The Ghost of Financing Gap

How the Harrod-Domar Growth Model Still Haunts Development Economics

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Abstract: The Harrod-Domar growth model supposedly died long ago. But for over 40 years, economists working on developing countries have applied (and still today apply) the Harrod-Domar model to calculate short-run investment requirements for a target growth rate. They then calculate a "Financing Gap" between the required investment and available resources, and often fill the "Financing Gap" with foreign aid. This paper traces the intellectual history of how a long-dead model came to influence today's aid allocation to developing countries. The paper then asks if the model's surprising afterlife has been due to its consistency with the 40 years of data that have accumulated during its use. The answer is "no."

In April 1946, Evsey Domar published an article on economic growth called "Capital Expansion, Rate of Growth, and Employment." This article did not discuss long run economic growth; it discussed the relationship between short-term recessions and investment in the United States. Domar assumed that production capacity was proportional to the capital stock. He admitted the assumption was unrealistic.

Eleven years later, complaining of an "ever-guilty conscience," he disavowed the original model altogether.[1] He said his purpose was to comment upon an esoteric debate on business cycles, not to derive "an empirically meaningful rate of growth." He said his model made no sense for long run growth. Domar endorsed the new growth model of Robert Solow, which would dominate economists' theoretical approach to growth for the next three decades.

To sum up, Domar's model was not intended as a growth model, made no sense as a growth model, and was repudiated as a growth model forty years ago by its creator. So it was ironic that Domar's growth model became, and continues to be today, the most widely applied growth model in economic history.

In this paper, I tell the story of how Domar's model (usually called the Harrod-Domar model) survived its supposed demise in the 1950s. Economists applied it (and still do apply it) to poor countries from Albania to Zimbabwe to determine a "required" investment rate for a target growth rate. The difference between the required investment and their own savings is the *Financing Gap*. Donors fill the Financing Gap with foreign aid to attain target growth. This is not a story about the *long-run* relationship between investment and growth -- it's a story about a model that promised poor countries growth in the *short-run* through aid and investment.

I tell the story of the Ghost of Financing Gap in part I. In part II, I test empirically how well the predictions of the Harrod-Domar growth model match the data. Part III concludes with ideas for future practice.

I. The Harrod Domar Model, 1946-1997

Domar's approach to growth became popular because it had a wonderfully simple prediction: *GDP growth will be proportional to the share of investment spending in GDP*. Domar assumed that output (Y) is proportional to machines (K) available at the beginning of the year, i.e. $Y(t) = \phi K(t-1)$. Then $Y(t)-Y(t-1) = \phi [K(t-1)-K(t-2)]$. The right-hand side is just last year's net investment $I(t-1)$. Divide both sides by last year's output. So GDP growth this year is just proportional to last year's investment/GDP ratio: [2]

$$(Y(t)-Y(t-1))/Y(t-1) = \phi I(t-1)/Y(t-1)$$

How did Domar get the idea that production was proportional to machines? Did not labor play some role in production? Domar was writing in the aftermath of the Great Depression that made many people running the machines lose jobs. Domar and many other economists expected a repeat of the Depression after World War II unless the government did something to avoid it.

Domar took high unemployment as a given, so there were always people available to run any additional machines that you built. The problem of balancing aggregate demand and supply was Domar's concern. Investment in building new machines had a dual character -- it added to desired purchases of goods (demand) and it also added capacity (supply). These two effects would not necessarily be equal, Domar argued, and so the economy would spiral off into either chronic overproduction or chronic underproduction. This was the Harrod-Domar model. (Roy Harrod had published in 1939 a similar but more convoluted article, about which the less said the better.)

You can see that Domar's interest was the short run business cycle. So how did Domar's fixed ratio of production to machines make it into the analysis of poor countries' growth?

The Invention of Development

For centuries, nobody had paid much attention to the economic problems of poor countries. The League of Nations 1938 World Economic Survey, prepared by the future Nobel

Prize Winner James Meade, included one paragraph on South America. That was more complete coverage than poor countries in Asia and Africa received, which was none at all.[3]

All this suddenly changed after World War II. Policy mavens, having ignored poor countries for centuries, now called for attention to their "urgent problems."[4] Everyone suddenly agreed that the poor countries should "develop." Economists rushed to give policy advice to the newly independent governments of the poor countries.

The first Development Economists were influenced by two simultaneous historical events: (1) like Domar, the Great Depression, and (2) the industrialization of the USSR through forced saving and investment. The Depression and the large number of underemployed rural people in poor countries motivated Sir Arthur Lewis to suggest a "surplus labor" model in which only capital was a constraint. Lewis suggested that building factories would soak up this labor without causing a decline in rural production.

How many new machines? Lewis and other 1950s development economists assumed a fixed ratio in production between people and machines, i.e. a Leontief production function. Since you had surplus labor, machines -- not labor -- were the binding constraint on production. Production was proportional to machines, just as in Domar. Lewis suggested that the supply of available workers was "unlimited." He cited a particular example of an economy that had grown through pulling in excess labor from the countryside -- the Soviet Union.

Economists usually discussed the growth to investment ratio the other way around -- the ratio of "required" investment to desired growth. They called this ratio the Incremental Capital Output Ratio (ICOR), and thought it was somewhere between 2 and 5.[5] Lewis said "the central fact of economic development is rapid capital accumulation."[6] A country that wanted to develop had to go from an investment rate of 4 percent of GDP to 12-15 percent of GDP. Investment had to keep ahead of population growth. Development was a race between machines and motherhood.

To give a numerical example -- a country with an investment rate of four percent of GDP and an ICOR of 4 will have growth of one percent per year. This does not even keep up with population growth of, say, two percent a year. If the country gets investment up to the Lewis magic number of twelve percent of GDP, then it will have GDP growth of three percent a year. Now the country is developing, with GDP per capita rising at one percent per year.

How do you get investment high enough? Say current national saving is 4 percent of GDP. The early development economists thought that poor countries were so poor they had little hope of increasing their saving. You have a "Financing Gap" of 8 percent of GDP between the required investment (12 percent of GDP for 3 percent GDP growth) and the current 4 percent of GDP level of national savings. So Western donors should fill the "Financing Gap" with foreign aid, which will make the required investment happen, which in turn will make the target output growth happen.

The early development economists were hazy about how long it took for aid to increase investment and in turn increase growth. In actual use of the model, as we will see below, the horizons were short-run: this year's aid will go into this year's investment, which will go into next year's GDP growth.

The ICOR was not a new concept. Domar ruefully mentioned in his 1957 book that an earlier set of economists very concerned about growth had already used the ICOR -- Soviet economists of the 1920s. N.A. Kovalevskii, the editor of *Planned Economy*, in March of 1930 used the ICOR to project Soviet growth exactly the way that development economists were going to use it from the 1950s through the 1990s.[7] Not only had the Soviet experience inspired the ICOR model, but the Soviets themselves should get some of the credit for the invention of the ICOR.

The Stages of Rostow

The next step in the evolution of the Financing Gap was to persuade rich nations to fill the gaps with aid. In 1960, W.W. Rostow published his best-selling *The Stages of Economic Growth*. Anticipating the self-help boom, Rostow figured out that all the world loves a stage. Before the four stages of grief of Kubler-Ross, we had the five stages of growth of Rostow. The stage that stuck in peoples' minds was the "takeoff into self-sustained growth".

But how was "takeoff" accomplished? The only determinant of output takeoff that Rostow cited was investment increasing from 5 to 10 percent of income. Since this was almost exactly what Sir Arthur Lewis had said six years earlier, "takeoff" just reasserted Domar and Lewis with vivid images of planes swooping off runways.

Rostow tried to show that the investment-led takeoff fit the stylized facts. Stalin's Russia influenced Rostow a great deal, as it had everyone else -- it fit the takeoff story. Then Rostow considered a number of historical and Third World cases. His evidence was weak: only three out of fifteen cases he cited fit the story of an investment-led takeoff. Kuznets (1963) found his own independent historical evidence even less supportive of Rostow's story:

In no case do we find during the takeoff periods the acceleration in the rate of growth of total national product implied in Professor Rostow's assumptions of a doubling (or more) in the net capital formation proportion and of a constant marginal capital output ratio. The capital formation proportions, if they rise, climb ... for a much longer period than the short span of takeoff. Rates of growth ..., if they show any long-term acceleration (and those for only a few countries ...) increase slowly... "[8]

(Stylized facts die hard. Three decades later, a leading economist would write: "One of the important stylized facts of world history is that massive increases in saving precede signficant takeoffs in economic growth."[9])

Rostow and Foreign Aid

Regardless of the evidence, the best-selling *Stages* drew a lot of attention to the poor nations. Rostow was not the only or even the most important advocate for foreign aid, but his arguments are illustrative.

Rostow played on Cold War fears in *Stages*. Rostow subtitled *The Stages of Economic Growth*, a little immodestly, *A Non-Communist Manifesto*. Rostow saw in Russia "a nation surging, under Communism, into a long-delayed status as an industrial power of the first order". Rostow shared a common view. Hard as it is to imagine today, many American opinion-makers thought that the Soviet system was superior for sheer output production, even if inferior in individual freedoms. In 1950s' issues of *Foreign Affairs,* writers noted the Soviet willingness to "extract large forced savings", the advantage of which "it is difficult to overemphasize". In "economic power", they will "grow faster than we do." Pundits warned that the competitor derived "certain advantages" from the "centralized character of the operation". There was danger that the Third World, attracted by "certain advantages", would go Communist.[10]

Rostow wanted to show the Third World that Communism was not "the only form of effective state organization that can ... launch a take-off" (p. 163). Rostow offered a non-Communist way. Western nations could provide Third World nations with aid to fill the "financing gap" between the necessary investment for takeoff and actual national saving. Rostow used the Harrod Domar growth model to figure out the necessary investment (using an ICOR of 3 to 3.5) for "takeoff."[11]

The Communist scare worked. US Foreign Aid had already increased a lot under Eisenhower in the late 1950s, to whom Rostow was an adviser (Figure 1). Rostow had also caught the eye of an ambitious senator named John F. Kennedy. Kennedy, advised by Rostow, successfully got the Senate to pass a foreign aid resolution in 1959. After Kennedy became President, he sent a message to Congress in 1961 calling for increased Foreign Aid:

in our time these new nations need help ... to reach the stage of self-sustaining growth ... for a special reason. Without exception, they are all under Communist pressure..

Rostow was in government throughout the administrations of Kennedy and Johnson. Under Kennedy, foreign aid increased by 25 percent in constant dollars (Figure 1). Under Johnson foreign aid maxed out at $14 billion in 1985 dollars, equivalent to 0.6 percent of American GDP. Rostow and other like-minded economists had triumphed on aid. [12]

The US decreased its foreign aid after that peak under Johnson, but other rich countries more than compensated. Figure 2 shows the whole long upward trend of total foreign aid (grants and soft loans) by the Western industrial countries.[13] Over the entire period 1950-95, the Western countries gave one trillion dollars (measured in 1985 dollars) in aid. Since virtually all of the aid advocates used the Harrod-Domar/Financing Gap model, this was one of the largest policy experiments ever based on a single economic model.

Don't forget to save

While there was a remarkable degree of consensus that the aid to investment to growth dogma "was substantially valid", as Bhagwati's 1966 text put it, there were warnings about excessive indebtedness to donors. Turkey had already developed debt servicing problems on its past aid loans, Bhagwati noted. One early aid critic, P.T. Bauer, ironically noted in 1972 that "foreign aid is necessary to enable underdeveloped countries to service the subsidized loans... under earlier foreign aid agreements."[14]

The obvious way to avoid a debt problem with official donors was to increase national saving. Bhagwati said this was a job for the state: the state had to raise taxes to generate public savings.[15] Rostow predicted the recipient country will *naturally* increase its savings as it takes off, so that after "ten or fifteen years" the donors can anticipate aid being "discontinued."

This emphasis on saving led economists to be optimistic about countries whose mineral resources gave them a pool of savings. Kamarck (1967) predicted that Congo (Brazzaville), Congo (Zaire), Gabon, Ghana, Guinea, Liberia, Nigeria, Sudan, Zambia, and Zimbabwe (using

their modern names) were likely to reach or surpass seven percent growth.[16] [None of these countries fulfilled Karmarck's prediction. Their median growth 1967-92 was 2.8 percent.]

Hollis Chenery stressed the need for national saving even more heavily in his famous application of the Harrod-Domar/Financing Gap model. Chenery and Strout (1966) start off in the usual way with a model in which aid will "fill the temporary gap between investment ability and saving ability."[17] Investment then goes into growth with the usual ICOR formulation (assumed as a matter of convenience). But they also had a marginal saving rate (i.e. the rate of saving out of the increase in income). This marginal saving rate had to be high enough for the country to eventually move into "self-sustained" growth, in which it financed its investment needs out of its *own* savings. They suggested that donors relate "the amount of aid supplied to the recipient's effectiveness in increasing the rate of domestic saving." (Donors did not follow this suggestion.)

Harrod-Domar meets the computer

Economists computerized Chenery's version of Harrod-Domar at the World Bank in 1971, where Chenery was now the chief economic adviser to Bank President Robert McNamara. The initial motivation for the modelling was to try to predict which countries were going to get into debt difficulties. Bank economist John Holsen wrote down during a long weekend what he called the Minimum Standard Model (MSM). Holsen expected the "minimum" model to have a useful life of about six weeks.[18] He expected country economists to build more elaborate country specific models to supplant it. (As it turned out, it is still being used today 26 years later.)

Economists Nicholas Carter and Norman Hicks revised the MSM a couple of years later and renamed it the Revised Minimum Standard Model (RMSM, known as RimSim in Bank jargon).[19] The growth part of the RMSM was Harrod-Domar -- the growth rate of GDP was equal to Investment/GDP (lagged by one year) divided by the ICOR. Or to put it the other way

round, target growth times the ICOR gave investment requirements. Staff (then and now)

justified target growth rates by targets for poverty reduction or employment creation.

For example, in one of the early uses, the World Bank (1975) set target growth at 7.7

percent for Kenya over 1974-78, which implied investment requirements of 26 percent at the

prevailing ICOR of 3.4. Even though this implied a Financing Gap larger than available

financing, the Bank economists said lower target growth of, say, 5 percent was "not an

acceptable alternative" because the income of the poor would fall. [Kenyan GDP growth over

1974-78 was 4.5 percent.][20]

The Financing Gap informed discussions with other donors over how much aid or other

financing that country needed. Following Chenery -- and equally unheeded -- the RMSM creators

calculated a marginal saving rate and cautioned this had to be high to avoid unsustainable debt.

(Much Latin American and African debt indeed turned out to be unsustainable in the early 80s.)

The use of ICORs and Financing Gaps at the World Bank was not new. A paper in

October 1955 by World Bank economist Dragoslav Avramovic had used the ICOR to discuss

financing needs of Southeast Asian economies.[21] In 1964, World Bank economists analyzing debt

sustainability used a Harrod Domar model with exactly the RMSM specification: aid goes into

investment, and investment/GDP divided by the ICOR equals growth in the following year.[22]

Getting prices right

The run of Harrod Domar in development economics was closing even as RMSM spread

throughout the World Bank. The heyday of the neoclassical critics of development policy, like

Bela Balassa, Arnold Harberger, Anne Krueger, and Ian Little, had come. They argued in the

1970s and 1980s that countries that had *not* had extensive state planning were doing better than

those that had. The success of outward-oriented East Asia suggested "getting prices right" was a

secret to success. The neoclassical critics thought resource *allocation* more important than

resource *quantity*. They pointed out growth failures who had high investment but "wrong" prices.

If asked what growth model they favored, the neoclassical critics would usually say the Solow model. They would say countries that became more open (got prices right) grew faster because they reallocated resources from low to high productivity uses. These efficiency gains would show up in the residual in the Solow model (e.g. Harberger 1983).

But vague connections with the Solow residual did not give a way to determine "aid requirements." And there was a logical fall-back for defenders of Harrod-Domar. Meier's (1995 and earlier versions) well-known book of readings gave what quickly became a new dogma: "Although physical capital accumulation may be considered a *necessary* condition of development, it has not proved *sufficient*."[23] As a leading textbook (Todaro 1994) echoes, "the basic reason why {the investment-led takeoff} didn't work was not because more saving and investment isn't a *necessary* condition -- it is -- but rather because it is not a *sufficient* condition."[24] Or for yet another leading textbook, (Gillis et al. 1996, p. 301) says "for countries with an ICOR of 3, a *necessary*, but not *sufficient* condition for achieving sustained aggregate growth in output of 5 percent is securing capital resources equivalent to 15 percent of GDP."

The "necessary but not sufficient" consensus gave Harrod-Domar a new lease on life. In the donor community in the 1980s, aid now often carried strict conditions on "getting prices right." But the use of the Harrod-Domar model for calculating the "Financing Gap" continued. The idea was that Harrod-Domar gave you the financing requirements for the "necessary" investment, while conditions on getting prices right would give you the "sufficient" conditions for growth.

Unfortunately, enforcement of "getting prices right" turned out to be more difficult than expected (just as enforcing saving conditionality had earlier). Burnside and Dollar 1996 find no evidence that aid affected countries' policies either positively or negatively over 1970-93.[25] The designers of conditionality did not fully appreciate the Samaritan's dilemma -- that a soft-hearted donor cannot credibly commit to withhold funds even if the recipient violates the conditions

(Svensson 1997). The Financing Gap calculation itself created perverse incentives, since -- if the saving conditionality proved ineffective -- it gave more aid to countries that saved less.

Harrod-Domar in The New Growth Literature

Harrod-Domar survived even a whole new wave of theorizing about growth. Ironically, at first the new growth literature seemed to support the Harrod-Domar linear growth-investment relationship. Paul Romer early on (1987) suggested that there WAS a linear relationship between output and physical capital. He started from the Cobb-Douglas version of the Solow model ($Y=AK^{\alpha}L^{1-\alpha}$), but suggested that there was a "learning by doing" externality from physical capital to technological knowledge (K^{β}) so that production was given by:

$$Y=AK^{\alpha}L^{1-\alpha}K^{\beta}$$

If you then assumed that $\alpha+\beta=1$, as Romer (1987) suggested it was convenient to do, then you got a linear relationship between output and capital. He found comfort for this view in cross-section regressions in which growth was significantly and linearly related to the investment rate. (Romer (1987) makes no reference to the longstanding linear growth-investment relation in development economics.)

However, Romer soon became disenchanted with the arbitrary assumption that physical capital would automatically lead to a technological spillover (and of just the right amount to give constant returns to capital). In a recent survey article on the new growth literature, Romer (1994 p. 20) said that his "greatest regret" was "the emphasis on physical capital" in his 1987 paper. He soon turned to models of endogenous creation of new ideas and new goods -- models that were very far from a linear relationship between output and physical capital. As he put it in another article, developing countries suffered *not* from an Object Gap -- like lack of physical capital -- but rather an Idea Gap -- lack of technology (Romer 1993).

Another production function in the new growth literature that seemed in the spirit of Harrod-Domar was Rebelo's (1991) classically simple model that Y=AK. This model had the

short-run linear payoffs to investment that the Harrod-Domar users had promised. However, Rebelo said he meant K to include not just physical capital, but all kinds of capital such as human capital, organizational capital, and technological knowledge. Rebelo's formulation wound up undermining Harrod Domar by adding many more factors of production. There could be too much physical capital relative to human capital, for example, so it was hard to know whether physical capital investment should increase or decrease if you want growth to increase.[26]

This paper is *not* about the long run relationship between investment and growth (about which there is still considerable controversy in the current growth literature.)[27] In the short run, we do not know much about the how long it will take for productive investment to translate into growth, and in what amounts. Even when just one other factor-- human capital -- is included, the dynamics are enormously variable (Mulligan and Sala-i-Martin 1993).

Harrod-Domar in the 90s

The Harrod Domar growth model still lives today in many international organizations. Over 90 percent of country desk economists at the World Bank, for example, use some variant of RMSM today to make projections.[28] They still make (optimistic) assumptions about ICORs and national saving -- World Bank RMSM-based growth forecasts have systematically been too optimistic[29] -- and still calculate the Financing Gap. Bank staff still present the result of this calculation at meetings where aid donors agree upon aid amounts for a specific country. The donors and multilaterals also apply analytical and strategic judgment to determine the aid given, of course, but the number produced by RMSM influences the outcome.

World Bank economists created an extended version called RMSM-X around 1990; I was one of the contributors. We made extensions to the framework by adding fiscal and monetary balances. Unfortunately, we left unchanged the ICOR and Financing Gap core of the model. (While in this confessional mood, I will also acknowledge that there are some ICORs in

my own sordid past.) According to the Spring 1995 RMSM-X reference guide, in the model today "the ICOR and prior investment determine GDP."[30]

The Harrod-Domar/Financing Gap shows up not only in the quantitative calculations of the RMSM-X; it also shows up in the thinking about development expressed by many international organizations. Let's start with several country examples.

Economists used the model even when the model clearly wasn't working. Total GDP in Guyana fell sharply from 1980 to 1990, as investment was increasing from 30 percent to 42 percent of GDP,[31] and while foreign aid every year was 8 percent of Guyana's GDP.[32] The public World Bank report in 1993 argued that Guyana "will continue to need substantial levels of foreign capital inflows ... to provide sufficient resources to sustain economic growth".[33]

Economists used the model amongst recovery from civil war. Bank economists programmed the Ugandan economy in 1996 to grow rapidly (at the ubiquitous 7 percent). With little savings and an ICOR of 3 implying substantial investment requirements, this implied high foreign aid inflows. The World Bank's public report on the economy argued for the high aid because anything less "could be harmful for medium-term growth in Uganda, which requires external inflows..."[34]

Economists also used the model amongst the chaotic transition from Communism to capitalism. The Bank's 1993 report on Lithuania said that "large amounts of external assistance will be required" in order to "provide the resources for critical investments" to stem the output decline.[35] (P. 20)

Economists used the model in the aftermath of macroeconomic crises. The Bank in 1995 told Latin Americans that "enhancing savings and investment by 8 percentage points of GDP would raise the annual growth figure by around 2 percentage points."[36] (i.e. an ICOR of 4).

The World Bank is not alone; virtually all international institutions addressing the needs of poor countries stress the *short-run* necessity of both investment and aid for growth. The

International Monetary Fund (IMF) today trains developing country officials to project

investment requirements as the "target growth rate times the ICOR."[37] The IMF in its own

writings also expresses confidence in a short-run investment-growth link. "Africa's economic

performance is expected to improve in 1992-93", but the improvement in these two years hinges

on -- among other things -- "the increase in investment that is needed to promote economic

growth." [IMF (1992, p. 18)] For Africa, "official financing on concessional terms will be

necessary, but not sufficient, to improve growth prospects." [IMF (1993, p. 79)] In a different

region, the IMF in 1996 told the ex-Communist countries in Europe that "raising investment rates

to 30 percent of GDP" would "double projected growth rates."[38]

The *Inter-american Development Bank* (1995) worried about "the challenge of

sustaining the level of investment necessary for continued output growth."[39] Things looked better

the next year, when the IDB (1996) noted an investment recovery in the 1990s that helped

explain in the short-run "the improved growth performance during the 1990s."[40]

The *European Bank for Reconstruction and Development* in 1995 announced it was

using the "Harrod-Domar growth equation" to project investment requirements. This equation

warned the ex-Communist countries that "investment finance of the order of 20 percent or more

of GDP will be required" to reach "growth rates of 5 percent" (there's that ICOR of 4 again).[41]

So the circle of irony closes. The Communist economies had partly inspired the ICOR,

the Cold War inspired foreign aid, and now the Capitalist economies gave foreign aid to ex-

Communist economies in amounts influenced by the ICOR.[42]

II. Testing the Financing Gap model

As far as I know, nobody has done a full-scale test of the model with cross-country data.

It's easy to understand why. By the time that large-scale cross-country datasets became

available, the model had already fallen out of favor in the academic literature. Yet, as we have

seen, the model lives on in the determination of aid requirements and growth prospects of poor

countries. Research should test not only models that dominate the academic literature, but also models that dominate applied economics practice. Let's now test this model.

Aid to investment

When Harrod-Domar users calculated aid requirements as the excess of "required" investment over actual saving, their presumption was that aid will go one for one into investment. Moreover, aid givers talked about conditionality that would require countries to increase their rate of national saving at the same time, which some thought would even happen naturally, as we saw above. So aid combined with conditionality should increase investment by even more than one to one. Let's see what actually happened.

We have 88 countries on which we have data spanning the period 1965-95 (Table 1).[43] How many of these countries show a significant and positive relationship of foreign aid to investment, with a coefficient greater than or equal to one? Well before getting to these niceties, I have to point out that 60 percent of the countries show a *negative* relationship between foreign aid and investment (Table 1). Just 6 of the 88 countries pass the test of a positive and significant coefficient greater than or equal to one. The magic six include two economies with trivial amounts of aid: Hong Kong (which got an average of .07 percent of GDP in aid 1965-95) and China (average of 0.2 percent of GDP). The other four -- Tunisia, Morocco, Malta, and Sri Lanka -- did have nontrivial amounts of aid. The other 82 countries fail the test.

Table 1: Results of regressing Gross Domestic Investment/GDP on ODA/GDP country by country, 1965-95

Coefficient of Investment on ODA	Number of countries	Percent of Sample
Total	88	100%
Positive, significant, and >=1	6	7%
Positive and significant	17	19%
Positive	35	40%
Negative	53	60%
Negative and significant	36	41%

This result is reminiscent of the results of Boone (1994), who found a zero coefficient on aid in a cross-section investment regression. Unlike Boone (1994), I do not intend here to make a general statement about whether foreign aid is effective. There are many problems in doing such an evaluation, most of all the endogeneity of aid. It could be that in any given country that there was an adverse shock like a drought that caused investment to fall and aid to increase. I am only testing the first link in a particular model -- the Financing Gap/Harrod Domar model. I am asking whether investment and aid jointly evolved the way that the users of this model expected. The Harrod Domar aid advocates anticipated that aid would go into investment, not into tiding countries over droughts. According to Table 1, investment and aid did not evolve the way they expected.

Investment to growth

The second link in the Financing Gap/Harrod-Domar model is the linear growth-investment relationship. Does the linear investment - growth relationship work well in the data? Of course if we recalculate ICOR every period to be (Lagged Investment/GDP) over Growth, then the relationship holds tautologically. What we really want to know is if the relationship has some predictive power, i.e. if we can predict growth with a constant ICOR.

I use Summers and Heston data for GDP and Investment so that the Investment/GDP ratios are in common international prices and comparable across countries. There are 4883 annual observations in a pooled sample of data over 1950-92, with at least partial data for 146 countries. A reasonable reader will object at this point that the use of annual data is inappropriate for a long run relationship like investment and output. I agree. I use annual data only because that is what most applications of the Harrod-Domar/Financing Gap model use (for example, RMSM-X in the World Bank). I will experiment with four-year averages below.

I start out imposing the same ICOR across all countries (an assumption I will relax in a moment). I will regress GDP growth on Lagged Investment/GDP in the entire pooled annual

sample for 146 countries 1950-92. Note that the Harrod-Domar formulation suppresses any

constant term (as does the RMSM version of it in the World Bank). Here is the estimated

relationship:

GDP Growth = 0.186748 * Lagged Investment/GDP   R2= -0.062 4883 observations
**   (0.004467)**

In the entire pooled sample, the ICOR is 5.35. The R-squared is negative, which is of course

possible in a regression that omits a constant term.[44] The negative R-squared says that we could

predict growth better by projecting the global average growth for all countries and years.   The

ICOR model just does not fit growth, as Figure 3 makes clear.

How much is the omission of a constant causing the poor results? With a constant the

relationship becomes:

GDP Growth = 0.033 + 0.039* Lagged Investment/GDP   R2= 0.003 4883 observations
**   (0.002)   (0.0099)**

With a constant (which is highly significant and so rejects the proportionality of growth to

investment of Harrod-Domar), variations in lagged investment/GDP now explain 0.3% of the

variation in annual growth rates. The coefficient on lagged investment is statistically significant

but not of the right magnitude. The implied ICOR on marginal changes in investment is 26,

which would certainly result in a large Financing Gap.

One more thing I can try with the marginal ICOR idea is to run the above equations in

first differences. This would remove any country fixed effects and give us the pure time

dimension of the data, which is what ICOR users emphasize. The results of this experiment are

discouraging. The change in lagged investment explains nothing of the change in growth: the R-

squared is 0.000002 with a constant and -0.0002 without one. The coefficient yields an ICOR of

277.

To check how much the poor performance of the Harrod-Domar model is due to the use

of annual data, I also tried a pooled regression on four-year averages. I lagged investment by one

four-year period, giving me about a thousand observations. Five years is a common forecast

horizon on country desks in the World Bank. Country economists usually project the first year

exogenously, so 4 years is de facto a common horizon.

The results with four-year averages do not bode well for Harrod-Domar. The R2 is -.26

in the regression without a constant (the estimated ICOR is 5.6). In the regression with a

constant, the R2 is 0.0008, lagged investment is statistically insignificant, and the implied ICOR

is 100 (results available upon request).[45] In first differences with four-year averages, I at last get

a positive R-squared in a regression without a constant; unfortunately, the relationship between

the change in growth and the lagged change in investment is *negative*.

Let's now allow the ICOR to vary across countries by regressing growth on lagged

investment to GDP individually for each country. We have 138 countries with at least 10

observations on growth and lagged investment. When we regress growth on lagged investment,

we have the same problem as in the pooled model with no constant: well over half of the

countries have a negative R-squared (Table 2). We would have been better off predicting growth

in each country by just presuming it was constant (at its historical average, for example).

Moreover, to make things worse, of the countries with positive R-squared, only half of them --

less than a fifth of the sample -- have an ICOR in the "reasonable" range between 2 and 5 (some

restriction to a "reasonable range" is desirable because the estimated ICORs in this sample vary

from -35 to 18).

Table 2: Regressing GDP growth on lagged Investment/GDP with no constant, for each country, 1950-92

	Number of countries	Share of sample
Total	138	100%
R2>0 and 2<ICOR <5	26	19%
R2>0	50	36%
R2<0	88	64%

Table 3 shows the results of including a constant in these country by country regressions.

Table 3: Results of regressing GDP Growth on Gross Domestic Investment/GDP with a constant, country by country, 1950-92

Coefficient of Growth on Investment/GDP	*Number of countries*	*Percent of Sample*
Total sample	**138**	**100%**
Positive, significant, "zero" constant, and 2<ICOR<5	**4**	**3%**
Positive and significant	**11**	**8%**
Positive	**77**	**56%**
Negative	**61**	**44%**
Negative and significant	**10**	**7%**

Only a small fraction of the countries have a positive and significant relationship between growth and lagged investment, and an even smaller fraction are in the "usual" ICOR range between 2 and 5. I also require these countries have a constant insignificantly different from zero to fit Harrod-Domar. The four economies that pass the Table 3 test are an unusual assortment: Israel, Liberia, Reunion (a French colony), and Tunisia.[46]

Remembering the few countries where the aid-to-investment link worked as expected, I can now say that the Financing Gap/Harrod-Domar model fits one country: Tunisia. Unfortunately, 1 success out of 138 countries is likely to have occurred by chance even if the model made no empirical sense -- which so far the evidence says it doesn't.

Is investment necessary in the short-run?

For the other 137 countries, the ritual incantation of practitioners at this point is that "investment is *necessary* but not *sufficient*." Table 4 shows how often the necessary investment rates (lagged one period) accompany one-year high growth episodes over 1950-92 (defining high growth as 7 percent or above, a desideratum often mentioned, as we have seen).[47] At the optimistic ICOR of 2 we have less than half of the sample complying with the necessary conditions. At the "normal" ICOR of 3.5, nine-tenths or more of the sample violate the "necessary" condition. At an ICOR of 5, the "necessary" investment accompanied just 1 percent

of the high growth episodes. (Recall that the regressions estimated ICOR to be above 5 in both the annual and four-year-average datasets).

The second column of Table 4 shows how many four-year-long growth episodes were accompanied by the necessary investment rates (lagged one period). There were *no* four-year high growth episodes that had the "required" investment implied by an ICOR of 5; even at the highly optimistic ICOR of 2 just half of the episodes had the "required" investment. At the short-run horizons at which development analysts work, there is no evidence that investment is a necessary condition for high growth.

Table 4: How "necessary" is investment in the short run?

High growth episodes (7 percent or above) that have "required" investment/GDP (%):

	Period lengths	
Assuming ICOR of:	**Annual averages**	**Four-year averages**
5	**1%**	**0%**
3.5	**9%**	**11%**
2	**37%**	**49%**

Note: investment is lagged one period, for both 1-year and 4-year averages.

Using the 1-year and 4-year averages for both growth and investment, let's also look at episodes where growth increased and see how often investment increased by the "required amount." Table 5 gives us the answer: during episodes of increased growth with four-year periods, investment increased by the "required amount" between 6 and 12 percent of the time, depending on the ICOR. The other 88 to 94 percent of the episodes violated the "necessary condition". Of course, the data are even more unkind to the "necessary condition" with annual averages. Empirically speaking, increases in investment are neither necessary nor sufficient for increases in growth over the medium run.

Table 5: How "necessary" is increased investment in the short run?
Increased growth episodes that have "required" increase in investment/GDP (%):

Assuming ICOR of:	Period lengths	
	Annual averages	Four-year averages
5	3%	6%
3.5	4%	6%
2	7%	12%

Note: investment is lagged one period, for both 1-year and 4-year averages.

Jointly evaluating the aid-to-investment and investment-to-growth links

We can construct a counterfactual of what income a country would have achieved if the predictions of the Financing Gap/Harrod Domar model had been correct, and then compare the counterfactual to the actual outcome. The Model predicts that aid goes into investment one to one, or more. I stick to the one to one prediction to be conservative. So investment/GDP will increase over the initial year by the amount that aid/GDP increases over the initial year. Then this investment will increase growth, with a one year lag. (I will use an ICOR of 3.5 since it's the mid-point of the commonly cited 2 to 5 range.) This predicts total GDP growth. To get per capita growth, we subtract population growth (remember in Harrod-Domar, more labor does not increase total GDP). So we have the prediction:

GDP Growth per capita = (Initial Investment/GDP + Aid/GDP (minus Aid/GDP in initial year))/ICOR - Population growth

Figure 4 shows the comparison of Zambians' actual average income to what would have been, if filling the Financing Gap in the Harrod-Domar model worked. Zambia would today be an industrialized country, instead of being one of the poorest countries in the world. Zambia is one of the worst-predicted cases because it initially had a high investment rate and it got a lot of aid. Zambia's investment rate went down, not up, as the aid increased and the investment in any case did not yield ICOR-like growth.[48]

Figure 5 shows the predicted Harrod-Domar/Financing Gap growth for all of the aid recipients. I show predicted per capita growth on the horizontal axis and actual per capita growth on the vertical axis. If the equation had predicted growth well, we would expect to see points

clustering along the 45% line through the diagram. We do not see such a clustering. We have

predicted superstars like Guinea-Bissau, Jamaica, Zambia, Guyana, Comoros, Mauritania, and

Zimbabwe, countries who instead turned out to be growth disasters. We have real superstars like

Singapore, Thailand, and Indonesia that the equation did not pick up. The correlation of actual

and predicted growth is slightly negative.

Another way that we can evaluate the Harrod-Domar/Financing Gap model is to test the

constraints it puts on the coefficients of a cross-section growth regression. I regress average

growth per capita 1960-92 on initial investment/GDP, average aid/GDP, and average population

growth. The unconstrained regression looks like this:

Growth per capita = 2.92 - .004 (Initial invsmt/GDP) - .119 (Aid/GNP) -.330 (Pop growth)
**   (0.86)   (.023)   (.033)   (0.274)**

72 observations, R2=.181

The Harrod Domar/Financing Gap model predicted that the constant would be zero, the

coefficients on initial investment and Aid would be equal and positive, and the coefficient on

population growth would be -1. All of these predictions are rejected. The constant is

significantly above zero.[49] The coefficient on Aid/GNP is significantly negative.[50] The

coefficient on population growth is significantly different from -1 (people do contribute to GDP

apparently).

Suppose I run constrained least squares imposing all of the predictions of the Harrod-

Domar/Financing Gap model:

Growth per capita = .171*(Initial invstmt/GDP + Aid/GDP) - 1 (Population growth)
**   (.022)**
72 observations, R2=-1.75

Here the only free parameter being estimated is the (equal) coefficient on Initial Investment/GDP

and Aid/GDP, which comes out to imply an ICOR a little over 5. I impose the constant to be

zero and the coefficient on population growth to be -1. These constraints do so much violence to

the data as would earn them a life sentence in most states. The R2 turns sharply negative, as can happen with constrained least squares. I perform an F-test of the null hypothesis that all three constraints (zero constant, equal coefficients on investment and aid, and -1 on population growth) hold. I reject the null hypothesis rather emphatically: the P-value for the test statistic is 7.3E-18 (about 1 in 100 quadrillion).

III. Conclusions

The Harrod Domar growth model lies behind Financing Gap calculations that influence economic policy and the allocation of aid resources. Yet, the Harrod Domar growth model makes no sense theoretically and it fails empirically.

It is not hard to think of better rules for determining aid amounts per country than Filling the Financing Gap. Donors could allocate aid per capita to poor countries according to which countries have the best track records on economic policies. Likewise, it's not hard to think of better ways of projecting growth than to use a model that makes no sense theoretically and fails empirically. Country economists could project growth subjectively using world average growth, the country's historical average growth, country policies, and external conditions. International organizations spending money on running Harrod-Domar/Financing Gap models could perhaps put those resources to better use elsewhere.

Even for countries that do not receive aid, like most in Latin America, the Harrod-Domar/Financing Gap model is not a reliable guide to policy. For example, as we have seen, ICOR calculations often lead to urgent calls for increasing saving. This in turn leads to calls for the government to increase saving, much like in the 1960s (cf. Bhagwati 1966 above). Since a decline in private saving offsets 40 to 60 percent of any increase in public saving (Serven and Schmidt Hebbel (1997), p. 92), one also has to make the far from obvious case that government can use these savings better than private firms and households.

This paper also raises the question of how such a wide gap developed between the academic growth literature and the applied economists trying to get real economies to grow. I suspect that once such a wide gap opens, incentives are weak on both sides to close it.

In sum, there is no theoretical or empirical justification for assuming a short-run proportional relationship between investment and growth. There is no theoretical or empirical justification for calculating a "financing gap" between "investment requirements" and saving. There is no theoretical or empirical justification for using such a "financing gap" calculation to influence policy or the allocation of foreign aid. After forty years, the Ghost of Financing Gap can finally be laid to rest.

Bibliography

Arndt, H.W. *Economic Development: The History of an Idea*, Chicago, 1987.

Avramovic, Dragoslav. *Postwar economic growth in Southeast Asia*, E.C. 48, International Bank for
    Reconstruction and Development, October 10, 1955.

Barro, Robert J. 1991 "Economic Growth in a Cross Section of Countries." *Quarterly Journal of
    Economics*. May

_____ and X. Sala-i-Martin, *Economic Growth*, McGraw Hill, 1995

PT Bauer, *Dissent on Development: Studies and debates in development economics*, Harvard University
    Press 1972

Bhagwati, Jagdish, *The Economics of Underdeveloped Countries*, McGraw Hill: New York, 1966

Boone, Peter. "The Impact of Foreign Aid on Savings and Growth," London School of Economics, mimeo,
    1994.

Boserup, Mogens. "Warning against optimistic ICOR statistics," *Kyklos* Vol. XXII, 1969, pp. 774-776.

Burnside, Craig and David Dollar, "Aid, Policies, and Growth," World Bank mimeo, November 1996.

Chenery, Hollis B. and Alan M. Strout, "Foreign Assistance and Economic Development", *The American
    Economic Review*, Volume LVI, Number 4, Part I, September 1966.

De Long, J. Bradford and Lawrence H. Summers, "How strongly do developing economies benefit from
    equipment investment?" *Journal of Monetary Economics* 32:395-415 December 1993

De Long, J. Bradford and Lawrence H. Summers, "Equipment investment and economic growth", *Quarterly
    Journal of Economics*, May 1991, Vol CVI, Issue 2, 445-502

Devarajan, Shanta, Vinaya Swaroop, and Heng-fu Zou. "The composition of public expenditure and
    economic growth." *Journal of Monetary Economics* 37:313-44, April 1996

Domar, Evsey. "Capital Expansion, Rate of Growth, and Employment", *Econometrica*, Vol. 14, (April
    1946), pp. 137-47.

Domar, Evsey. *Essays in the Theory of Economic Growth*, Oxford University Press, 1957.

Easterly, W. And S. Fischer, "The Soviet Economic Decline," *World Bank Economic Review*, Volume 9,
    No. 3: 341-371.

Easterly, W. and Rebelo S., "Fiscal policy and economic growth: an empirical investigation," *Journal of
    Monetary Economics*, Volume 32, No. 3, December 1993.

Edwards, Sebastian. *Crisis and Reform in Latin America: From Despair to Hope*. Oxford University Press
    for the World Bank. New York. 1995.

European Bank for Reconstruction and Development, *1995 Transition Report*

Gillis, Malcolm, Dwight Perkins, Michael Roemer, and Donald Snodgrass, *Economics of Development*,
    WW Norton and Company (New York: 1996).

Harberger, Arnold. "The Cost-Benefit Approach to Development Economics," *World Development* Vol. 11, no. 10 (1983), pp. 864-66 (reprinted in Meier 1995)

Hayes, J.P. assisted by Hans Wyss and S. Shahid Husain, "Long-run growth and debt servicing problems: projection of debt servicing burdens and the conditions of debt failure", in Dragoslav Avramovic et al., *Economic Growth and External Debt*, Economic Department, International Bank for Reconstruction and Development, 1964

Inter-american Development Bank*, Economic and Social Progress in Latin America,* 1996 Report

Inter-american Development Bank*, Economic and Social Progress in Latin America,* 1995 Report

International Monetary Fund, *Financial Programming and Policy: The Case of Sri Lanka*, 1996a.

International Monetary Fund, *World Economic Outlook* October, 1996c

International Monetary Fund, *World Economic Outlook*, October 1993

International Monetary Fund, *World Economic Outlook*, May 1992

Kamarck, Andrew M. *The Economics of African Development*. Praeger: New York, 1967

King, Robert and Ross Levine, "Capital Fundamentalism, economic development, and economic growth," *Carnegie-Rochester Conference Series on Public Policy* 40 (1994), North-Holland, 259-292

Kuznets, Simon, "Notes on the Takeoff", in W.W. Rostow, ed., *The Economics of Takeoff into Self-Sustained Growth*, MacMillan Ltd. (London: 1963)

Leibenstein, H. "Incremental Capital-Output Ratios and Growth Rates in the Short Run," *Review of Economics and Statistics*, February 1966, pp. 20-27.

Lewis, W. Arthur, "Economic Development with Unlimited Supplies of Labor", *Manchester School*, May 1954, 22, 139-92.

Meier, G.M. ed. *Leading Issues in Economic Development*, 6th ed, Oxford, 1995.

Mulligan, Casey B. and Sala-i-Martin, Xavier. "Transitional dynamics in two- sector models of endogenous growth," *Quarterly Journal of Economics* 108:739-73 August 1993

Patel, Surendra J. "A Note on the Incremental Capital Output Ratio and Rates of Economic Growth in the Developing Countries," *Kyklos* Vol. XXI, 1968, pp. 147-150.

Pritchett, Lant. "Mind your p's and q's: the cost of investment is not the value of public capital", World Bank Working Paper 1660, October 1996.

Rebelo, Sergio. 1991. "Long run policy analysis and long run growth," *Journal of Political Economy* 99, 500-521.

Rodrik, Dani. "Getting interventions right: how South Korea and Taiwan grew rich." *Economic Policy* 20:55-107 April, 1995a

Rodrik, Dani. "Trade Strategy, Investment, and Exports: Another Look at East Asia." NBER Working Paper #5339, November, 1995b

Romer, Paul. "The Origins of Endogenous Growth." *Journal of Economic Perspectives*, Volume 8, Number 1, Winter 1994, Pages 3-22.

Romer, Paul. "Idea gaps and object gaps in economic development," *Journal of Monetary Economics*, Volume 32, No. 3, December 1993, 543-574.

Romer, Paul. "Crazy Explanations for the Productivity Slowdown," in Fischer, S. Ed., *NBER Macroeconomics Annual*. Cambridge: MIT Press, 1987, 163-202

Rostow, W.W. *The Stages of Economic Growth: A Non-Communist Manifesto*, Cambridge, 1960.

Schmidt-Hebbel, Klaus and Luis Serven, *Saving Across the World: Puzzles and Policies*, World Bank Discussion Paper No. 354, 1997.

Svensson, Jakob. "When is Foreign Aid Policy Credible? Aid Dependence and Conditionality", World Bank Working Paper #1740, March 1997.

Thorp, Willard. "American Policy and the Soviet Economic Offensive", *Foreign Affairs*, October 1956

Vanek, J. And A. H. Studenmund, "Towards a better understanding of the incremental capital-output ratio," *Quarterly Journal of Economics*, August 1968, pp. 452-64.

Wiles, Peter. "Soviet Economy Outpaces the West", *Foreign Affairs*, July 1953, pp. 566-580.

World Bank, 1996, *Uganda: The Challenge of Growth and Poverty Reduction*

World Bank, 1995a, *Latin America After Mexico: Quickening the Pace*, June 1995

World Bank, 1995b, *RMSM-X Model Building Reference Guide*, July

World Bank, 1993a, *Guyana: From Economic Recovery to Sustained Growth*

World Bank, 1993b, *Lithuania: The Transition to a Market Economy*

World Bank, 1991, *World Development Report*

World Bank, 1975, *Kenya: Into the Second Decade*, The Johns Hopkins University Press.

Young, Alwyn. "The Tyranny of Numbers: Confronting the Statistical Realities of the East Asian Growth Experience," *Quarterly Journal of Economics*, August 1995, pp. 641-680.

Young, Alwyn. "A Tale of Two Cities: Factor Accumulation and Technical Change in Hong Kong and Singapore," *NBER Macroeconomics Annual 1992*, Olivier J. Blanchard and Stanley Fischer, eds. (Cambridge MA: The MIT Press, 1992).

Endnotes

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[1] see pp. 7-8, Domar (1957)

[2] Note that the theory says that investment net of depreciation should be the relevant concept. Most economists who have used the ICOR ever since have erroneously used gross rather than net investment.

[3] Arndt, 1987, p. 33.

[4] Arndt 1987, p. 49. quote from UN World Economic Report 1948.

[5] For example, Meier 1995, p. 164. Note that ICOR is not really a pure number since it depends on the relative price of investment goods in the base year..

[6] W.A. Lewis 1954, p. 139

[7] p. 255, Domar 1957

[8] Kuznets (1963), P. 35. This was a rare example of actually testing the Harrod-Domar-Lewis-Rostow ICOR model. There was afterwards a curious literature (e.g. Patel 1968, Vanek and Studenmund 1968) noting the strong inverse correlation between growth and the ICOR (Investment/growth). Leibenstein (1966) and Boserup (1969) were clear-headed enough to point out that this negative correlation would come about mechanically if there was a low short-run correlation between growth and investment.

[9] Edwards (1995, p. 224)

[10] Wiles 1953 and Thorp 1956.

[11] Rostow 1960, p. 37.

[12] Rostow was unfortunately also on the winning side of the debate in the Johnson administration about whether to send American troops to an aid recipient named South Vietnam. Excluding aid to South Vietnam does not change the directions of trends shown in figure 1.

[13] Defined as members of the Organization for Economic Cooperation and Development, which includes Western Europe, North America, Australia, New Zealand, and Japan. Data is from OECD.

[14] PT Bauer 1972, p. 127.

[15] Bhagwati 1966, p. 69, p. 170, p. 219.

[16] Kamarck 1967, p. 247.

[17] Chenery and Strout 1966 called their model the Two Gap model. The investment-savings gap was one of the Two Gaps; the other was the trade gap which ex post is equal to the investment gap, but ex ante might be a constraint in a shortage prone economy with fixed prices. I'll ignore the other gap throughout this paper, since it was less influential in development practice once market-friendly policies came into vogue and made shortage prone economies less likely.

[18] Correspondence with John Holsen, December 17, 1996.

[19] Correspondence with Nick Carter and Norman Hicks, December 16, 1996.

[20] World Bank 1975, p. 104, 108.

[21] Avramovic, 1955.

[22] Hayes 1964

[23] P. 153 Meier 1995

[24] p. 73, Todaro 1994.

[25] p. 29, Burnside and Dollar 1996.

[26] The new growth literature also emphasized that physical investment responded to the rate of return to investment (not to availability of foreign aid). Private investment was endogenous, after all, not a policy lever of the government. The one part of investment that was exogenous, and a policy lever -- public investment --was not doing well. Researchers failed to find significant positive coefficients in growth regressions on aggregate public investment (Easterly and Rebelo 1993, Devarajan et al. 1995), which is plausible once one realizes that much public "investment" did not translate into productive capital (Pritchett 1996).

[27] The literature found a robust association between cross-section 30-year averages for investment and growth, although causality was unclear (Levine and Renelt 1992). Many regressions for growth across countries omitted investment altogether on the grounds that it was endogenous (Barro 1991). Some growth regressions that included investment but instrumented for it failed to find it significant (Barro and Sala-i-Martin 1995). Growth accounting exercises across all countries (e.g. King and Levine 1993) found a fairly small share of growth differences accounted for by capital accumulation. On the other side of the debate, there are the famous growth accounting exercises of Young (1995,1992) that argued that capital

accumulation explained much of East Asian growth. Rodrik (1995a,b) also argues that increases in investment were a causal force in East Asia's success. DeLong and Summers (1991, 1993) argue that equipment investment is a causal force in long-run growth.

[28] Estimate by Jos Verbeek, the World Bank's RMSM-X coordinator, from a survey.

[29] World Bank 1991, p. 28 shows that in 1979 the Bank forecast average LDC growth of 5 percent in the 1980s. The actual average growth in the 1980s was 3 percent.

[30] p. 7, World Bank 1995b.

[31] World Bank 1993a.

[32] OECD data

[33] World Bank, 1993a, p. 32.

[34] p. 23, World Bank 1996.

[35] p. 20 World Bank, 1993b.

[36] The World Bank 1995a. (P. 10, p. 23)

[37] p. 228 and p. 239, IMF 1996a.

[38] IMF 1996c. (P. 88)

[39] Interamerican Development Bank 1995, p. 19

[40] Interamerican Development Bank 1996, p. 35

[41] European Bank for Reconstruction and Development 1995, p. 66, p. 5, p. 71.

[42] The Soviets' own linear Growth- Investment relation fell apart. In the 1960s, 1970s, and 1980s, growth rates were falling even though investment rates kept rising (Easterly and Fischer 1995).

[43] I am using data in domestic prices for investment, since ODA is not purchasing power adjusted. When I put all the data together I will be forced to mix PPP and domestic price data. The data on Overseas Development Assistance is from the OECD.

[44] The coefficient (standard error in parentheses) is positive and highly significant, but this significance does not tell us anything about the relationship between growth and investment. In the absence of a constant and when both GDP growth and Investment/GDP have positive means, the coefficient is guaranteed to be positive even if Growth is negatively related to Investment.

[45] These results are like those of Blomstrom, Lipsey and Steiner 1996, who found with 5-year periods found that investment was a function of lagged growth, but growth was not a function of lagged investment.

[46] These calculations are done with Summers Heston data at international prices for both output and investment. However, similar results obtain if you use World Bank national accounts at domestic prices

[47] For example, the developing nations in September 1980 in the UN set a target of 7 percent growth for themselves as part of the ill-fated North-South negotiations; also note earlier text examples.

[48] I used Summers and Heston GDP and Investment rates. For aid/GDP, I used the numbers from the OECD for overseas development assistance in current prices. This is not ideal, since aid/GDP is not PPP adjusted and so how much investment it would buy could be over- or under-estimated.

[49] One could rationalize a constant because of the use of gross rather than net investment; unfortunately the predicted constant is negative (it is just -depreciation rate) and so is even further from the results in the unrestricted equation.

[50] I don't intend this to be a test of whether aid raises or lowers growth; it's simply a test of whether this set of variables jointly evolved as the Harrod Domar/Financing Gap Model predicted they would. I would have to address the selection bias problem that more aid will be given to those that have low income or adverse exogenous income shocks to address the efffect of aid on growth, as studies like Boone (1995) and Burnside and Dollar (1996) have done. However, the users of the Harrod-Domar model did not intend aid to be cushioning adverse shocks, so the negative coefficient contradicts their expectation that aid would go into investment and thus into growth.