Journal of Monetary Economics 32 (1993) 485–512. North-Holland

The role of macroeconomic factors in growth

Stanley Fischer*
M.I.T., Cambridge, MA 02139, USA

Received March 1993, final version received September 1993

Using a regression analog of growth accounting, I present cross-sectional and panel regressions showing that growth is negatively associated with inflation, large budget deficits, and distorted foreign exchange markets. Supplementary evidence suggests that the causation runs from macroeconomic policy to growth. The framework makes it possible to identify the channels of these effects: inflation reduces growth by reducing investment and productivity growth; budget deficits also reduce both capital accumulation and productivity growth. Examination of exceptional cases shows that while low inflation and small deficits are not necessary for high growth even over long periods, high inflation is not consistent with sustained growth.

Key words: Growth; Inflation; Budget deficits; Productivity; Investment

JEL classification: E00; O11; O57

1. Introduction

It is now widely accepted that a stable macroeconomic framework is necessary though not sufficient for sustainable economic growth.[1] In this paper I present international cross-sectional regression evidence that supports the view that growth is negatively associated with inflation and positively associated with good fiscal performance and undistorted foreign exchange markets. I also present evidence suggesting that the causation runs in part from good macroeconomic policy to growth.

Correspondence to: Stanley Fischer, M.I.T., E52–373, Cambridge, MA 02139, USA.

* Also affiliated with the NBER. This paper is part of the World Bank's Growth Project. I am grateful to Michael Bruno, Jose de Gregorio, Robert King, Ken Rogoff, and Sweder van Wijnbergen for helpful suggestions and comments, to participants in a Hebrew University seminar, especially Michael Beenstock and Giora Hanoch, for suggestions, and to Ruth Judson for excellent research assistance.

[1] See World Bank (1989, 1990, 1992).

The view that a stable macroeconomic framework is conducive to growth is also supported by much striking nonregression evidence. In Latin America, the recovery of economic growth in Chile and Mexico was preceded by the restoration of budget discipline and the reduction of inflation.[2] By contrast, the ongoing growth crisis in Brazil coincides with high inflation punctuated by stabilization attempts and continued macroeconomic instability. The fast growing countries of East Asia have generally maintained single- or low double-digit inflation, have for the most part avoided balance of payments crises, and when they have had them – as for instance in Korea in 1980 – moved swiftly to deal with them. The lessons of the case study evidence amassed in the major World Bank research project, headed by Little, Cooper, Corden, and Rajapatirana (1992),[3] support the conventional view. The notion that macroeconomic stability is not sufficient for growth is supported by evidence from Africa, where most of the countries of the franc zone have grown slowly since 1980 despite low inflation.

This paper considerably extends and strengthens results presented in Fischer (1991). In that paper, I used the conventional approach of adding macroeconomic variables to the basic growth regression. In this paper, in sections 4 through 6, I develop an alternative approach due to Elias (1992), a regression analog of growth accounting. I present both pure cross-sectional regressions as well as panel regressions, which exploit the time series as well as cross-sectional variation in the data. I also explore nonlinearities in the relationship between inflation and growth.[4] In section 7 I discuss the issue of the causality between inflation and economic growth. Then in section 8 I identify and discuss some apparent exceptions, countries where high growth took place despite high inflation and/or large deficits, and conclude that the statement that macroeconomic stability is necessary for sustainable growth is too strong, but that the statement that macroeconomic stability is conducive to sustained growth remains accurate.

The paper opens in section 2 with a discussion of the notion of a stable macroeconomic framework and of the theoretical considerations linking growth to macroeconomic policies. In section 3 I briefly review recent evidence on the link between macroeconomic conditions and growth, most of it based on the standard mixed regression which includes among its regressors the rate of investment.

2. Definitions and theoretical considerations

In practice the concept of a stable macroeconomic framework is used to mean a macroeconomic policy environment that is conducive to growth. The

[2] However, in both cases it took several years to reduce inflation to the moderate, 15–30 percent, range.

[3] Summarized in Corden (1991).

[4] Nonlinearities in the inflation–growth relationship have also been explored by Levine and Zervos (1992).

macroeconomic framework can be described as stable when inflation is low and predictable, real interest rates are appropriate, fiscal policy is stable and sustainable, the real exchange rate is competitive and predictable, and the balance of payments situation is perceived as viable.[5] This definition goes beyond the stability of macroeconomic policy variables to include also the criterion that policy-related variables are at levels conducive to growth.

Of the five criteria specified in the preceding definition, only low and stable inflation is readily quantifiable.[6] None of the specified variables is directly controllable by policy, and each should optimally vary in response to shocks. Given the practical difficulty of defining and measuring the stability of the macroeconomic framework, or the optimal or appropriate inflation rate, real interest rate, real exchange rate, and so forth, I instead proceed by specifying indicators of macroeconomic policy.

The basic indicators of macroeconomic policy are the inflation rate, the budget surplus or deficit, and the black market exchange premium. I shall use the inflation rate as the best single indicator of the conduciveness of macroeconomic policies to growth[7] and the budget surplus as the second basic indicator.

In essence, the inflation rate serves as an indicator of the overall ability of the government to manage the economy. Since there are no good arguments for very high rates of inflation, a government that is producing high inflation is a government that has lost control. All governments announce that they aim for low inflation, and the macroeconomic situation in any medium or high inflation economy can therefore be expected to change. While there are economies in which inflation remains at moderate levels for prolonged periods [Dornbusch and Fischer (1993)], economic agents in a high or medium inflation economy have to expect an attack – typically many attacks – on inflation at some point.

Countries may for a long time succeed in maintaining low and stable inflation through policies that are not ultimately sustainable. Such countries, for instance those in the franc zone, may face fiscal or balance of payments crises that could necessitate sharp changes in macroeconomic policy and that certainly increase macroeconomic uncertainty. The fiscal deficit is a good, though imperfect, indicator of such an unsustainable situation. In addition, as discussed below, the deficit is likely to affect growth through its effects on capital accumulation.

[5] This definition is based on World Bank (1990a, p. 4).

[6] With regard to quantification of the other four variables: Measures of the fiscal deficit provide some information about fiscal policy; however it is difficult to characterize fiscal policy by a single variable [MacKenzie (1989)], and international fiscal data are poor. Estimates of sustainable deficits could in principle be calculated along the lines of Hamilton and Flavin (1986), but that level of detail would require a much more extensive study than can be carried out in the current project. The competitiveness of the real exchange rate could in principle be estimated by its implications for current and future levels of the current account, while the appropriateness of the real interest rate is difficult to specify.

[7] The potential links between inflation and growth are discussed and developed in Fischer (1983) and by implication in Fischer and Modigliani (1978), and are taken up below.

I use the black market premium on foreign exchange as an indicator of the sustainability and appropriateness of the exchange rate. The black market premium is a good indicator of a distorted or controlled market for foreign exchange, but is less good as an indicator of the unsustainability of the exchange rate, since an exchange rate may be overvalued and unsustainable even when there is no black market premium.

Most developing countries experienced major terms of trade shocks during the period over which the regressions in this paper are estimated. The terms of trade are included as a separate exogenous determinant of macroeconomic performance.[8]

The usual emphasis on the stability of the macroeconomic framework (rather than its conduciveness to growth) suggests that the main reason macroeconomic factors matter for growth is through uncertainty. There are two main channels through which uncertainty could affect growth. First, policy-induced macroeconomic uncertainty reduces the efficiency of the price mechanism, as in the classic Lucas (1973) contribution. This uncertainty, associated with high inflation or instability of the budget or current account, can be expected to reduce the *level* of productivity and, in contexts where the reallocation of factors is part of the growth process, also the *rate of increase* of productivity. Second, temporary uncertainty about the macroeconomy tends to reduce the rate of investment, as potential investors wait for the resolution of the uncertainty before committing themselves [Pindyck and Solimano (1993)]. This channel suggests that investment would be lower at times when uncertainty is high, and its presence should therefore be more noticeable in the time series than cross-sectional data.[9] Capital flight, which is likely to increase with domestic instability, provides another mechanism through which macroeconomic uncertainty reduces investment in the domestic economy.

The variability of inflation might serve as a more direct indicator of the uncertainty of the macroeconomic environment. However, the inflation rate and the variance of the inflation rate are highly correlated in the cross-section, making it difficult to disentangle the effects on growth of the level of inflation from the effects of uncertainty about inflation. By adding a time series measure of inflation variability to the panel regressions, I attempt in this paper to bring further evidence to bear on the level–uncertainty distinction, but with limited success.[10]

The 1950s and 1960s growth theory literature on inflation and growth emphasized the positive impact of inflation on capital accumulation that occurs

[8] Data sources are described in the appendix.

[9] Solimano (1989) presents time series evidence supporting this relationship.

[10] Aizenman and Marion (1991) attempt to quantify policy uncertainty by estimating autoregressive processes for policy variables and using the standard deviations of policy surprises as a measure of uncertainty. This is a promising approach, which however does not distinguish contemporaneous variability caused by responses to exogenous shocks from purely random variability.

as a result of the portfolio shift away from money when the rate of return on money falls, the Mundell–Tobin effect. Subsequent contributions, noting various complementarities between real balances and capital – whether through the production function or because of a cash-in-advance constraint – predicted that higher inflation would reduce capital accumulation.[11] Similarly, all the costs of inflation detailed in Fischer and Modigliani (1978) – including the impact of inflation on the taxation of capital – would imply a negative association between the level of income and inflation and, through the new growth theory mechanisms, between inflation and growth. It is also possible that the relationship between inflation and growth is nonlinear.

Turning to the other macroeconomic indicators: The budget surplus should be positively associated with capital accumulation. There are again two reasons. The first is crowding out. The second is that, like the inflation rate, the deficit serves as an indicator of a government that is losing control of its actions.

An increase in the black market exchange premium is an indicator of expectations of depreciation of the exchange rate and foreign exchange rationing. This suggests that capital accumulation and the black market premium are likely to be negatively related. One influence in the opposite direction arises from the fact that when foreign exchange access is controlled, there is frequently preferential treatment for the import of investment goods.

Of course, each of these indicators has its shortcomings as a policy measure. In the short run, neither the inflation rate nor the budget deficit is unaffected by the growth rate. For instance, a supply shock will both reduce the growth rate and raise the inflation rate; and given government spending, a reduction in growth will increase the deficit. Two main types of regressions are reported in this paper. In the cross-sectional regressions, the period average (usually 1961–88) growth rate or other dependent variable for each country is regressed on period average values of such right-hand-side variables as inflation and the budget deficit. In the panel regressions, similar regressions are run using both the time series variation within each country and the cross-sectional variation. The problem of reverse causation is more likely to arise in the panel regressions. In principle, the use of instrumental variables can deal with the endogeneity problem, but in practice appropriate instruments are difficult to find. The endogeneity problem is less severe in the cross-sectional regressions, where the length of period is more than 25 years. Over such long periods, the average rates of inflation and the deficit are more likely to be determined by the government's basic policy stance than by the short-run association between shocks and the endogenous policy indicators. In addition, I use prior knowledge, the timing of the 1973 oil shock, to break the period down into one in which demand shocks predominated (pre-1973) and one in which there were many supply shocks, and

[11] For references to the literature through 1983, see Fischer (1983).

show that the results based on the pre-1973 data also support the basic contention of this paper.

3. Existing empirical evidence

Beyond the evidence of the examples presented in the introduction, the simple statistical evidence supports the basic proposition that macroeconomic stability is conducive to growth. Inflation in fast-growing Asia is well below the rates of price increase in slower-growing Africa and Latin America (table 1), and across the three periods shown in table 1 inflation in each area has moved inversely with growth.[12] Levine and Renelt (1992) show that high growth countries are also lower inflation countries, have smaller governments, and lower black market exchange rate premia – the latter reflecting disequilibria in the official foreign exchange markets.

The large volume of empirical work inspired by the new growth theory consists largely of cross-country regressions, typically using the Summers–Heston (1988) ICP data.[13] Levine and Renelt (1992), list 40 cross-sectional growth studies published between 1980 and 1990.[14] Their paper starts from a basic regression in which per capita real income growth (*GYP*, from the World Bank data base) is regressed on Summers–Heston initial real income (*RGDP60*), population growth (*GN*), the 1960 rate of secondary school enrollment (*SEC*), and the share of investment in GDP (*INV*). The regression is estimated on a sample of 101 countries, over the period 1960–89 (*t*-statistics in parentheses):

$$\begin{aligned} GYP = & -0.83 - 0.35\ RGDP60 - 0.38\ GN \\ & (-0.98)\ (-2.50) \qquad (-1.73) \\ & + 3.17\ SEC + 17.5\ INV, \\ & (2.46) \qquad (6.53) \\ & \bar{R}^2 = 0.46. \end{aligned} \tag{1}$$

[12] The World Bank SAVEM tables from which table 1 is derived present more regional detail than does table 1. For both South Asia and East Asia, growth and inflation change in the same direction between 1965–73 and 1973–80. For the Middle East and North Africa, growth and inflation exhibit the same general correlation as is seen in table 1, that is, they move in opposite directions from period to period. [I should also note that a table similar to table 1 is presented in Fischer (1991). The inflation rate for Asia in that table (for which the first period is 1960–73) is shown as increasing from period to period, with an average of only 2 percent for 1960–73. Both tables are taken from the same source, and I am unable to account for the different patterns of Asian inflation, though they may arise from changes in country coverage and data revisions or possibly a transcription error.]

[13] For examples, see Barro (1991) and the many studies listed in Levine and Renelt (1992).

[14] Their list is necessarily incomplete; in particular, it does not include the comparative cross-country analysis by Adelman and Morris (1988), which is based on work dating back to the 1960s. Several other earlier cross-country studies are listed by Chenery [chapter 2 in Chenery, Robinson, and Syrquin (1986, p. 27)]. Reynolds (1986, p. 101) also presents a cross-sectional growth regression, despite his general preference for time series studies.

Growth is robustly (in the Leamer sense) related to initial income and to investment, but not to the other variables.

When Levine and Renelt extend the analysis to include a variety of other variables, they find, first, that several measures of economic policy are related to long-run growth and, second, that the relationship between growth and almost every particular macroeconomic indicator other than the investment ratio is fragile. The strongest results are that investment in physical capital, and either the level or the rate of change of human capital, increase the rate of growth.

In Fischer (1991), I extended the basic Levine–Renelt growth equation to include macroeconomic indicators. Per capita growth is negatively associated with inflation and positively associated with the budget surplus as a share of GNP. While the coefficients on inflation and the budget surplus are statistically significant, the negative coefficient on external debt is not, in a sample that includes all countries for which data were available.[15]

As discussed in section 2, these macroeconomic indicators cannot be regarded as truly exogenous. Instruments are difficult to find; for instance, such candidates as measures of political instability not only cause but also are caused by inflation.[16] Given the difficulties of choosing instruments, I do not pursue instrumental variables regressions in the remainder of this paper, but address the issue of endogeneity in section 7.

The negative relationship between inflation and economic growth has been found also in other papers [for instance, in Fischer (1983), de Gregorio (1993), and Gylfason (1991)]. To deal with the endogeneity of inflation, Cukierman et al. (1992) use measures of central bank independence as an instrument for inflation. They conclude that, even after instrumenting with the better indicators of central bank independence, there remains a significant negative relationship between inflation and economic growth. De Long and Summers (1992) likewise implicitly use the degree of central bank independence as an instrument for inflation and argue that lower inflation is associated with higher growth.

Levine and Zervos (1992), returning to the questions examined by Levine and Renelt, show that an inflation variable has a significant coefficient when added to the basic growth equation, but that the relationship is not robust and can be traced to several high inflation countries. They also examine possible nonlinearities in the relationship between inflation and growth. Their final innovation is to create an index of macroeconomic policy, a function of the rate of inflation and the budget deficit, and to show that growth is positively associated with better

[15] It can be argued that developing countries are sufficiently and systematically different from industrialized countries that the latter should be excluded from the regressions. While it is easy to agree with this view at the extremes, it is hard to know where to draw the line, and I therefore worked mostly with all countries for which there were data. For some regressions (not reported here), I excluded all countries that in 1970 had an income level above Italy's; if anything, this gave stronger results with respect to macroeconomic variables, particularly the debt.

[16] Results obtained using different sets of instruments are presented in Fischer (1991).

(low inflation, larger budget surplus) macroeconomic policy indicators. Easterly and Rebelo (1992) find a consistent negative relationship between growth and budget deficits.

The simple correlations suggested by table 1, and the more detailed empirical work that builds on eq. (1), thus support the view that a stable macroeconomic framework is conducive to growth.

4. Interpreting the evidence

The basic growth regression (1) includes the investment rate as a regressor. The effects of macroeconomic policy variables are usually studied by adding them as right-hand-side variables to the basic regression. The resultant regression therefore presents severe difficulties of interpretation when used to examine the role of policy variables or other indicators in the growth process. Presumably the interpretation of such equations is that, conditional on the rate of investment, other variables affect growth. But it is hard to conceive of variables that would not affect growth through their effect on investment as well as through other routes, mostly the rate of productivity increase – and this is especially true of macroeconomic variables.

Recognizing this, Barro (1991) also presents investment equations, as does Fischer (1991). Nonetheless, since some of the same variables explain both growth and investment, the policy variable-augmented growth regression has no straightforward interpretation. Rather there seem to be mongrel regressions, born out of a legitimate study of convergence and the desire to study the effects of policy on growth.[17]

In this section I use a simple alternative to the mixed regression, a production function-based approach pioneered by Elias (1992). The approach is a regression analog of growth accounting, which helps identify the channels through which macroeconomic variables affect economic growth. As a matter of accounting, growth can be attributed to increases in supplies of factors and to a residual productivity category, reflecting changes in the efficiency with which factors are used. The approach is to examine the relationships between growth and macroeconomic variables, and then between the macroeconomic variables and changes in both the supplies of factors, and the residual, or productivity.

Consider the production function

$$Y_t = F(K_t, L_t, H_t, A_t), \tag{2}$$

[17] Some of the more recent papers, [for instance, Cukierman et al. (1992) and Levine and Zervos (1992)] do not include investment in the equation that also includes inflation, but do include other conditioning variables such as initial real income.

Table 1

Inflation and economic growth (% per annum).[a]

	Africa			Asia			Latin America		
	65–73	73–80	80–90	65–73	73–80	80–90	65–73	73–80	80–90
GDP growth	3.7	3.4	2.1	5.8	5.8	6.9	6.0	5.0	1.1
GDP per cap. growth	1.1	0.4	− 1.0	3.2	3.7	4.9	3.3	2.5	− 0.9
Inflation	5.2	15.8	18.9	14.8	8.9	6.9	22	53	249

[a] Source: World Bank.

where K, L, and H are physical capital, raw labor, and human capital, respectively, and A_t is an overall efficiency factor, including not only the level of technology, but also for example representing the quality of government management of the economy or institutional factors.

Differentiating (2), we obtain the conventional growth accounting equation

$$\dot{Y}/Y = \eta_1(\dot{K}/K) + \eta_2(\dot{L}/L) + \eta_3(\dot{H}/H) + \eta_4(\dot{A}/A), \tag{3}$$

where η_i is the elasticity with respect to argument i in eq. (2). The product $\eta_4(\dot{A}/A)$ will be referred to as the productivity residual.

Macroeconomic factors can in principle affect economic growth through all four factors on the right-hand side of eq. (3). The standard procedure of adding macroeconomic variables to a growth regression that already includes some of the right-hand-side variables thus implicitly assumes that policy variable does not affect the other included variables, and affects growth only through its impact on the right-hand-side variables in (3) not explicitly included in the regression, typically the productivity residual.

Productivity residuals

Three alternate estimates of productivity residuals were made. *Bhalla residuals* start from an estimated panel regression equation like (3), with the three factor inputs included explicitly. The data are those provided by Surjit Bhalla through the Bank's 1991 *World Development Report* (WDR) database. The Bhalla panel regression implies productivity residuals for each country for each year; the mean productivity residual for each country, plus the dummy for its region, is an estimate of the average rate of productivity increase for that country, on the (maintained) assumption that the production function for each country is the same up to the productivity variable.[18]

[18] The Bhalla production function estimated on the full panel by GLS (t-statistics in parentheses) is

$$\underset{}{ZGDP} = \underset{(14.25)}{0.398}\ ZKAP + \underset{(3.53)}{0.440}\ ZLAB + \underset{(0.38)}{0.012}\ ZED + RD_i, \quad N = 1912. \tag{F1}$$

ZGDP is the growth rate of real GDP (in 1980 prices); *ZKAP* is the growth rate of capital; *ZLAB* is the growth rate of the labor force; and *ZED* is the growth rate of the educational stock in the labor force (calculated as the product of the average years of education of the adult population and the labor force). Regional dummies (RD_i) are included for the five World Bank regions as of 1991 and the OECD. Coefficients are: *EMENA* (Europe, Middle East, and North Africa), 0.011; *LACAR* (Latin America and Caribbean), 0.002; *AFRIC*, − 0.004; *EASIA*, 0.006; *SASIA*, 0.001; and *OECD*, 0.007. These coefficients are small in absolute value and only those on *EMENA* and *OECD* are significantly different from zero.

Two other sets of residuals were calculated for each country. *Solow residuals* are calculated as

$$RES_{it} = ZGDP_{it} - 0.4\,ZKAP_{it} - 0.6\,ZLAB_{it}, \tag{4}$$

$$i = 1, \ldots, 68, \quad t = 1961, \ldots, 1988.$$

Mankiw–Romer–Weil residuals are calculated as

$$REMRW_{it} = ZGDP_{it} - 0.333\,ZKAP_{it} - 0.333\,ZLAB_{it} - 0.333\,ZED_{it}, \tag{5}$$

$$i = 1, \ldots, 68, \quad t = 1961, \ldots, 1988.$$

Calculation of the Solow residuals imposes a common Cobb–Douglas production function in which the share of capital is somewhat higher than in the industrialized countries, as it generally is estimated to be in developing countries. Mankiw–Romer–Weil residuals are calculated imposing coefficients used in their 1992 paper.

The productivity residuals constructed by these three methods are very highly correlated in the time series for each country (with pairwise R^2s all exceeding 0.98), and we therefore use the Solow residuals in the remainder of the paper.

Table 2 presents the minima and maxima of the mean rates of Solow productivity growth calculated for each of the five 1991 World Bank regions and the OECD. These estimates raise obvious questions about the underlying Summers and Heston data, or perhaps the input data. When similar calculations were made using World Bank income data, the productivity residuals looked more plausible. For instance, Pakistan had the highest rate of productivity growth in South Asia and Congo had the highest in Africa. However, since the Summers–Heston income data are widely used, I chose to work with those, leaving the investigation of the apparent anomalies in table 2 for later research. The difference between the maximum (Brazil) and minimum (Haiti) rates of productivity increase is very large, 6.7 percent per annum. Even the range across regions – 2.19 percent – is large.

5. Results in the growth accounting framework

Cross-sectional regressions for the largest possible number of countries on single macroeconomic indicator variables are presented in table 3.[19] These are

[19] Differences in data coverage raise the issue of whether all regressions should be run on the maximal possible common set of countries or on as many countries as possible for the particular regression. Since the intersection of the data sets covers only 32 countires, I have chosen the latter approach. I have also excluded any data series that includes less than 10 observations.

Table 2

Estimated productivity growth, 1961–1988 (% per annum).[a]

Region	Number of countries	Regional mean	Maximum		Minimum	
			Country	Rate	Country	Rate
EMENA	7	0.55	Malta	1.72	Iraq	− 1.70
LACAR	21	− 0.24	Brazil	1.90	Haiti	− 4.81
AFRICA	21	− 1.51	Tanzania	1.64	Madagascar	− 4.64
SASIA	5	− 0.72	Burma	1.47	Bangladesh	− 3.63
EASIA	8	0.22	Taiwan	1.69	Singapore	− 2.82
OECD	24	0.68	Greece	1.63	New Zealand	− 1.01

[a] Source: Calculations of Solow residuals [eq. (4)], based on Summers–Heston income data and World Bank input data (see appendix for data descriptions). Maximum data period is 1961–88.

Table 3

Cross-sectional growth regressions (*t*-statistics in parentheses).[a]

Eq.	*INFLAT*	*SURRAT*	*ZTOTI*	*EXCHPREM*	*SMAPI*	No. of obs.
(6)	− 0.037 (− 2.13)					80
(7)		0.133 (2.07)				40
(8)			0.113 (0.83)			80
(9)				− 0.022 (− 2.95)		94
(10)					− 0.093 (− 2.98)	80
(11)	− 0.026 (− 1.34)	0.277 (3.36)	− 0.040 (− 0.20)	− 0.041 (− 3.32)		22

[a] Dependent variable is *ZGDP*, growth rate of real GDP. Other variable definitions are: *INFLAT*, inflation rate; *SURRAT*, ratio of budget surplus to GDP; *ZTOTI*, change in terms of trade; *EXCHPREM*, black market exchange premium; *SMAPI*, mean of the standard deviation of the inflation rate around its mean for overlapping seven-year periods. (Variable definitions are in the appendix.)

regressions in which there are no regional dummies, and only a constant in addition to the variable indicated. However, the coefficients change very little when regional dummies are added. The inflation rate, budget surplus, black market exchange premium, and the standard deviation of inflation are each individually significantly correlated with the growth rate.[20]

Regression (11) is included for completeness, though there is only a small number of countries for which the full set of data is available.[21] The coefficients on the budget surplus and the black market exchange premium are strongly significant.[22]

[20] In Fischer (1992), in a similar table, only the inflation rate and the budget surplus were significantly correlated with the growth rate. The change is a result of the increase in sample sizes since that paper was written. I have also substituted the moving average measure of inflation for the standard deviation of the inflation rate over the entire period (*SINFLAT*) in eq. (10) for comparability with the panel regressions. The coefficient on *SINFLAT* in the analog of eq. (10) is − 0.026, with a *t*-statistic of − 2.34.

[21] They are: Ghana, Cote d'Ivoire, Kenya, Malawi, Morocco, Zambia, Dominican Republic, Jamaica, Mexico, Argentina, Chile, Colombia, Ecuador, Paraguay, Venezuela, India, Indonesia, Korea, Pakistan, Thailand, Greece, Turkey.

[22] As noted above, the high correlation between the inflation rate and its standard deviation preclude the inclusion of both variables in the regressions.

Table 4

Panel growth regressions (*t*-statistics in parentheses).[a]

Eq.	*INFLAT*	*SURRAT*	*ZTOTI*	*EXCHPREM*	*SMAPI*	No. of obs.
(12)	− 0.046 (− 7.43)					1998
(13)		0.226 (6.30)				714
(14)			0.057 (5.93)			1732
(15)				− 0.026 (− 1.48)		2088
(16)					− 0.064 (− 4.54)	1685
(17)	− 0.039 (− 4.65)	0.228 (4.49)	0.043 (2.71)	− 0.017 (− 2.76)		351

[a] Variables are as defined in table 3. Regressions are run using GLS (seemingly unrelated regressions).

This first cross-sectional look at correlations between growth and macroeconomic variables is broadly consistent with prior expectations. However, in using only period averages the cross-sectional regressions discard the information in the time series for individual countries. The results of similar panel regressions are presented in table 4.

The simple panel regressions in table 4 [eqs. (12) to (16)] confirm the relationships between inflation and inflation variability[23] and growth, and also between the budget surplus and growth, seen in table 3. In the time series, the black market exchange premium correlation with growth is lower than in the cross-section, while the correlation between changes in terms of trade and growth is increased; improvements in the terms of trade are associated with higher growth. The numerical value of the coefficient on inflation in eq. (12) is a bit higher than that in eq. (6), while the coefficient on the standard deviation of inflation falls between the cross-section and the time series. The coefficient on the budget surplus in eq. (13) is almost double that in eq. (7), possibly a result of reverse causation between growth and the budget within the time series for individual countries.

[23] Values of *SMAPI* in this sample range from 1.8 (South Africa) to 44.5 (Bolivia). The regression implies that the high inflation variability in Bolivia would reduce its growth 2.7 percentage points relative to South Africa.

Regression (17) includes all the regressors except inflation uncertainty. All the coefficients are significantly different from zero. They imply that a country that has an inflation rate 100 percentage points higher than another (e.g., 110 percent per annum rather than 10 percent per annum) will have a growth rate that is 3.9 percent lower, and that a country with a budget surplus that is higher by 1 percent of GDP will have a growth rate that is 0.23 percent larger. Countries with higher black market exchange premia grow more slowly. The units[24] imply that the black market premium in the country where it was largest, Mozambique, would be associated with a reduction in the growth rate of 2.5 percent. Adverse changes in the terms of trade reduce growth, though the coefficient is small relative to the range of the change in the terms of trade. Similar regressions that include regional dummies give almost identical coefficients on the macroeconomic variables.

The regressions reported in table 4 reinforce the evidence in favor of the view that macroeconomic stability, as measured by the (inverse of the) inflation rate, and indicators of macroeconomic policy, like the budget surplus and the black market exchange premium, are associated with higher growth and are on average good for growth. We turn now to the mechanisms through which the macroeconomic variables affect growth.

5.1. Capital accumulation

Pursuing the approach described in section 4, we start with equations in which the rate of capital accumulation is regressed on the same macroeconomic variables as in tables 3 and 4. The results presented in table 5 are all for panel regressions estimated by GLS. (Results for the corresponding cross-section regressions will be discussed below.) In the simple regressions (18) through (22) all the coefficients are significantly different from zero, and all have the expected sign.

In regression (23), the coefficients on the inflation rate and the black market exchange premium are significantly different from zero, while surprisingly the budget surplus and the terms of trade coefficients lose their significance. The coefficient on inflation implies that an increase in the inflation rate by 100 percentage points (e.g., from 10 to 110 percent per annum) reduces the growth rate of the capital stock by 3.7 percentage points. This is a large effect: if the investment rate is about 20 percent of GDP and the capital output ratio is 2.5, then the growth rate of capital is 8 percent. According to the regression, capital in such a country would stop growing when the inflation rate reaches about 210 percent per annum. The point estimate of the coefficient on the budget surplus implies that an increase in the budget deficit of 1 percent of GDP would reduce the growth rate of capital by 0.08 percentage points. Again assuming a capital

[24] The black market exchange premium enters the equation in the form $\ln(1 + EXCHPREM)$.

Table 5

Panel regressions, capital accumulation (t-statistics in parentheses).[a]

Eq.	*INFLAT*	*SURRAT*	*ZTOTI*	*EXCHPREM*	*SMAPI*	No. of obs.
(18)	− 0.046 (− 11.05)					1626
(19)		0.222 (7.11)				716
(20)			0.028 (3.54)			1300
(21)				− 0.027 (− 12.01)		1653
(22)					− 0.094 (− 9.46)	1340
(23)	− 0.037 (− 4.77)	0.075 (1.61)	0.008 (0.62)	− 0.019 (− 3.56)		352

[a] Dependent variable is *ZKAP*, the growth rate of the real capital stock. Variable definitions are as in table 3. Regressions are estimated by GLS.

output ratio of 2.5, the investment share in GNP would decline by 0.2 percentage points. This estimate implies a relatively low level of crowding out on average. The effect implied in the one-variable regression (19) is above 0.5 percentage points. The coefficient on the black market premium again suggests that it has quite large effects on investment and capital accumulation.

In single-variable cross-sectional regressions corresponding to those in table 5, the coefficients on all variables except the terms of trade are significantly different from zero, and all are of the same sign as in table 5. However, the coefficients are generally larger than in table 5. In the overall cross-sectional regression, corresponding to eq. (23), the coefficient on the inflation rate is insignificant, while that on the deficit becomes larger (0.50) and strongly significant.

These results suggest that one important route through which inflation affects growth is by reducing capital accumulation;[25] similarly, an increase in the black market exchange premium, which reflects foreign exchange controls and expectations of devaluation, reduces capital accumulation. An increase in the budget surplus is associated with more capital accumulation, but the effect is not significant even at the 10 percent level. The numerical values of the coefficients are plausible, even though these cannot be thought of as structural regressions.

[25] De Gregorio (1993) also finds strong effects of inflation on investment.

Table 6

Panel regressions, productivity growth (*t*-statistics in parentheses).[a]

Eq.	*INFLAT*	*SURRAT*	*ZTOTI*	*EXCHPREM*	*SMAPI*	No. of obs.
(24)	− 0.016 (− 2.88)					1598
(25)		0.125 (4.57)				714
(26)			0.039 (3.85)			1251
(27)				− 0.014 (− 4.46)		1566
(28)					− 0.022 (− 1.89)	1327
(29)	− 0.018 (− 2.49)	0.137 (3.23)	0.038 (2.60)	− 0.006 (− 1.17)		351

[a] Dependent variable is *RES*, the Solow residual, calculated as in eq. (4). Other variable definitions are as in table 3. Regressions are estimated by GLS.

5.2. *Productivity growth*

The impacts of the macroeconomic variables on productivity growth estimated by the Solow residual are presented in table 6. The inflation rate is significantly negatively correlated with the rate of productivity growth, with a coefficient which implies that an increase in the inflation rate by 100 percent is associated with a decline in the rate of productivity growth of 1.8 percent per annum. Increases in the budget surplus and improvements in the terms of trade are associated with improvements in productivity growth. The effect of inflation is robust to the inclusion of other variables. The black market exchange rate premium is significantly negatively correlated with the rate of productivity growth, but the coefficient on the black market premium loses its significance in the multiple regression.

Theories in which inflation distorts price signals suggest that uncertainty about inflation should have an impact on productivity. The negative coefficient on the standard deviation of inflation (*SMAPI*) in eq. (29) is consistent with this view, but the coefficient is not statistically significant.

In the cross-sectional regressions equivalent to (24) to (28), none of the coefficients in any of the single-variable regressions were significantly different from zero. This implies that the significant correlations in table 6 are mainly a result of the time series variation between the regressors and productivity growth. In the overall regression equivalent to (29), the coefficients on inflation

Table 7

Panel regressions, labor force growth (t-statistics in parentheses).[a]

Eq.	*INFLAT*	*SURRAT*	*ZTOTI*	*EXCHPREM*	*SMAPI*	No. of obs.
(30)	− 0.001 (1.75)					2021
(31)		− 0.0015 (− 0.14)				716
(32)			− 0.0007 (− 0.64)			1668
(33)				0.0009 (2.60)		2020
(34)					0.003 (2.57)	1669
(35)	− 0.002 (− 1.14)	− 0.007 (− 0.53)	0.0009 (0.29)	0.0003 (0.22)		352

[a] Dependent variable is *ZLAB*, the growth rate of the labor force. Regressions are estimated by GLS.

and the budget surplus were similar to those in (29), but again not statistically significant.

5.3. *Labor force growth*

For the sake of completeness, table 7 presents estimates of the panel equations for labor force growth. It would be surprising if the macroeconomic variables had a major impact on the growth of the labor force. In fact, the regressions in table 7 show no coefficients to be significantly different from zero in the overall regression (35), and only the correlations with the exchange premium and inflation variablity to be significant in the one-independent-variable regressions.

5.4. *Summary*

The strongest result that comes out of the regressions reported in tables 5 through 8 is the consistent negative correlation between inflation and growth. Inflation is negatively associated with both capital accumulation and productivity growth. There is a strong positive correlation between the budget surplus and growth, with the evidence suggesting some influence of the surplus on capital accumulation and a stronger effect on the rate of growth of productivity. Adverse changes in the terms of trade reduce growth, mainly through their effect on productivity growth. The black market exchange premium is negatively

related to growth, mainly through lower capital accumulation. The macroeconomic variables are not significantly associated with labor force growth.

6. Inflation nonlinearities and other variations

While it is easy to believe that triple-digit inflation has adverse effects on economic growt through the mechanisms discussed in section 2, and reflected in the regressions for capital accumulation and productivity growth, it is possible that there is a range of low inflation rates in which variations in inflation have very little effect on growth. Thus, in testing for nonlinear effects of inflation, I expect to find more significant effects of inflation at high than at low inflation rates.

To allow for possible nonlinearities in the effects of inflation, the basic regressions for growth, capital accumulation, and productivity were estimated using a spline function, with breaks at 15 and 40 percent.[26] In table 8, the inflation variables enter as:

$INFLL$ = value of the inflation rate if it is 15 percent or less,
$INFLM$ = value of the inflation rate if it is between 15 and 40 percent,
$INFLH$ = value of the inflation rate if it is above 40 percent.

Table 8 shows the variants of panel regressions (17), (23), and (29), with the inflation rate broken into three categories. The results show that the effects of inflation are nonlinear, but that, per percentage point of inflation, the association between inflation and growth and its determinants on average weakens as inflation rises.[27] It is thus not the case, as I had expected, that it is the high inflation outliers that are responsible for the overall negative correlations between inflation and growth, capital accumulation, and productivity growth, seen in tables 5 through 7. Rather the association between inflation and growth and between inflation and capital accumulation is stronger at the low and moderate inflation levels than at high inflation. When inflation is decomposed as in table 8, none of the inflation components in eq. (38), the equation for productivity growth, is significant, even though inflation enters significantly in the corresponding linear eq. (23).

Note also that, when the inflation rate is decomposed in this way, the coefficient on the budget surplus in the capital accumulation equation becomes statistically significantly different from zero. An increase in the budget deficit is statistically significantly associated in table 8 with lower growth through both lower capital accumulation and lower productivity growth.

[26] See Greene (1993, pp. 235–238) for spline regressions.

[27] Levine and Zervos (1992) obtain similar results.

Table 8
Nonlinear effects of inflation (t-statistics in parentheses), $N = 351$.[a]

	Eq. (36)	Eq. (37)	Eq. (38)
	Dependent variable		
Variable	*ZGDP*	*ZKAP*	*RES*
INFLL	− 0.127	− 0.008	− 0.079
	(− 1.99)	(− 0.15)	(− 1.37)
INFLM	− 0.075	− 0.115	− 0.029
	(− 1.84)	(− 3.23)	(− 0.77)
INFLH	− 0.019	− 0.017	− 0.009
	(− 1.43)	(− 1.46)	(− 0.76)
SURRAT	0.230	0.115	0.141
	(4.66)	(2.50)	(3.24)
ZTOTI	0.048	0.009	0.041
	(2.97)	(0.70)	(2.80)
EXCHPREM	− 0.014	− 0.018	− 0.004
	(− 2.19)	(− 3.28)	(− 0.69)

[a] See variable definitions in the appendix. Regressions are estimated by GLS.

The results in table 8 suggest that the basic nonlinearity in the relationship between inflation and growth could be captured by a function in which $\log(1 + \pi)$ appears. When regressions like (17), (23), and (29) are run with $\log(1 + \pi)$ replacing the inflation rate, the t-statistic on the inflation variable rises in each case, and the remaining coefficients are little affected.

Inflation uncertainty: Grier and Tullock (1989) report a significant negative association between inflation variability and growth and a relationship between inflation and growth that varies across regions. Tables 3–6 show the simple relationship between the moving standard deviation of inflation (*SMAPI*) and the dependent variables. In all cases, the direction of the relationship is the same as that between inflation and the dependent variable.

Both the inflation rate and *SMAPI* have been included in several regressions, to try to separate out the effects of high from uncertain inflation. No consistent pattern of results emerged. In the panel regressions, both with and without the other variables in the regression, the coefficient on the inflation rate was almost always negative, and that on the standard deviation measures was sometimes negative and more often positive, sometimes significantly so.

Standard variables: In table 9 I report the results of adding the standard cross-country variables to regressions (17), (23), and (29). These all enter as period averages or initial values. Initial real GNP per capita enters the growth and capital accumulation equations significantly and negatively; a measure of tariff protection openness, defined as the product of the volume of trade relative to GNP and the tariff rate, affects productivity growth negatively; and the

Table 9

Addition of standard variables (*t*-statistics in parentheses), $N = 206$.[a]

	Eq. (39)	Eq. (40)	Eq. (41)
	Dependent variable		
Variable	*ZGDP*	*ZKAP*	*RES*
INFLAT	− 0.031	− 0.032	− 0.017
	(− 2.72)	(− 4.21)	(− 1.59)
SURRAT	0.241	0.038	0.146
	(3.00)	(0.61)	(2.04)
ZTOTI	0.066	0.002	0.063
	(3.39)	(0.13)	(3.41)
EXCHPREM	− 0.015	− 0.014	− 0.007
	(− 1.94)	(− 2.72)	(− 1.08)
ln(*GNPO*)	− 0.021	− 0.035	− 0.007
	(− 2.18)	(− 2.55)	(− 0.82)
OPENTAR	− 0.003	− 0.0002	− 0.003
	(− 1.27)	(− 0.06)	(− 2.13)
BHKAVG	0.005	0.013	0.0001
	(1.44)	(2.72)	(0.03)
LLY	− 0.020	− 0.039	− 0.016
	(− 0.36)	(− 0.50)	(− 0.35)

[a] *GNPO* is the Summers–Heston 1960 per capita GNP; *OPENTAR* is a measure of tariff protection, equal to $((X + M)/2GDP) \ln(1 + tar)$ where X and M are exports and imports and *tar* is the WDR measure of tariffs and other surcharges on imports; *BHKAVG* is the Barro–Lee measure of human capital; and *LLY* [from Levine and Zervos (1992)] is the average ratio of liquid liabilities to GDP for the period 1960–89.

human capital measure is estimated to increase capital accumulation. The measure of financial intermediation does not enter any of the equations significantly.

The most important result in table 9 is that the addition of these variables leaves the basic relationships between the dependent and macroeconomic policy variables unchanged.

7. Causality

While inflation is negatively associated with growth and with its production function determinants, it is not clear – especially in the panel regressions – which way the causation runs. If supply shocks predominate, then possibly adverse supply shocks cause both inflation and slower growth, and the regressions may merely be reflecting that association.

Table 10
Inflation–growth correlations, subperiods 1961–72 and 1973–88.[a]

	Dependent variable					
	ZGDP		*ZKAP*		*RES*	
	61–72	73–88	61–72	73–88	61–72	73–88
	Single regression					
Eq.	(42)	(43)	(44)	(45)	(46)	(47)
INFLAT	− 0.072	− 0.033	− 0.052	− 0.026	− 0.032	− 0.013
	(− 3.74)	− (4.67)	− (3.46)	(− 6.30)	(− 1.47)	(− 2.16)
No. of obs.	773	1225	631	995	640	958
	Multiple regressions					
Eq.	(48)	(49)	(50)	(51)	(52)	(53)
INFLAT	− 0.200	− 0.039	− 0.031	− 0.029	− 0.173	− 0.019
	(− 3.37)	− (4.04)	− (0.69)	(− 3.40)	(− 3.09)	(− 2.33)
No. of obs.	44	306	44	306	44	306

[a] See variable definitions in the appendix. Regressions are estimated by GLS.

The inclusion of changes in the terms of trade as a regressor goes a long way towards dealing with this problem. For most of the developing countries, changes in the terms of trade are a major source of supply shocks, and these have been taken into account in the multi-variable regressions in sections 5 and 6. The use of measures of central bank independence as instruments for inflation in the cross-sectional regressions, as in Cukierman et al. (1992), provides another method of dealing with the endogeneity of inflation. Their results suggest that the causation runs significantly, but not exclusively, from inflation to growth.

Subperiod regressions: In addition, I have split the period up into two parts, from 1960 to 1972 and from 1973 to 1988.[28] Demand shocks probably predominated in the first period and supply shocks in the second. If supply shocks are primarily responsible for the negative association between inflation and growth, we should expect the negative association to be stronger in the second period than in the first, where we might even expect to find a positive association.

Table 10 shows the results of this breakdown, presenting only the coefficient on inflation from the multiple regressions corresponding to (17), (23), and (29). In the simple regressions, (42) to (47), the coefficient on inflation is always negative, and absolutely larger in the first period than in the second. The t-statistics are always lower for the first period. Similarly, in the multiple regressions, the

[28] Michael Bruno suggested this approach.

absolute value of the coefficients is larger in the first period than in the second, but there are much fewer degrees of freedom and the t-statistics are smaller.

The breakdown into subperiods thus strengthens the view that the relationship between inflation and growth is not merely a result of supply shocks.

8. Some reservations

The results so far support the conclusions that high inflation, large budget deficits, and exchange market distortions are associated with lower growth. Most of the results suggest also that these relationships are to some extent causal. The positive association between the budget surplus and growth appears particularly robust, and that between the black market exchange premium and growth is also strong. Thus, the evidence from the regressions and from case studies is consistent with the view that the causation is not fully from low growth to high inflation, and therefore that countries that are able to reduce the inflation rate in a sustainable way can on average expect higher growth to follow. There is nothing in the results to contradict the view that inflation is merely a symptom of a government out of control – but there is nothing in that argument that contradicts the view that controlling inflation will help restore growth.

While the regressions provide suggestive evidence, it is also useful to look at the exceptions. Table 11 shows that some countries have experienced rapid

Table 11

High inflation and economic growth (% per annum).[a]

	High growth period			Entire spell[b]		
Country	Period	Inflation	GNP growth	Period	Inflation	GNP growth
Argentina	1977	101.5	6.2	1975–87	112	0.5
	1979	95.4	6.8			
	1986	64.5	5.3			
Brazil	1980	60.3	8.7	1980–87	90	3.5
	1984–86	105.3	7.1			
Chile	1977	65.2	9.4	1972–77	115	− 1.2
Ghana	1978	54.9	9.4	1977–78	66	5.6
Israel	1979–80	70.3	6.0	1979–85	95	3.8
Peru	1979	51.1	5.6	1979	51	5.6
	1986–87	59.8	7.9	1983–87	73	2.4
Uganda	1981	73.6	8.0	1981	74	8.0
	1988	104.3	6.3	1985–88	102	0.1

[a] Source: Inflation data from IMF; growth data from World Bank.
[b] A spell is a period in which the annual inflation rate year exceeds 50 percent each year.

Table 12

Large deficits, inflation, and growth.[a]

Country	Period	Deficit/GDP	Growth rate	Inflation
Argentina	1975–76	13.4	− 0.3	134
	1981–84	13.9	− 1.8	124
Chile	1973	19.0	− 5.7	153
Cote d'Ivoire	1976	12.4	10.9	11
	1979–83	12.3	0.7	11
Ghana	1975	13.2	− 14.3	26
Greece	1981	10.9	0.0	22
	1984–88	12.7	2.1	17
Israel*	1974–84	19.4	3.6	64
Jamaica	1977–85	17.6	− 1.2	21
Mauritius*	1978–82	11.6	2.2	16
Malawi	1979–82	13.4	0.1	11
Mexico	1981–82	13.5	3.9	36
Morocco	1976–79	13.8	6.2	9
	1981	13.6	− 1.3	12
	1983	11.5	2.3	6
Nicaragua*	1981–86	20.8	− 0.4	70
Turkey	1978	10.6	2.8	37
	1980	11.9	− 0.7	74
Zambia	1977–87	16.1	− 1.6	20
Zimbabwe	1981–87	13.3	1.6	18

[a] Source: Deficit data from Easterly, except for countries indicated by asterisks, where the deficit data are from the IMF. Other variables are from WDR Database.

growth at high inflation rates. During the period 1961–88, at least 14 countries in the World Bank database experienced an annual inflation rate greater than 50 percent in at least one year. Growth in some of these countries exceeded 5 percent during a year or more of the 50 percent or more inflation. Table 11 lists those cases, as well as information about growth and inflation during the entire period of high inflation of which the high growth period is a part.

Similarly, treating the budget deficit as a macroeconomic indicator, the 15 countries in table 12 have experienced deficits in excess of 10 percent of GDP during the periods shown.[29] Some of them, including Brazil and Israel, are also

[29] For countries for which the Easterly fiscal data are available, the data listed in table 12 are from that source; for other countries for which IMF deficit data are available (indicated by an asterisk), that is the source.

listed in table 10. Others listed in table 12 include rapid growers such as Morocco during the period 1976–79.[30]

The data presented in tables 11 and 12 raise the question of the circumstances under which countries can continue to grow fast when such standard indicators of the macroeconomic situation as the deficit and inflation are exceptionally high. Every country that appears in table 11 ran into severe trouble at some later stage. Thus, table 11 seems to show only that rapid growth is possible for a time even with high inflation. In some cases, such as Peru, the period of rapid growth is associated with a rapidly accelerating inflation and a situation that is heading rapidly for disaster.

By drawing the line in table 11 at 50 percent inflation, I omit those countries that have succeeded in growing over sustained periods with inflation that persisted in the moderate range of 15–30 percent, typically with the assistance of extensive indexation.[31] Such situations are sustainable, provided the government takes action to prevent inflation rising above the 30 percent range. The explosive situations appear to be those in which governments believe the inflation rate is of no major consequence, and permit it to continue rising even after it leaves the moderate range.

The data in table 12 provide a much less clear lesson. For most of the countries in the table, growth rates were low during the periods of high deficits, but Morocco grew fast during the high deficit period, as did Italy in the 1980s. It is clearly possible to sustain large deficits for some time, with the assistance of high saving rates and financial repression. Notice though that inflation rates are low for almost all the non-Latin American high deficit countries. The lesson seems to be that a high deficit by itself is not a certain indicator of later trouble. It may be sustainable for a while, and it may be consistent with low inflation. It would take supplementary studies of the budgetary situation and debt dynamics to determine whether a large deficit is sustainable, and therefore consistent with macroeconomic stability, or unsustainable, and therefore a harbinger of macroeconomic instability.

9. Concluding comments

The broad range of evidence reviewed and presented in this paper supports the conventional view that a stable macroeconomic environment, meaning a reasonably low rate of inflation and a small budget deficit, is conducive to sustained economic growth. The growth accounting framework makes it possible to identify the main channels through which inflation reduces growth. As a great deal of prior theory predicts, the results presented here imply that

[30] Industrialized countries such as Italy are not included in the database from which table 12 is drawn.

[31] See Dornbusch and Fischer (1993).

inflation reduces growth by reducing investment and by reducing the rate of productivity growth. Larger budget surpluses are also strongly associated with more rapid growth, through greater capital accumulation and greater productivity growth. An undistorted foreign exchange market is also conducive to growth.

The cross-sectional regression methodology that is associated with the new growth theory has been extended in this paper to include panel regressions, whose results typically reinforce those of the simple cross-sections. The endogeneity issue is difficult to deal with formally, but the weight of the evidence implies that the relationship between inflation and growth is not purely a result of low growth producing high inflation. The evidence that small deficits are good for growth is strong, as is the support for the view that distorted foreign exchange markets, as reflected in a large foreign exchange market premium, are bad for growth.

The examples presented in tables 11 and 12 show that low inflation and small deficits are not necessary for high growth, over even quite long periods. They do imply that very high inflation is not consistent with sustained growth. The results also suggest that the sustainability of the budget deficit has to be investigated in more detail than is possible in the aggregative approach that has been taken in this paper.

To make further progress in defining a stable and sustainable macroeconomic framework, and in clarifying the channels through which macroeconomic variables affect growth, it will be necessary to undertake more detailed case studies of individual countries, based on structural models. A good start on this approach has already been made in some of the contributions in Little et al. and in many studies of individual countries. The conclusions of those studies agree with the conclusions in this paper.

Appendix: Data sources

All time series that have less than ten observations have been excluded from regressions.

ZGDP is the log difference of real GDP, as estimated by Heston and Summers.

ZKAP is the growth of the capital stock, using the World Bank (Nehru) data set. The data start with an assumed capital stock of zero in 1950, which leads to very rapid rates of growth of the capital stock in early years. Further, some estimates are based on an assumed stock of zero in 1960. All observations for which the capital stock grows by more than 30 percent per annum have been excluded.

ZLAB is the log difference of the labor force, from the *WDR* dataset.

ZED is the log difference of the product of *LABOR*, the size of the labor force, and *BHK*, the Barro–Lee (1993) measure of the average years of educational

attainment of the labor force. It is an estimate of the growth rate of human capital.

INFLAT is the inflation rate, computed from the CPI series in *International Financial Statistics*. GDP deflator data from the World Bank were used to extend inflation series for the Central African Republic, Malawi, and Chad.

SINFLAT is the standard deviation of the inflation rate over all the observations on inflation for a given country.

SMAPI is a time series estimate of inflation uncertainty, calculated as the standard deviation of the inflation rate around its mean for overlapping seven-year periods.

EXCHPREM is the black market exchange rate premium from the WDR dataset. The variable used in regressions is $\ln(1 + EXCHPRM)$.

ZTOT1 is the log difference of the terms of trade from the WDR dataset.

SURRAT is the budget surplus (+) or deficit (−) provided by William Easterly.

AFRICA, *ASIA*, *EASIA*, *LACAR*, *OECD*, and *SASIA* are regional dummies.

References

Aizenman, Joshua and Nancy Marion, 1991, Macroeconomic uncertainty, persistence and growth, Mimeo., Dec. (Dartmouth College, Hanover, NH).

Barro, Robert J., 1991, Economic growth in a cross section of countries, Quarterly Journal of Economics 106, 407–444.

Chenery, Hollis B., Sherman Robinson, and Moshe Syrquin, 1986, Industrialization and growth (Oxford University Press, New York, NY).

Corden, Max, 1990, Macroeconomic policy and growth: Some lessons of experience, Proceedings of the World Bank Annual Conference on Development Economics, 59–84.

Cukierman, Alex, Pantelis Kalaitzidakis, Lawrence H. Summers, and Steven B. Webb, 1992, Central bank independence, growth, investment, and real rates, Presented at Carnegie–Rochester Conference on Public Policy, Nov.

De Gregorio, Jose, 1993, Inflation taxation, and long-run growth, Journal of Monetary Economics 31, 271–298.

Dellas, Harris, 1990, Stabilization policy and long term growth: Are they related? A Darwinian perspective, Mimeo. (University of Maryland, College Park, MD).

De Long, J. Bradford and Lawrence H. Summers, 1991, Equipment investment and economic growth, Quarterly Journal of Economics 106, 369–406.

De Long, J. Bradford and Lawrence H. Summers, 1992, Macroeconomic policy and long-run growth, Federal Reserve Bank of Kansas City Economic Review 77, no. 4, 5–30.

Dornbusch, Rudiger and Stanley Fischer, 1993, Moderate inflation, World Bank Economic Observer 7, 1–44.

Easterly, William and Sergio Rebelo, 1992, Fiscal policy and growth: An empirical investigation, Mimeo. (World Bank, Washington, DC).

Elias, Victor J., 1992, Sources of growth (ICS Press, San Francisco, CA).

Fischer, Stanley, 1983, Inflacion y crecimiento (Inflation and growth), Cuadernos de Economia 20, 267–278 (Sidrauski memorial lecture, in English as NBER working paper no. 1235).

Fischer, Stanley, 1991, Macroeconomics, development, and growth, NBER Macroeconomics Annual, 329–364.

Fischer, Stanley, 1992, Growth: The role of macroeconomic factors, Mimeo. (M.I.T., Cambridge, MA).

Fischer, Stanley and Franco Modigliani, 1978, Towards an understanding of the real effects and costs of inflation, Weltwirtschaftliches Archiv, 810–832. Reprinted in: S. Fischer, 1986, Indexing, inflation, and economic growth (M.I.T. Press, Cambridge, MA).
Greene, William H., 1993, Econometric analysis (Macmillan, New York, NY).
Grier, Kevin B. and Gordon Tullock, 1989, An empirical analysis of cross-national economic growth, 1951–80, Journal of Monetary Economics 24, 259–276.
Gylfason, Thorvaldur, 1991, Inflation, growth, and external debt: A view of the landscape, The World Economy 14, 279–298.
Hamilton, James D. and Marjorie A. Flavin, 1986, On the limitations of government borrowing: A framework for empirical testing, American Economic Review 76, 808–819.
Kormendi, Roger C. and Philip G. Meguire, 1985, Macroeconomic determinants of growth: cross-country evidence, Journal of Monetary Economics 16, 141–164.
Levine, Ross and David Renelt, 1992, A sensitivity analysis of cross-country growth regressions, American Economic Review 82, 942–963.
Levine, R. and S. Zervos, 1992, Looking at the facts: What we know about policy and growth from cross-country analysis, Mimeo., Oct. (World Bank, Washington, DC).
Little, Ian, Richard Cooper, Max Corden, and Sarath Rajapatirana, 1992, Boom, crisis and adjustment: The macroeconomic experience of developing countries, Mimeo.
Lucas, Robert E., 1973, Some international evidence on output–inflation tradeoffs, American Economic Review 63, 326–334.
Mackenzie, G. A., 1989, Are all summary indicators of the stance of fiscal policy misleading?, IMF Staff Papers 36, 743–770.
Mankiw, N. Gregory, David Romer, and David N. Weil, 1992, A contribution to the empirics of economic growth, Quarterly Journal of Economics 107, 407–438.
Morris, Cynthia T. and Irma Adelman, 1988, Comparative patterns of economic development 1850–1914 (Johns Hopkins Press, Baltimore, MD).
Pindyck, Robert and Andres Solimano, 1993, Economic instability and aggregate investment, NBER Macroeconomics Annual, 259–303.
Romer, Paul M., 1989, Human capital and growth: Theory and evidence, NBER working paper no. 3173.
Solimano, Andres, 1989, How private investment reacts to changing macroeconomic conditions: The case of Chile in the eighties, Working paper no. 212 (World Bank, Washington, DC).
World Bank, 1989, Adjustment lending: An evaluation of ten years of experience, Policy and research series paper no. 1 (World Bank, Washington, DC).
World Bank, 1990, Adjustment lending policies for sustainable growth, Policy and research series paper no. 14 (World Bank, Washington, DC).
World Bank, 1991, World development report (World Bank, Washington, DC).
World Bank, 1992, The third report on adjustment lending: Private and public resource for growth, March (World Bank, Washington, DC).