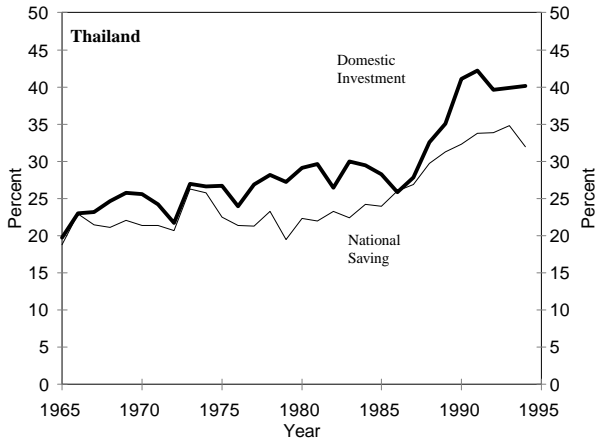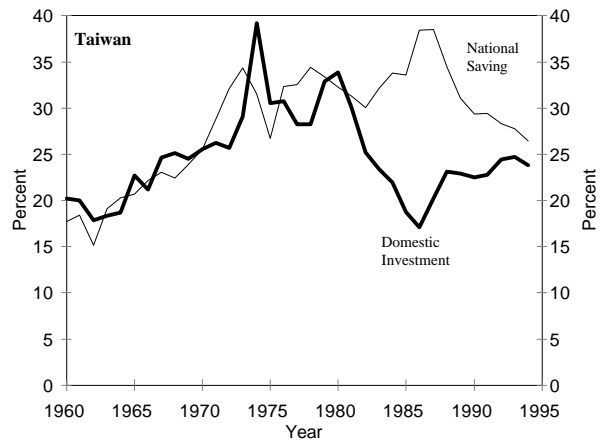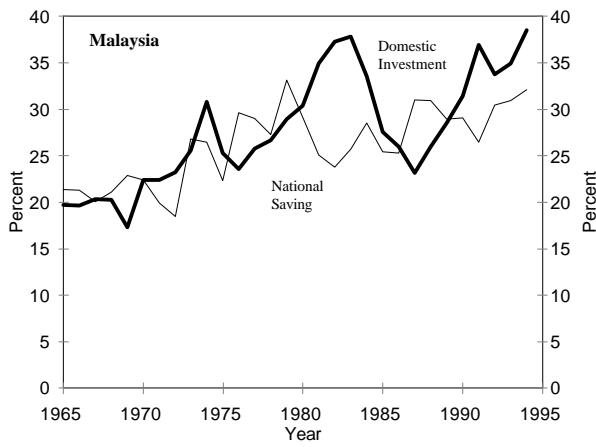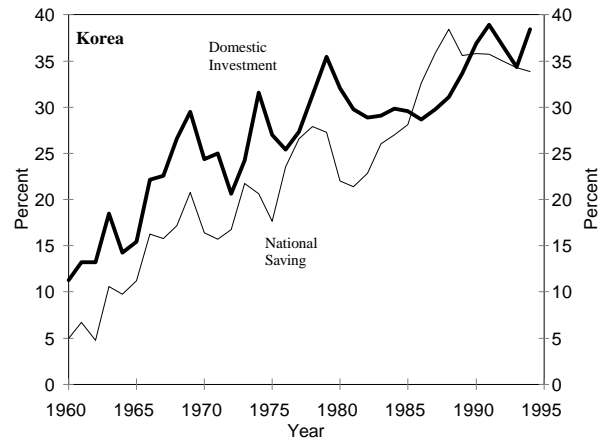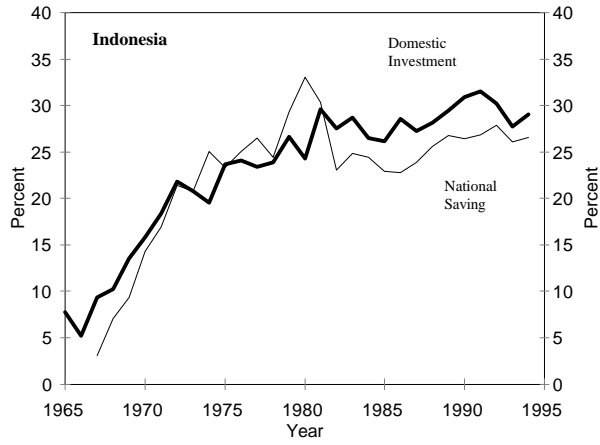
Table A1. Country Sample, by Regional Grouping

East Asia	Middle East and North Africa	Industrial Countries
China	Algeria	Australia
Indonesia	Cyprus	Austria
Korea	Egypt	Belgium
Malaysia	Iran	Canada
Philippines	Israel	Denmark
Singapore	Jordan	Finland
Taiwan	Malta	France
Thailand	Morocco	Germany
	Tunisia	Greece
South Asia		Iceland
Bangladesh	**Latin America**	Ireland
India	Argentina	Italy
Myanmar	Bolivia	Japan
Pakistan	Brazil	Netherlands
Sri Lanka	Chile	New Zealand
	Columbia	Norway
	Costa Rica	Portugal
Sub-Sahara Africa	Dominican Rep.	Spain
Cameroon	Ecuador	Sweden
Cote d' Ivoire	El Salvador	Switzerland
Ethiopia	Guatemala	Turkey
Ghana	Guyana	United Kingdom
Kenya	Haiti	United States
Madagascar	Honduras	
Malawi	Jamaica	
Mali	Mexico	
Mauritius	Nicaragua	
Mozambique	Panama	
Nigeria	Paraguay	
Rwanda	Peru	
Senegal	Trinidad & Tobago	
Sierra Leone	Uruguay	
South Africa	Venezuela	
Sudan		
Tanzania		
Uganda		
Zaire		
Zambia		
Zimbabwe		

Table A2. Educational Attainment of the Adult Population, 1960

Country/ Region	No Schooling	Primary		Secondary		Higher		Average returns to schooling
		Incomplete	Completed	Incomplete	Completed	Incomplete	Completed	
East Asia								
Indonesia	75.5	15.0	7.6	1.4	0.5	0.1	0.0	17.0
Korea	56.9	3.4	26.2	5.1	5.8	0.7	1.9	10.6
Malaysia	58.5	21.5	11.2	4.8	2.4	0.2	1.3	9.4
Philippines	33.5	32.3	17.4	6.1	4.5	2.2	4.0	8.0
Singapore	64.0	7.9	5.3	15.3	7.6	0.0	0.0	13.4
Thailand	48.1	12.5	33.9	3.3	1.6	0.0	0.6	10.4
Taiwan	47.0	24.9	13.9	5.8	4.2	2.1	2.2	6.0
Regional Averages								
East Asia	56.6	16.3	17.7	4.2	3.0	0.7	1.4	10.7
South Asia	76.7	14.5	5.2	2.1	1.3	0.0	0.1	7.2
Sub-Saharan Africa	66.8	11.7	8.5	9.6	3.2	0.1	0.2	13.3
Middle East	82.3	6.6	4.4	2.6	2.5	0.7	0.8	10.6
Latin America	41.5	34.7	13.0	5.2	3.6	0.7	1.2	12.3
Industrial Countries	4.4	26.7	30.8	18.1	12.0	3.7	5.2	7.0
Labor Quality Weights								
7 percent return	100.0	125.0	150.0	187.0	225.0	262.0	300.0	
12 percent return	100.0	150.0	200.0	300.0	400.0	500.0	600.0	

Source: Barro and Lee(1994), Psacharopoulos (1994), and authors' calculations.

Table A3. Indexes of Labor Quality, 1960-94

Country/ Region	7 Percent Return			12 Percent Return		
	Labor Quality 1960	Labor Quality 1994	% Annual Growth	Labor Quality 1960	Labor Quality 1994	% Annual Growth
East Asia						
China	109.9	135.3	0.6	120.5	183.9	1.3
Indonesia	109.7	142.8	0.8	119.9	192.4	1.4
Korea	130.6	197.4	1.2	167.8	331.5	2.0
Malaysia	121.0	160.0	0.8	145.9	233.8	1.4
Philippines	139.3	182.8	0.8	188.1	293.4	1.3
Singapore	127.3	155.2	0.6	162.4	226.4	1.0
Thailand	126.2	158.2	0.7	154.6	227.9	1.1
Taiwan	131.1	182.1	1.0	169.5	294.2	1.6
Regional Averages						
East Asia	123.2	166.1	0.9	151.8	252.9	1.5
South Asia	109.9	129.9	0.5	121.2	169.5	1.0
Sub-Sah. Africa	114.4	128.3	0.3	130.8	162.4	0.6
Middle East	111.8	143.0	0.7	126.3	199.5	1.4
Latin America	127.7	153.8	0.5	160.3	222.6	1.0
Industrial Countries	168.6	200.4	0.5	255.8	338.3	0.8

Source: Authors' calculations as explained in the text.

Note: Regional Averages are weighted.

Table A4. Sources of Growth by Region With Alternative Assumptions, 1960-94
annual percentage rate

Region/Capital Share	Education Return	Output per Worker	Contribution of:		
			Physical Capital	Education	Factor Productivity
China					
0.3	7%	4.5	1.3	0.4	2.7
0.4	7%	4.5	1.8	0.4	2.4
0.3	12%	4.5	1.3	0.9	2.3
0.4	12%	4.5	1.8	0.7	2.0
East Asia (1)					
0.3	7%	4.2	2.1	0.6	1.4
0.4	7%	4.2	2.8	0.5	0.8
0.3	12%	4.2	2.1	1.0	1.0
0.4	12%	4.2	2.8	0.9	0.4
South Asia					
0.3	7%	2.3	1.0	0.3	1.0
0.4	7%	2.3	1.3	0.3	0.7
0.3	12%	2.3	1.0	0.7	0.6
0.4	12%	2.3	1.3	0.6	0.4
Africa					
0.3	7%	0.3	0.7	0.2	-0.6
0.4	7%	0.3	0.9	0.2	-0.7
0.3	12%	0.3	0.7	0.5	-0.8
0.4	12%	0.3	0.9	0.4	-0.9
Middle East					
0.3	7%	1.6	1.2	0.5	-0.1
0.4	7%	1.6	1.7	0.4	-0.5
0.3	12%	1.6	1.2	1.0	-0.6
0.4	12%	1.6	1.7	0.8	-0.9
Latin America					
0.3	7%	1.5	0.8	0.4	0.3
0.4	7%	1.5	1.0	0.3	0.1
0.3	12%	1.5	0.8	0.7	0.0
0.4	12%	1.5	1.0	0.6	-0.1
Industrial Countries					
0.3	7%	2.3	1.0	0.4	1.0
0.4	7%	2.3	1.3	0.3	0.7
0.3	12%	2.3	1.0	0.6	0.7
0.4	12%	2.3	1.3	0.5	0.5

Source: Authors' calculations as explained in text. Regional averages are weighted
1. Excludes China.