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No. 19

THE PATH OF OUTPUT FROM PLAN TO MARKET

Thorvaldur Gylfason

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Comments

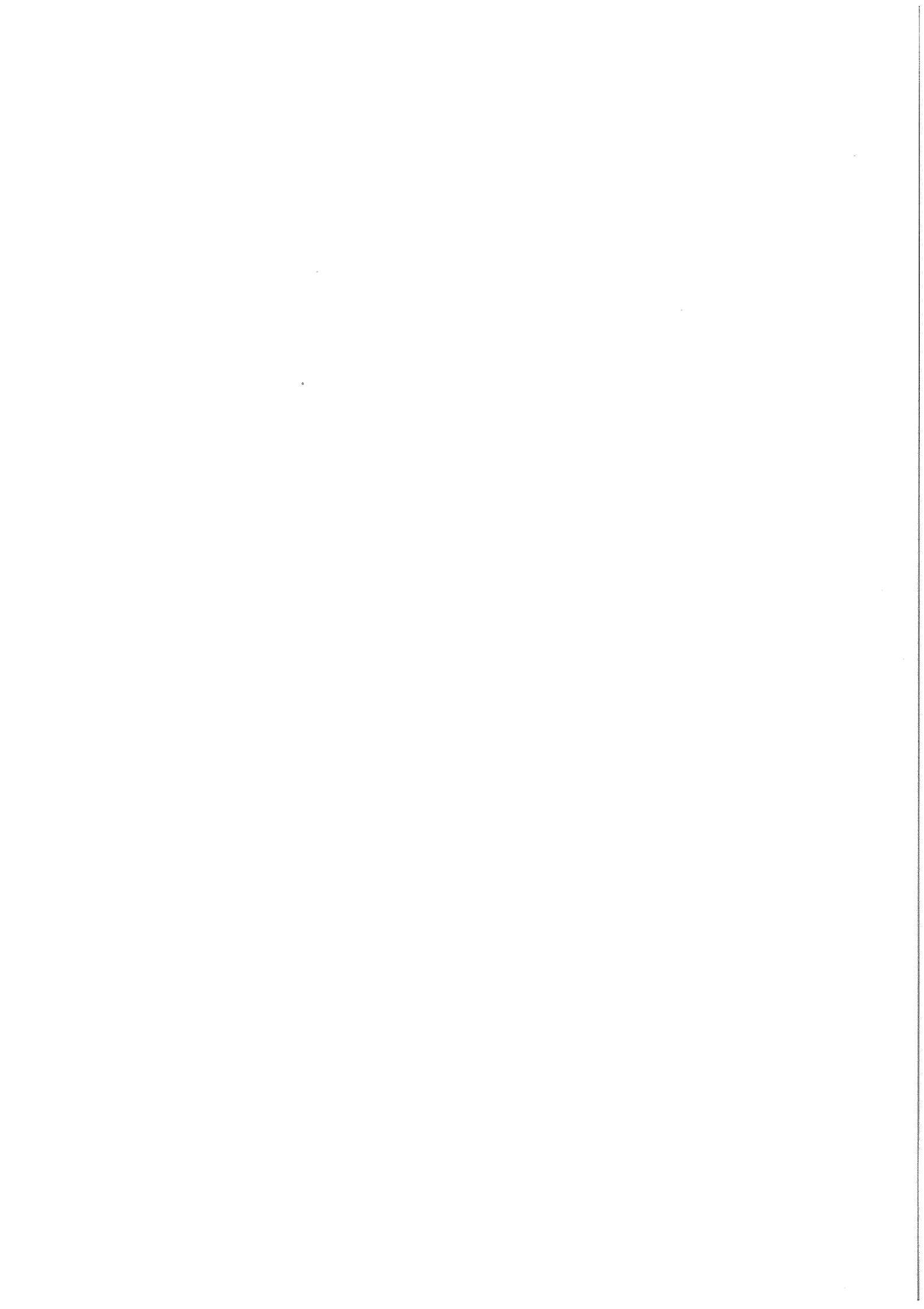
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Abstract

This paper is intended to clarify the contribution of macroeconomic stabilization and structural adjustment to the transformation from plan to market in Central and Eastern Europe and elsewhere. Four main points emerge. First, increased price stability improves the utilization of capital and thus increases the level of output at full employment in the long run, even though output decreases initially. Second, the static output gain from stabilization is captured in a simple formula in which the gain is approximately proportional to the square of the original inflation distortion. Third, successful stabilization increases the rate of growth of output per head, and not only its level, in the presence of constant returns to capital in a broad sense. Fourth, substitution of plausible parameter estimates into the simple formulae reflecting the gains from stabilization indicate that the static and dynamic output gains can be substantial.

JEL Classification

E23, E31, P21



I. Introduction

Without exception, the radical economic reforms that have taken place in the formerly planned economies of Central and Eastern Europe since 1989 have been accompanied by a substantial decrease in output thus far. The cumulative decline in output during 1990-94 has ranged from 9 percent in Poland to 75 percent in Georgia (Table 1). On average, output has fallen by 28 percent in Central and Eastern Europe (without the former Soviet Union) and by 44 percent in the former Soviet Union.¹ The collapse of output has been accompanied by a price explosion. Inflation, repressed before through price controls, has increased to high double-digit annual rates in Central and Eastern Europe and to triple-digit or even quadruple-digit rates in parts of the former Soviet Union. Unemployment, concealed before, has now become visible, and has jumped to double-digit rates in several countries in the region.

Against this background, the purpose of this paper is to consider the behavior of output on the road from a centrally planned to a market economy and beyond. Special emphasis is placed on the role of price stabilization in the structural adjustment process. Specifically, the paper is intended

- To show how stabilization ultimately increases aggregate output at full employment, even though output falls in the short run, and to compare the temporary output loss with the permanent output gain;
- To develop a simple formula in which the potential static output gain from stabilization is approximately proportional to the square of the original inflation distortion;
- To consider the potential dynamic output gain from stabilization when economic growth is an endogenous variable in the presence of constant returns to capital in a broad sense; and, at last,

¹ An even deeper decline in output is suggested by taking weighted averages of the cumulative figures in the last column of the table.

- To provide a rough quantitative assessment of the potential static and dynamic output gains from adjustment by numerical simulations of conceivable scenarios.

The path of output suggested by the discussion to follow is described by the sickle-shaped schedule EJHFI in Chart 1. The centrally planned economy is stagnant until time t_1 when economic reforms are initiated at point E. The reforms typically include trade liberalization, price reform, privatization, and macroeconomic stabilization, all of which are intended primarily to improve the allocation and utilization of resources and hence economic efficiency. During the transition to a market economy, output first declines, for reasons discussed by Bruno (1992), Borensztein, Demekas, and Ostry (1993), Calvo and Coricelli (1993), and Williamson (1993) among others, and then recovers and rises ultimately above its initial level to point F on the strength of a more efficient allocation and utilization of resources. When the reallocation is completed at time t_2 , the economy continues to grow more rapidly than before along the path FI, because improved efficiency stimulates growth permanently when output is proportional to capital in a broad sense (as in Romer 1986, 1989).

The main message of the paper is that sound monetary, fiscal, and financial policies can, by bringing inflation down, play an important role in encouraging the reallocation of resources and the reorganization of production that are necessary, in Central and Eastern Europe and elsewhere, to foster a favorable development of output and employment after the initial slump. In particular, macroeconomic stabilization not only helps raise the level of output, but also its rate of growth over time. This is crucial.

II. Structural adjustment, stabilization, and output

Consider an economy characterized initially by full employment of all available resources and by excess aggregate demand (denoted by the horizontal distance

EG in Chart 2), repressed inflation, and a general shortage of goods and services. Two types of capital, real and financial, both measured at constant prices, are used as inputs in the production process. Financial capital, including money, is included in the production function on the grounds that it enables firms to economize on the use of other inputs and that it can be expensive to run short of cash or other financial assets (see Fischer 1974). Both types of capital are inefficiently employed initially, because repressed inflation distorts efficiency. Aggregate supply is assumed to be unresponsive to changes in the price level. Aggregate demand is held constant by the monetary and fiscal authorities: this is what is meant here by macroeconomic stabilization.

A. From temporary loss to permanent gain

When prices are set free, the general price level begins to rise towards point H in Chart 2. This general price increase is accompanied by a change in relative prices, because prices tend to increase most rapidly in those sectors where the initial excess demand was largest. At first, output contracts and unemployment emerges as inefficient firms go bankrupt in those parts of the economy where relative prices have fallen. The resulting contraction of aggregate supply from AS to AS' increases the pressure on the price level so that it rises farther towards point J in the chart.² The slump in aggregate demand along the AD schedule may reduce output and employment temporarily also in those markets where relative prices have risen, due to the spillover effects of bankruptcies across sectors. With or without such chain reactions triggered by 'Keynesian' demand deficiency, this process continues until new profit opportunities and incentives arising in markets where relative prices have increased begin to be exploited by resourceful entrepreneurs. When this occurs,

² Consumers would not necessarily be worse off at J than at E, however, because the adjustment from E towards J may involve the reduction of 'forced' consumption through the removal of unwanted low-quality goods from the consumption basket in addition to the evaporation of money holdings through inflation.

productive resources that have become redundant in the contracting sectors of the economy are drawn into more efficient employment than before in the expanding sectors and the decline of aggregate output, represented by the horizontal distance between points E and J in the chart, is gradually reversed. The speed at which idle resources are thus absorbed into gainful employment elsewhere depends on many factors, including local infrastructure and institutions and the costs of adjustment and installation of new productive capacity. At any rate, the economy ends up at point F where all profit opportunities have been exploited in full and full employment has been restored at a higher level of output than initially. Output thus follows a J-shaped path, essentially because it takes less time to destroy than to build: unprofitable enterprises can be closed down overnight, but the establishment of new firms to take their place is a more time-consuming process. The ultimate output gain from the intersectoral reallocation of resources is indicated by the thick segment of the horizontal axis. This gain, however, does not reflect more efficient use of those resources within each sector.

The J-shaped response of output to economic reform is reinforced by the effects of the price explosion. This is because the restructuring and stabilization of the economy occur in two phases. Inflation rises at first and then recedes. In the initial phase, inflation jumps as prices that were controlled previously are set free. In this inflationary phase, some financial capital is replaced by physical capital in production. Because physical capital takes time to build and install, output contracts at first as financial capital is removed from the production process, but this output decline is tempered by the gradual accumulation of physical capital. This first phase corresponds to the trajectory of output decline from E to J in Charts 1 and 2. As output declines, unemployment emerges. Sooner or later, however, the second phase sets in as inflation is brought under control and money, credit, and other financial assets are redrawn into the production process. The business opportunities created by stable prices and by

a correspondingly favorable business environment will begin to be exploited by profit-seeking entrepreneurs. As aggregate supply begins to recover from AS' to AS", inflation begins to recede, and increased price stability will reinforce the expansion of output by improving the allocation and utilization of capital and thereby efficiency. As financial capital begins to grease the wheels of trade and production, the economy moves to the right from the unemployment point J towards point F on the production possibility frontier (not shown) corresponding to maximum efficiency in the allocation and utilization of real and financial capital. Gradual adjustment trajectories of this type involving unemployment of labor and other factors of production can be derived from optimal producer behavior if the adjustment itself is costly (see Mussa 1982).

B. Static gains from stabilization: A simple formula

How is the ultimate increase in output following stabilization, structural adjustment, and improved allocation and utilization of resources related to the magnitude of the initial inflation problem?

Let there be two types of capital, real and financial, as before. The production function is

$$(1) \quad Y = F(K, M)$$

with $F_K > 0$, $F_M > 0$, $F_{KK} < 0$, and $F_{MM} < 0$ as usual. One may think of K as tractors, for example, and M as the money balances that are needed to buy spare parts to keep the tractors running. Other factors--labor, land, energy, and so on--are held fixed. Consider two periods, 1 and 2. A firm starts out in year 1 with a given amount of assets A. It buys tractors K for part of this amount to begin production, and keeps the rest as money balances M. Production in year 2 is $Y = F[A-M, M/(1+\pi)]$, where π is the annual rate of inflation. Real capital

retains its value in year 2, but inflation causes financial capital to depreciate. The first-order condition for maximum output is $-F_K + F_M/(1+\pi) = 0$. Therefore, the equilibrium ratio of the marginal products of M and K is³

$$(2) \quad \frac{F_M}{F_K} = 1 + \pi$$

Inflation drives a wedge between the marginal products of the two types of capital (see Easterly 1992), and thus reduces the output that can be produced by given total capital. To maximize output, the inflation distortion must be eliminated.

In Chart 3, the initial long-run full-employment equilibrium position is described by point E at which the domestic relative factor price line with slope $-(1+\pi)$ is tangential to the isoquant corresponding to the maximum level of output (per head, because the labor force is fixed) attainable from the initial composition of the capital stock at E. (This point corresponds to its namesakes in Charts 1 and 2.) The flatter line through E with the slope -1 reflects the undistorted factor price ratio that prevails when the inflation rate is zero. This line is tangential at point F to a higher isoquant corresponding to the highest level of output attainable from a more efficient composition of the capital stock at F. This line connecting E and F cuts the vertical axis at point N that indicates national output (i.e., GNP) at factor cost measured in terms of real capital. The parallel price line tangential to the lower isoquant at point G cuts the vertical axis at point Q that shows the initial lower level of output at factor cost, also in terms of real capital.

³ In the Sidrauski model, this condition takes a slightly different form: $F_K = F_M - \pi$. If the net marginal product of real capital equals the real interest rate r , and the net marginal product of financial capital equals the nominal interest rate i , the Sidrauski condition is simply $r = i - \pi$. In the text, the relationship between the marginal products of the two types of capital is formulated in gross terms: $F_M/F_K = (1+i)/(1+r) = (1+\pi)$, so that $r = (i-\pi)/(1+\pi)$. Increased inflation is thus accompanied by either an increase in the nominal interest rate or a decrease in the real interest rate or both.

The distance between the two points, Q and N, shown by the thick segment of the vertical axis in Chart 3, thus indicates the static output gain from the reallocation of capital from E to F according to the total differential of the production function (1):

$$(3) \quad \Delta Y = F_K \Delta K + F_M \Delta M$$

where ΔY , ΔK , and ΔM are the changes in output, real capital, and financial capital that take place between E and F. Our next objective is to find the relationship between the increase in output ΔY and the policy-induced reduction of inflation from π to zero (through currency reform, for example) that triggered the output gain.

The static output gain from moving from E to F in Chart 3 depends on the magnitude of the initial inflation distortion, that is, the angle between the two relative price lines where they intersect at point E in the chart, and on the curvature of the isoquant. To see this, first invert the production function by writing $K = f(Y, M)$ where $f_M = -F_M/F_K < 0$ and $f_{MM} > 0$ by assumption. Next, ΔK can be approximated by a second-order Taylor expansion for given Y (say, around point E in Chart 3):

$$(4) \quad \Delta K = f_M \Delta M - \left(\frac{1}{2}\right) f_{MM} (\Delta M)^2$$

Substituting this into equation (3) yields⁴

$$(5) \quad \Delta Y = F_K \left[f_M \Delta M - \left(\frac{1}{2}\right) f_{MM} (\Delta M)^2 \right] + F_M \Delta M = -\left(\frac{1}{2}\right) F_K f_{MM} (\Delta M)^2$$

⁴ The equation shows the change in output measured from the *new* equilibrium position. Therefore, the negative sign of the output change in equation (5) signifies an increase in output.

At last, we need to relate the change in financial capital ΔM to inflation. At the initial equilibrium point E in Chart 3 the slope of the isoquant equals the slope of the relative price line:

$$(6) \quad \frac{\partial K}{\partial M} = f_M(Y, M) = -(1 + \pi)$$

By linearizing this equation we find that

$$(7) \quad \Delta M = -\left(\frac{1}{f_{MM}}\right)\Delta\pi = -\left(\frac{1}{f_{MM}}\right)\pi$$

because $\Delta\pi = \pi$ when inflation is brought down from π to 0. By squaring equation (7) and substituting the result into equation (5) we obtain

$$(8) \quad \Delta Y = -\frac{1}{2}\left(\frac{F_K}{f_{MM}}\right)\pi^2$$

In words, the output gain is, to a second-order approximation, directly proportional to the square of the inflation distortion. This formulation is general, and can be applied to any pair of inputs such as capital and energy, for example. Then equation (5) can be used to derive the output gain from bringing the domestic price of energy up to the world market level, *ceteris paribus*. A similar quadratic formula for the output gain from economic liberalization can be derived from a two-sector general equilibrium model (see Gylfason 1993). As noted before, these gains reflect only the intersectoral reallocation of resources, but not increased efficiency in the use of those resources within each sector over time (see Gylfason 1995). Moreover, the formula abstracts from the distribution of seignorage: it shows the effect of removing the inflation distortion on total output without taking the conceivable consequences of increased public debt or taxation or reduced government spending needed to compensate for the loss of inflation tax revenue into account.

But what can be said about the proportionality factor, $-\frac{1}{2}(F_K/f_{MM})$?

C. Examples and simulations

To make the simple formula (8) operational as a rough guide to the potential magnitude of the responsiveness of output to structural adjustment and stabilization, it is necessary to assume the production function to take a particular form.

Consider, for example, the following CES function:

$$(9) \quad Y = \left[\alpha K^\beta + (1-\alpha)M^\beta \right]^{\frac{1}{\beta}}$$

where the distribution parameter α is a positive constant between 0 and 1, and $\beta = 1 - 1/\sigma$, where σ is the constant elasticity of substitution of real for financial capital. In this case, the optimal reaction of producers to reduced inflation is to raise output according to

$$(10) \quad \frac{\Delta Y}{Y} = \lambda \pi^2$$

where

$$(11) \quad \lambda = -\frac{1}{2} \left(\frac{\alpha^{\frac{4-\frac{1}{\sigma}}{\sigma}}}{1-\alpha} \right) \left[\left(\frac{K}{Y} \right)^{2-\frac{2}{\sigma}} \right] \left(\frac{M}{K} \right)^{1+\frac{1}{\sigma}}$$

The proportional increase in output brought about by a more efficient utilization of capital because of less inflation is thus approximately proportional to the square of the initial inflation distortion. The proportionality factor, in its turn, is a well-defined function of the parameters of the production function: the elasticity of substitution σ ; the distribution parameters α and $1-\alpha$; the real capital/output ratio, K/Y ; and the optimal ratio of financial to real capital, M/K . Notice also that K/Y can be expressed as a function of M/K by the production function (9), so that λ then becomes a complicated function of α , σ , and M/K alone by equation (11).

The simple formula (10) makes it possible to map the expansion of output $\Delta Y/Y$ as a function of the underlying parameters of the production structure, factor proportions, and the initial inflation distortion. In particular, the more severe the original inflation distortion π , the larger is the correction that is needed and, hence, the greater will be the gain in output. In short, if the proportional expansion of output is denoted by E , the multiplicative proportionality factor by m , and the constant inflation distortion by c , we have $E = mc^2$.

In the special case where $\sigma = 1$, the CES production function (9) boils down to a Cobb-Douglas function: $Y = AK^\alpha M^{1-\alpha}$, where A is a constant of integration. The expression for the proportionality factor in equation (11) simplifies accordingly to

$$(12) \quad \lambda = -\frac{1}{2} \left(\frac{\alpha^3}{1-\alpha} \right) \left(\frac{M}{K} \right)^2$$

Precedents. The formulae developed above are a variation on a well-known theme in welfare economics. The welfare gain from removing a single distortion (a tax or a tariff, for instance) is proportional to the square of the initial distortion (see Harberger 1964, 1971). The square of the distortion enters the formula, because the welfare gain is measured by an area enclosed by a right triangle whose short sides are both proportional to the tax rate. In the reviews of the theory of optimal taxation provided by Atkinson and Stiglitz (1980) and Dixit (1985), however, the aggregate output gains from improved allocation of resources are not linked to the theory and measurement of deadweight welfare loss from inefficient taxation.

The welfare cost of the *status quo* is another matter. This cost is measured by the external transfer of resources that would be required at unchanged relative factor prices (i.e., inflation in this case) to lift the economy to the same level of social welfare as could be achieved by structural adjustment through

stabilization. In Chart 3, the welfare cost in terms of real capital is indicated by the vertical distance between the initial relative factor price line tangential to the lower isoquant at point E and a parallel factor price line (not shown) tangential to the upper isoquant that goes through point F. In general, this hypothetical welfare cost of the *status quo* is different from the output gain from stabilization and structural adjustment denoted by the thick segment NQ of the vertical axis in the chart, and will not concern us further here.

Numbers. To illustrate the possible macroeconomic and empirical significance of price stabilization through increased efficiency in the use of capital, let us now proceed to plug some parameter values into our formula (10) in an attempt to provide a glimpse of the possible magnitudes involved. This is inevitably a highly speculative exercise in view of the simplicity of the formula and of the unavailability of hard evidence on the explanatory parameters. The example that follows is meant as an illustration only.

Let us assume that domestic inflation is initially between 10 percent and 1,000 percent a year. This range of values seems reasonable for the purpose of the exercise, because inflation has been measured in tens and hundreds of percent annually in many Central and Eastern European countries since 1990. The ratio of financial and real capital in equilibrium is determined by the first-order condition for maximum output (or profit):

$$(13) \quad \frac{M}{K} = \left[\left(\frac{\alpha}{1-\alpha} \right) (1 + \pi) \right]^{-\sigma}$$

The distribution parameter α is assumed to be 0.8. This is consistent with a financial capital/output ratio of $M/Y = 0.33$ and a real capital/output ratio of $K/Y = 1.32$, so that $M/K = 1/4$ if $\sigma = 1$ and $\pi = 0$, for instance. The elasticity of substitution σ is assumed to range in four steps from 0.25 to 2.0.

The proportional output gains that follow from these assumptions are illustrated in Chart 4. The schedules in the chart indicate that the static output

gains from stabilization can be considerable at high rates of inflation. The thick schedule at the top of the chart shows that the elimination of 250 percent annual inflation increases output by 4 percent when $\sigma = 1$, for instance. These gains are permanent, other things being equal.⁵ The financial capital/output ratio rises from 0.12 to 0.33 in this case as more financial assets are drawn into production when inflation goes down, and the real capital/output ratio falls from 1.70 to 1.32. When α is lowered from 0.8 to 0.7, the output gain from eliminating 250 percent inflation increases from 4 percent to 5 percent. When α is raised to 0.9, on the other hand, the output gain from the same experiment falls to 2 percent. The output gains are smaller when σ equals $\frac{1}{2}$ or $\frac{1}{4}$, because firms then have less scope for replacing physical by financial capital when inflation goes down. The gains are also smaller when σ equals $1\frac{1}{2}$ or 2, for then the amount of financial capital involved in production is small anyway.

These results must not be taken too literally, however, for three main reasons. First, they include only the effects of the reallocation of real and financial capital in production, but not of increased efficiency in the use of each type of capital. Second, they do not reflect the possible fiscal ramifications of price stabilization. Third, if the product cycle is short and if product prices rise with inflation, then financial capital will be replenished more quickly (and smaller as well) and its depreciation will be reduced. The first qualification suggests that the effects shown in Chart 4 may be too small, whereas the third suggests that they may be too large; the second one could move the effects in either direction, probably downwards. Even so, if the numbers above provide an indication of the results that would emerge from detailed empirical case studies, it seems reasonable to conclude that economic stabilization can improve allocative efficiency and, over time, increase output substantially and permanently in individual enterprises and in the economy as a whole.

⁵ For comparison, the permanent static output gain expected from the market unification of Europe in 1992 over a period of about six years is also close to four percent according to Cecchini (1988).

III. Dynamic gains: Endogenous growth

To recapitulate, the path of output following stabilization and structural adjustment was shown in Chart 1. The economy is stagnant up to time t_1 , when an economic reform program is launched. Output falls at first and then rises along the trajectory EJHF. The shaded area enclosed by E, J, and H represents the cumulative decline in output during the transition. When the transformation is completed at time t_2 , output exceeds its initial level by $\Delta Y/Y = \lambda\pi^2$ as in equation (10). This is the static output gain from structural adjustment and stabilization.

But where does the economy go from there?

A. Growth with a fixed saving rate

The CES production function (9) means that output is proportional to a bundle of real and financial capital. This implies constant returns to the capital bundle. The labor force remains constant by assumption. Suppose, moreover, that saving S is proportional to output (as in Solow 1956), and equals the net accumulation of both types of capital plus depreciation. Then we have $S = sY = \Delta K + \Delta M + \delta K + [\pi/(1+\pi)]M$. Here s is the saving rate that is constant by assumption, δ is the annual rate of depreciation of real capital, and $\pi/(1+\pi)$ similarly reflects the rate at which financial capital "depreciates" because of inflation.⁶

Along the long-run steady-state equilibrium growth path of the economy, output must expand at the same rate as total capital net of depreciation d , so that $\Delta Y/Y = sY/(K+M) - d$. This means that

$$(14) \quad g = sE - d$$

⁶ For example, financial capital loses two-thirds of its value in a year if the annual rate of inflation rate is 200 percent, *ceteris paribus*. Put differently, $M[(1-\pi)/(1+\pi)] = M/(1+\pi)$.

where $g = \Delta Y/Y$ is the rate of growth, $E = Y/(K+M)$ reflects the efficiency of capital, broadly defined, and

$$(15) \quad d = \left(\frac{K}{K+M} \right) \delta + \left(\frac{M}{K+M} \right) \left(\frac{\pi}{1+\pi} \right)$$

is a weighted average of the two rates of depreciation, δ and $\pi/(1+\pi)$, both of which are bounded by 0 and 1.

Therefore, economic growth in the long run depends crucially on the saving rate, the efficiency of capital, and depreciation by equation (14). Put differently, growth depends on the quantity and quality of capital. Equation (14) is essentially a restatement of the economic growth theory of Harrod and Domar.

Generally, E reflects the efficiency of resource allocation in the economy. By implication, all improvements in efficiency, including those resulting from price reform, privatization, trade liberalization, education, research and development (as in Grossman and Helpman 1991), and so on, lead not only to a higher level of output once and for all, as we know, but also to a higher rate of growth of output over time by equation (14). This is why the economy follows the path EJHFI rather than EJHFK in Chart 1. The shaded area FIK represents the dynamic output gain from economic reforms, including even price stabilization.

This can be seen by first dividing through the production function (9) by real and financial capital, $K+M$, to find:

$$(16) \quad E = \frac{\left(\alpha + (1-\alpha) \left(\frac{M}{K} \right)^\beta \right)^{\frac{1}{\beta}}}{1 + \left(\frac{M}{K} \right)}$$

An increase in the ratio of financial to real capital, M/K , can be shown by differentiation to increase efficiency as long as $M/K < [\alpha/(1-\alpha)]^{-\sigma}$, that is, as

long as inflation remains above zero by equation (13). A decrease in the inflation rate increases M/K by equation (13) as long as $\sigma > 0$, and thus increases the efficiency of capital by equation (16) and thereby also economic growth by equation (14) provided that $\pi > 0$ at the outset. Moreover, a decrease in inflation generally stimulates growth by slowing down the depreciation of the financial part of the capital stock.

Less inflation leads to more growth in this model essentially because the disinflation reduces a distortion in production (as in Easterly 1992). The resulting increase in growth is permanent by the construction of the CES production function (9). Specifically, the mechanisms that prevented increased efficiency and increased saving from stimulating growth permanently in the models of Harrod and Domar and Solow are absent here, because the production function (9) exhibits constant returns to capital, broadly defined (as in Romer 1986, 1989).

Even so, a link between efficiency and growth is present in the neoclassical growth model. There, as here, increased price stability can be shown to increase the output that can be produced from given inputs, and thus to be tantamount to technical progress that increases the growth of output while the economy moves from one steady-state growth path to another, higher path. This adjustment process can take a long time. The medium-term properties of the neoclassical model of Solow may thus be difficult to distinguish empirically from the long-run properties of the Romer version of the endogenous-growth model employed here.

B. Growth with a variable saving rate

Thus far, saving behavior has been assumed to be unaffected by inflation and other aspects of the economic environment. This is an unrealistic assumption, especially if inflation is high initially. So how does the model change if the saving rate is variable?

Let us suppose that consumers choose a path of consumption C_t that maximizes their utility U_t over time. Specifically, they maximize the integral $\int_0^{\infty} U_t(C_t) e^{-\rho t} dt$, where ρ is the discount rate as before, subject to the constraint that gross investment equals output less consumption and the accumulation of financial capital, that is, $\Delta K + \delta K = Y - C - \Delta M - [\pi/(1+\pi)]M$. Using $Y = E(K+M)$ as in equation (16), we see that $\Delta(K+M) = E(K+M) - \delta K - [\pi/(1+\pi)]M - C = (E-d)(K+M) - C$ by equation (15). Suppose that the utility function is isoelastic, $U_t = C_t^{1-1/\theta}/(1-1/\theta)$, where θ is the elasticity of intertemporal substitution. Then the present discounted value of utility over time is at a maximum when

$$(17) \quad g = \theta(E - d - \rho)$$

Here g is the rate of growth of consumption and real and financial capital and, therefore, also of output along the optimal consumption path.⁷ Equation (17) is the standard solution to the Ramsey problem except E now plays the role of the marginal product of capital and d is a composite of the depreciation rates of the two types of capital.

Equations (14) and (17) can now be solved for the optimal propensity to save:

$$(18) \quad s = \theta + \frac{(1-\theta)d - \theta\rho}{E}$$

The optimal saving rate is constant for given θ , ρ , d , and E .⁸ The two taste parameters, θ and ρ , have predictable effects on saving. Increased patience, that

⁷ If money is included in the utility function so that $U_t = [C_t^\lambda M_t^\mu]^{1-1/\theta}/(1-1/\theta)$ where $\lambda + \mu \leq 1$ (as in Fischer 1979), then the optimal rate of growth of consumption, real and financial capital, and output is $g = (E-d-\rho)\theta/[(\lambda+\mu)(1-\theta)+\theta]$. This is larger than the growth rate shown in the text as long as $\theta > 0$ and $\lambda + \mu < 1$. Without financial capital in the utility function (i.e., with $\lambda = 1$ and $\mu = 0$), the above expression for optimal growth simplifies to the one shown in the text.

⁸ A fixed saving rate s can also be derived from the standard intertemporal optimization model within the neoclassical constant-returns-to-scale framework without money by

is, a reduction in ρ , raises the saving rate, because $\partial s/\partial \rho = -\theta/E < 0$. Increased flexibility in consumption over time, that is, an increase in θ , also boosts the saving rate, because $\partial s/\partial \theta = 1 - (d+\rho)/E$, which is positive as long as the growth rate is positive by equation (17).

Inflation affects saving behavior through efficiency and depreciation, E and d . Consider first the simple case where the elasticity of intertemporal substitution is one ($\theta = 1$). This means that the utility function is logarithmic. Then the optimal saving rate is $s = 1 - \rho/E$ by equation (18). Increased inflation lowers the saving rate unambiguously in this case by reducing efficiency, see equations (13) and (16). When $\theta > 1$, the negative effect of increased inflation on saving is reinforced by more rapid depreciation: consumers then respond to increased financial depreciation by saving less. When $\theta < 1$, however, consumers react to increased financial depreciation by saving more. In this case, the net effect of increased inflation on saving through efficiency and depreciation is ambiguous. This is the most relevant case when consumers face severe borrowing constraints in financial markets, as they do in Central and Eastern Europe, and the flexibility of consumption over time is correspondingly restricted.

In sum, then, inflation affects economic growth not only through efficiency and depreciation, but also through saving when the saving rate is variable, see equation (14).

C. Numerical simulations

How strong are the links between inflation and growth that have been outlined above? It now remains to attempt to quantify the potential dynamic gains from macroeconomic stabilization.

assuming that $\theta = s$ and $\rho = \alpha - s$ where α is the elasticity of output with respect to capital. See Kurz (1968) and Sala-i-Martin (1990).

Charts 5 and 6 illustrate the relationship between inflation, efficiency, and saving when the elasticity of intertemporal substitution $\theta = 0.2$, the discount rate $\rho = 0.1$, and the distribution parameter $\alpha = 0.8$; see the production function (9). The elasticity of substitution of real for financial capital σ spans the range from 0.25 to 2.0 as before. The benchmark case with $\sigma = 1$ is distinguished by the thick schedules in the charts. In this case, as inflation rises from zero to 1,000 percent per year along the horizontal axes in the charts, the financial capital/output ratio M/Y decreases from 0.33 to 0.05 and the real capital/output ratio K/Y increases from 1.32 to 2.13. This means that the ratio M/K collapses from 0.25 to 0.02. The total depreciation rate d rises from 0.08 at zero inflation to 0.15 at 150 percent inflation, and then declines gradually to 0.12 as inflation approaches 1,000 percent per year and the depreciable stock of financial capital decreases; see equation (15). The optimal saving rate rises at first from 0.27 at zero inflation to 0.37 at 200 percent inflation to meet the increased depreciation of financial capital, and then stabilizes at 0.36 as the increase in depreciation is reversed (Chart 5). On the other hand, efficiency (i.e., the average productivity of total capital) decreases uniformly from 0.61 to 0.46, as inflation increases from zero to 1,000 percent (Chart 6).

The positive relationship between the saving rate and inflation at or below 200 percent a year has been built into the simulation by assuming the intertemporal elasticity of substitution θ to be far below unity to reflect borrowing constraints in the banking system. An elasticity of substitution at or above unity would produce a uniformly negative relationship between inflation and the saving rate, other things being equal. It would also entail a very high saving rate ($s = 0.84$ if $\theta = \sigma = 1.0$ and $\pi = 0$) in this model and a growth rate to match ($g = 0.43$) because of the farsightedness of fully rational consumers that live forever and can borrow and lend at will in a flexible banking system.

Inflation influences growth by equation (17), through E and d . Growth can also be viewed as being influenced by inflation through saving, efficiency, and depreciation by equation (14). Either way, the effect is indeterminate in theory. The relationship between inflation and growth is illustrated in Chart 7 for different values of the elasticity of substitution of real for financial capital. The optimal growth rate is directly related to the elasticity of substitution in production at any given rate of inflation: the more flexible the production structure, the higher is the rate of growth.

Inflation and growth are also inversely related throughout. If $\sigma = 1$, for example, reducing inflation from 250 percent a year to zero raises the optimal rate of growth of output from 6 percent to almost 9 percent per year through the combined effect of greater efficiency (from $E = 0.55$ to $E = 0.61$) and reduced depreciation (from $d = 0.14$ to $d = 0.08$), even though the saving rate falls from 0.37 to 0.27 in this process; see Chart 5. A growth bonus of 3 percent a year makes a difference: it doubles output every 23 years, other things being equal. The dynamic gains from stabilization are inversely related to the elasticity of substitution in production: the more rigid the production structure, the lower is the initial rate of growth at any given rate of inflation and, therefore, the greater is the growth bonus due to stabilization.

But what if the saving rate is held fixed by short-sighted consumers at, say, $s = 0.2$? Then the growth rate rises from -3 percent to 4 percent when inflation is brought down from 250 percent to zero. The dynamic output gains are greater when the saving rate is fixed, because an optimally determined saving rate is reduced in response to the eradication of inflation when the elasticity of intertemporal substitution θ is low; see Chart 5. If θ is high, on the other hand, the saving rate rises when inflation goes down: in that case the dynamic gains from stabilization are greater than when the saving rate is flexible.

In sum, these simulations indicate that economic stabilization may bring substantial dynamic gains through growth on top of the static gains discussed

in the preceding section. This is a matter that calls for close econometric scrutiny in future work on inflation and growth (see Fischer 1991).

IV. Conclusion

The purpose of this paper has been to attempt to clarify the effects of structural adjustment and stabilization on the path of output from plan to market in Central and Eastern Europe and elsewhere. At first, the restructuring of the economy is accompanied by a collapse of output, increased unemployment, and sky-rocketing inflation. The inflation drives a wedge between the marginal products of real and financial capital, and thus distorts production. To maximize output, the inflation distortion must be eliminated. The static output gain from stabilizing prices and thus improving the utilization of capital at full employment is captured in a simple formula in which the gain is approximately proportional to the square of the original inflation distortion. This formula is analytically equivalent to Harberger's (1964) triangular measure of the deadweight welfare loss from inefficient taxation. Substitution of plausible parameter values into the simple formula indicates that the static output gains from stabilization may be considerable.

The efficiency boost that is obtained through an improved allocation and utilization of capital is also likely to increase economic growth, either permanently according to the new theory of endogenous growth or at least over an extended period according to the neoclassical growth model. The stimulating effect of stabilization on growth through increased efficiency is complicated, however, by its interaction with the depreciation of financial capital through inflation and the endogenous determination of optimal saving. All things considered, the numerical simulations of the model under scrutiny for different values of the parameters reflecting institutions, tastes, and technology indicate that the dynamic output gains from economic stabilization may also be substantial.

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**Table 1. The Path of Output in Eastern Europe
and the Former Soviet Union, 1990-94**

(Changes in real GDP or NMP in percent)

	1990	1991	1992	1993	1994	Total
Albania	-10	-28	-10	11	8	-30
Armenia		-12	-52	-15	3	-63
Azerbaijan		-1	-27	-13	-6	-41
Belarus	-3	-1	-10	-12	-17	-37
Bulgaria	-9	-12	-6	-4	-2	-29
Croatia	-9	-29	-16	-3	2	-46
Czech Rep.	-0	-16	-8	-0	2	-21
Estonia	-4	-11	-17	-2	1	-30
Georgia		-21	-43	-39	-10	-75
Hungary	-4	-10	-5	-2	1	-19
Kazakhstan	-2	-13	-14	-12	-6	-39
Kyrgyzstan	3	-5	-19	-16	-6	-37
Latvia	3	-8	-34	-12	4	-43
Lithuania	-5	-13	-38	-16	5	-55
FYRM	-11	-11	-15	-16	-15	-52
Moldova	-2	-18	-21	-15	-2	-47
Poland	-12	-8	3	4	5	-9
Romania	-7	-15	-14	-6	1	-35
Russia	-4	-13	-19	-12	-12	-48
Slovakia	0	-16	-8	-4		-26
Slovenia	-5	-9	-6	1	4	-15
Tajikistan		-9	-30	-28	-15	-61
Turkmenistan		-5	-5	-8	2	-15
Ukraine		-12	-17	-14	-25	-53
Uzbekistan		-1	-10	-2	-10	-21
E-Europe	-7	-15	-8	-2	1	-28
FSU		-8	-24	-15	-6	-44

Sources: *World Economic Outlook*, October 1994, Table 11, International Monetary Fund, Washington, D. C., and EBRD Economic Review, *Annual Economic Outlook*, Table 5.1, European Bank for Reconstruction and Development, London, September 1993.

Chart 1. The path of output following price stabilization

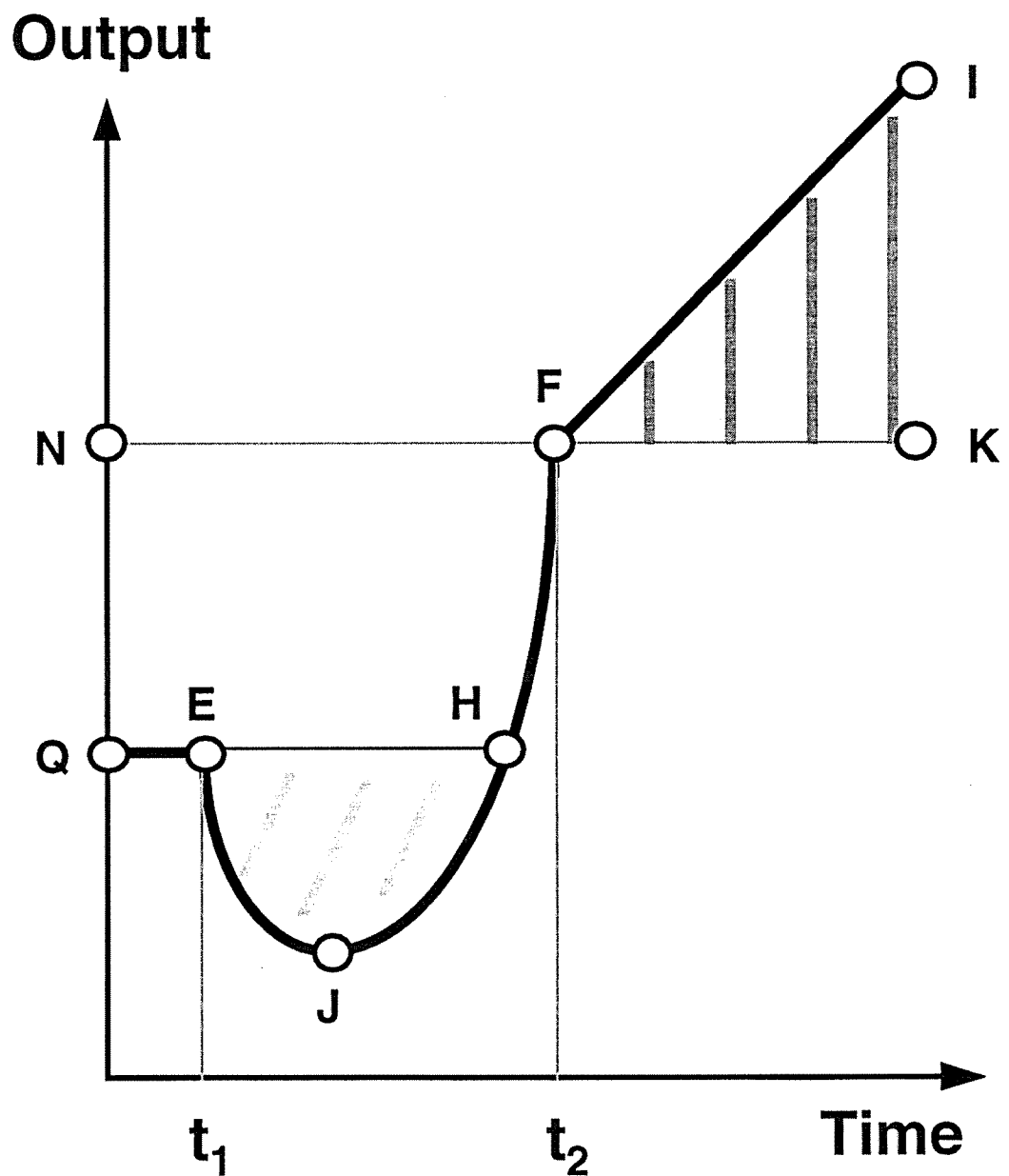


Chart 2. Temporary loss *versus* permanent gain

Price level

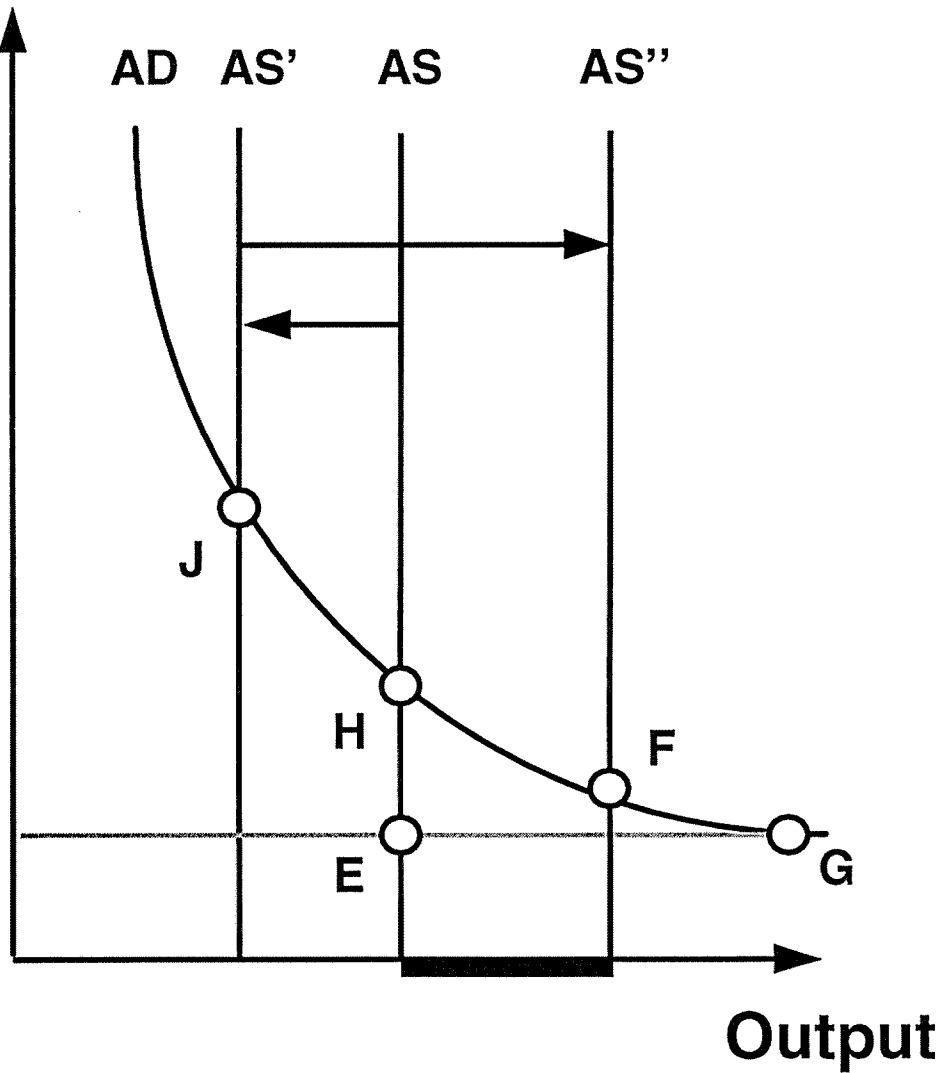


Chart 3. Static output gain from stabilization

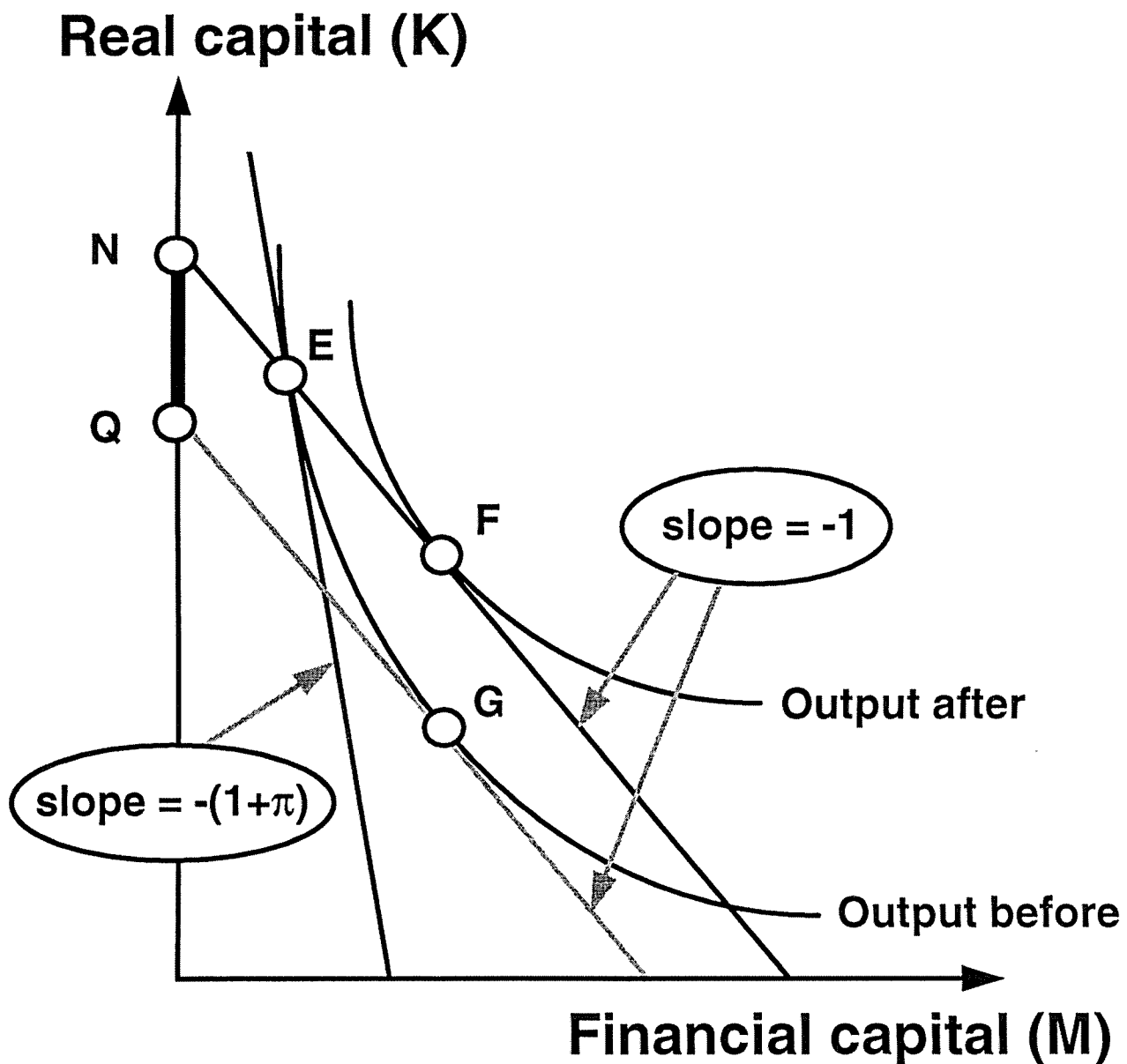


Chart 4. Static output gains from stabilization

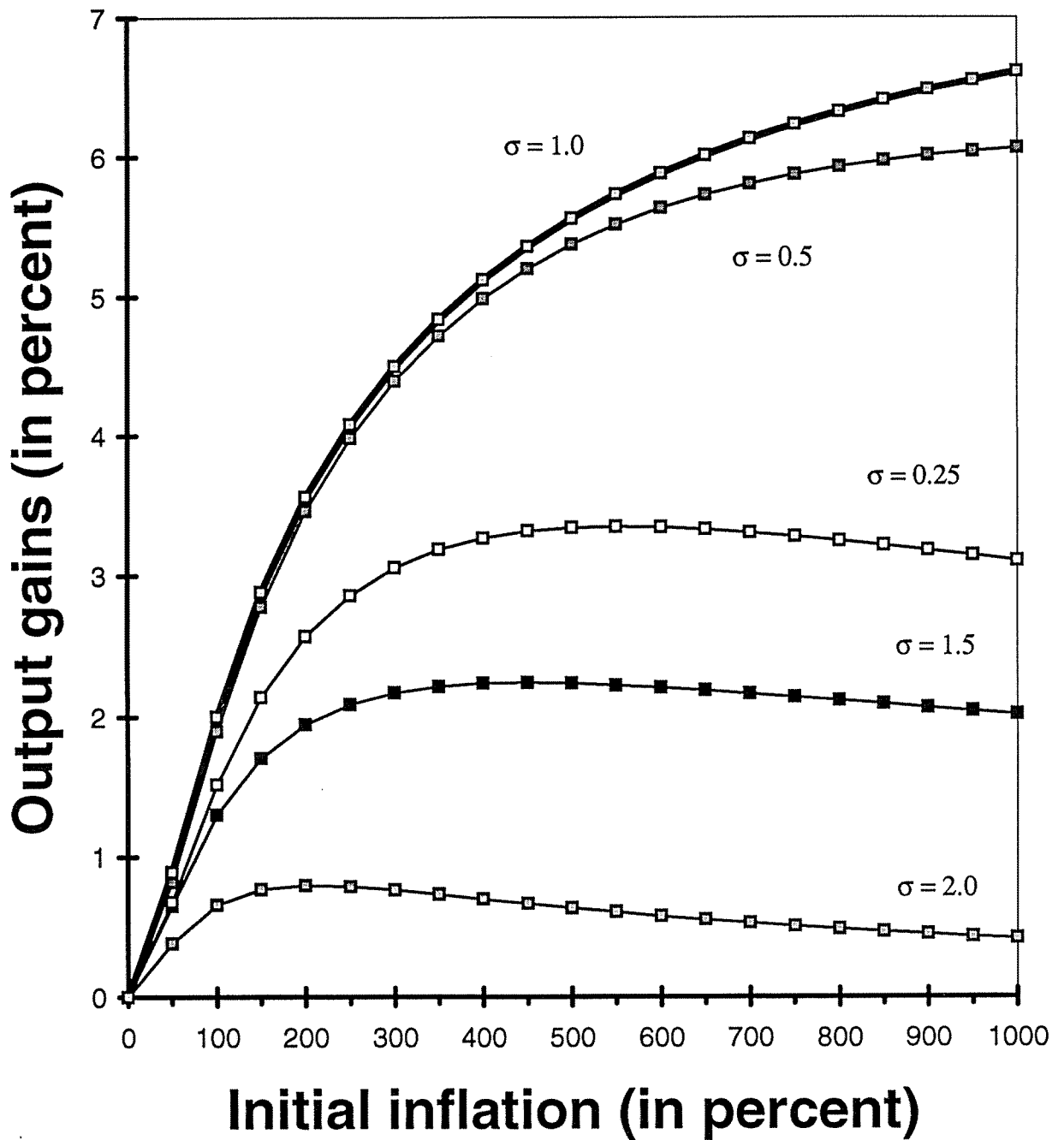


Chart 5. Inflation and saving

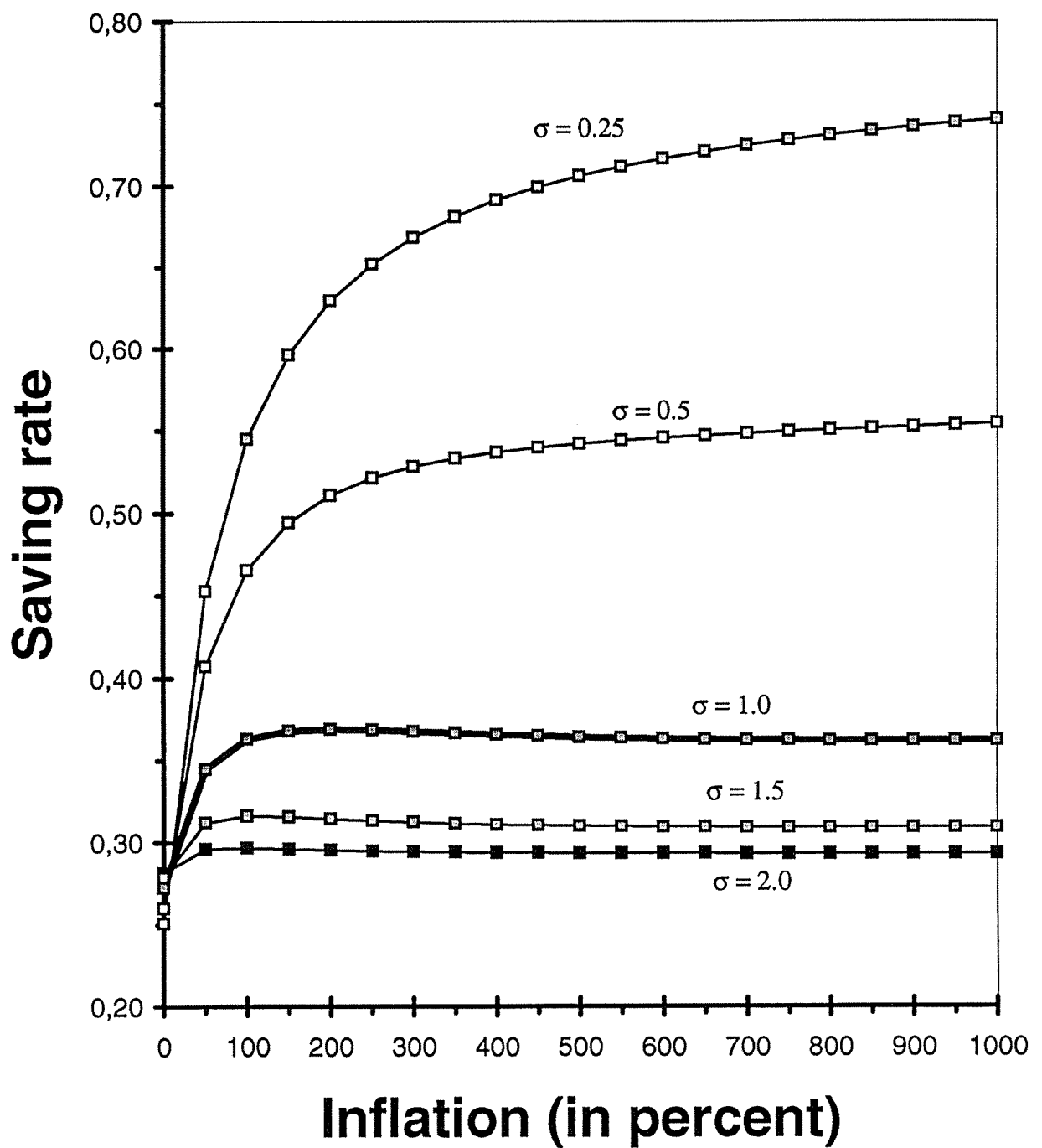


Chart 6. Inflation and efficiency

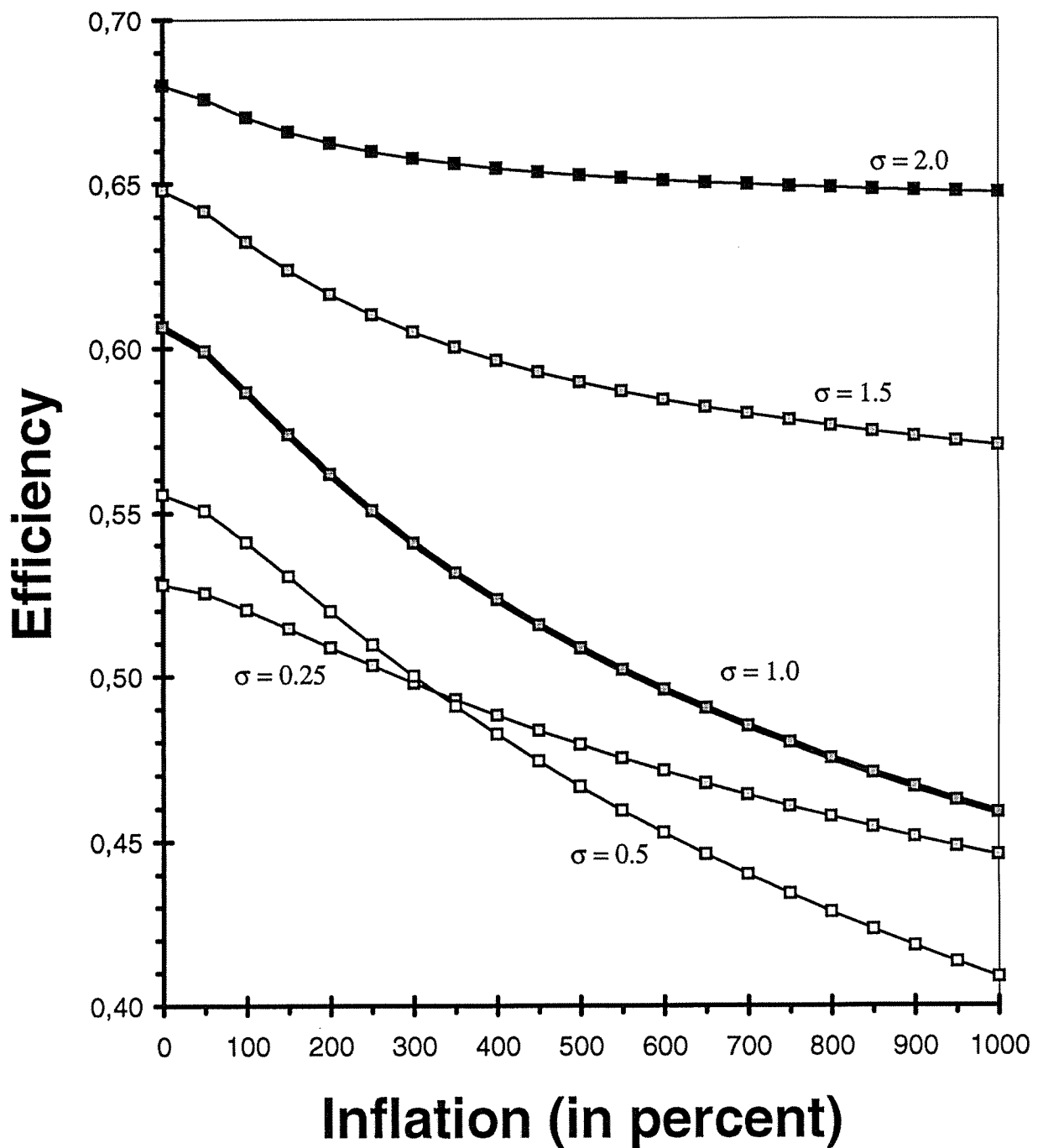
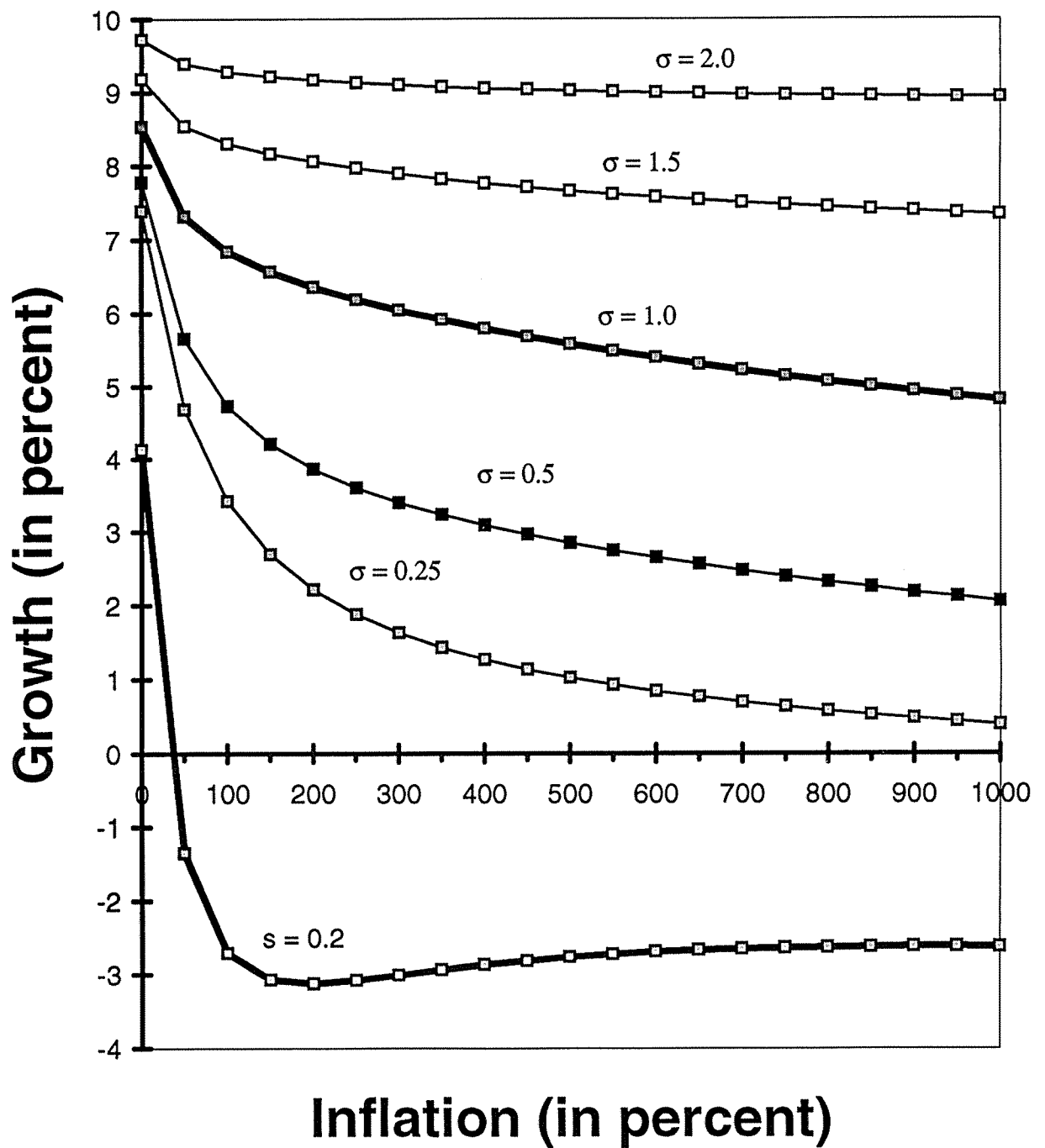
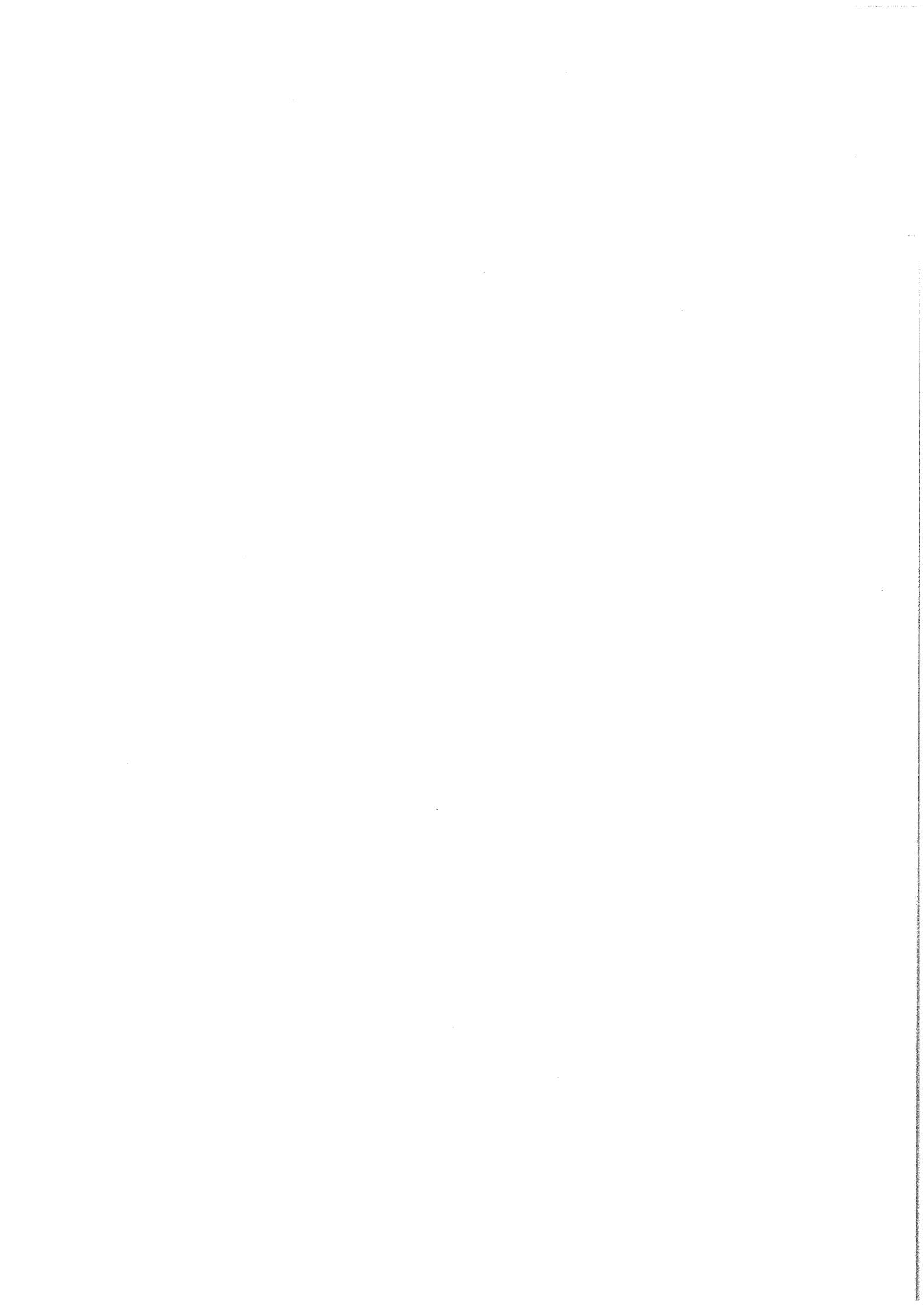


Chart 7. Inflation and growth





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